



YOUTOPIA

A PASSION FOR THE DARK

ARCHITECTURE AT THE INTERSECTION
BETWEEN DIGITAL PROCESSES AND
THEATRICAL PERFORMANCE

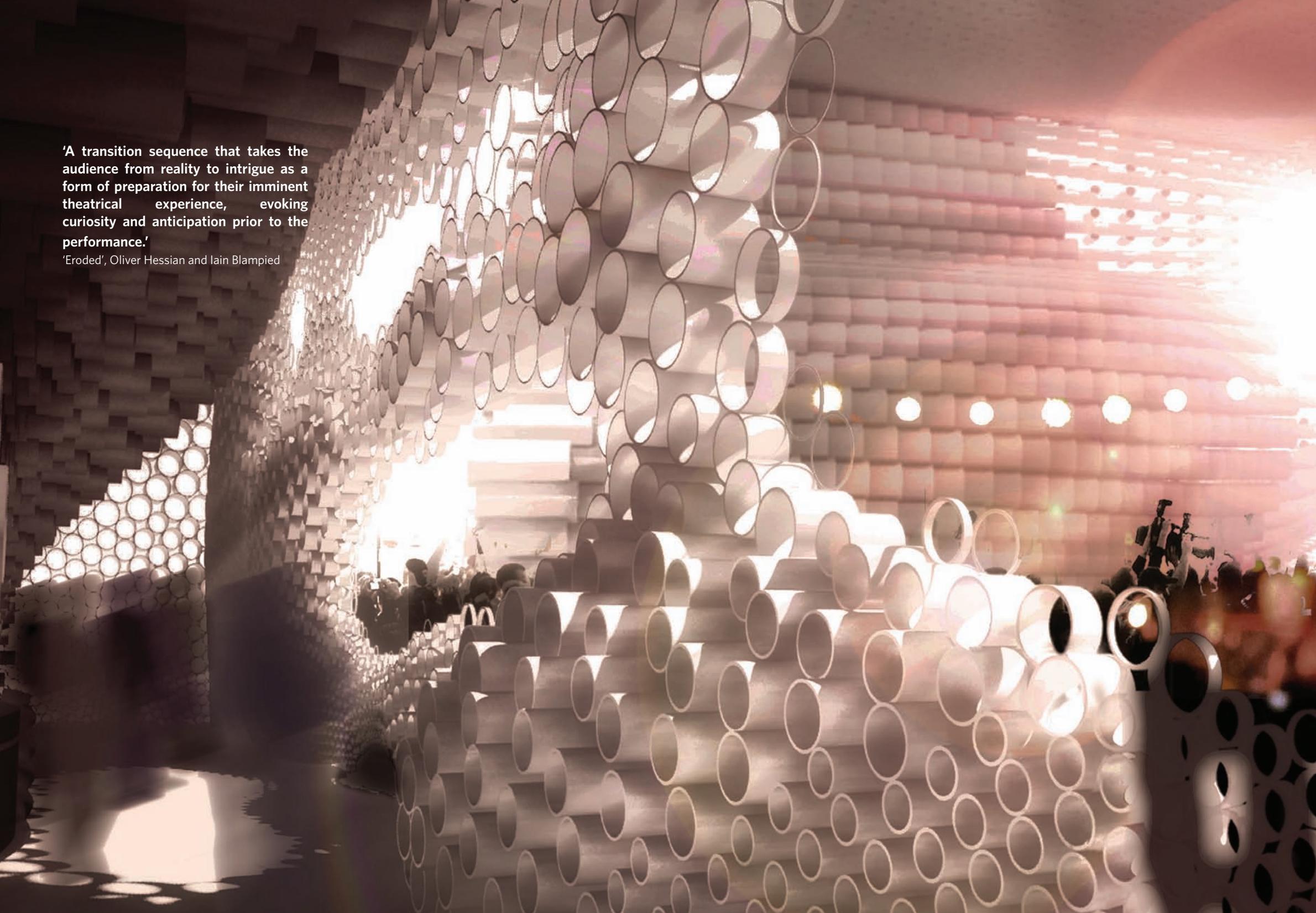
EDITED BY DAGMAR REINHARDT

FREERANGE PRESS



'A transition sequence that takes the audience from reality to intrigue as a form of preparation for their imminent theatrical experience, evoking curiosity and anticipation prior to the performance.'

'Eroded', Oliver Hessian and Iain Blampied



'Theatre is a heterotopian world. Unlike Utopia, which, by definition, can never be real, Heterotopia is both real and unreal at the same time. The Spritz plays on a theatrical notion of ephemerality, of being transported elsewhere whilst remaining exactly where you are.'

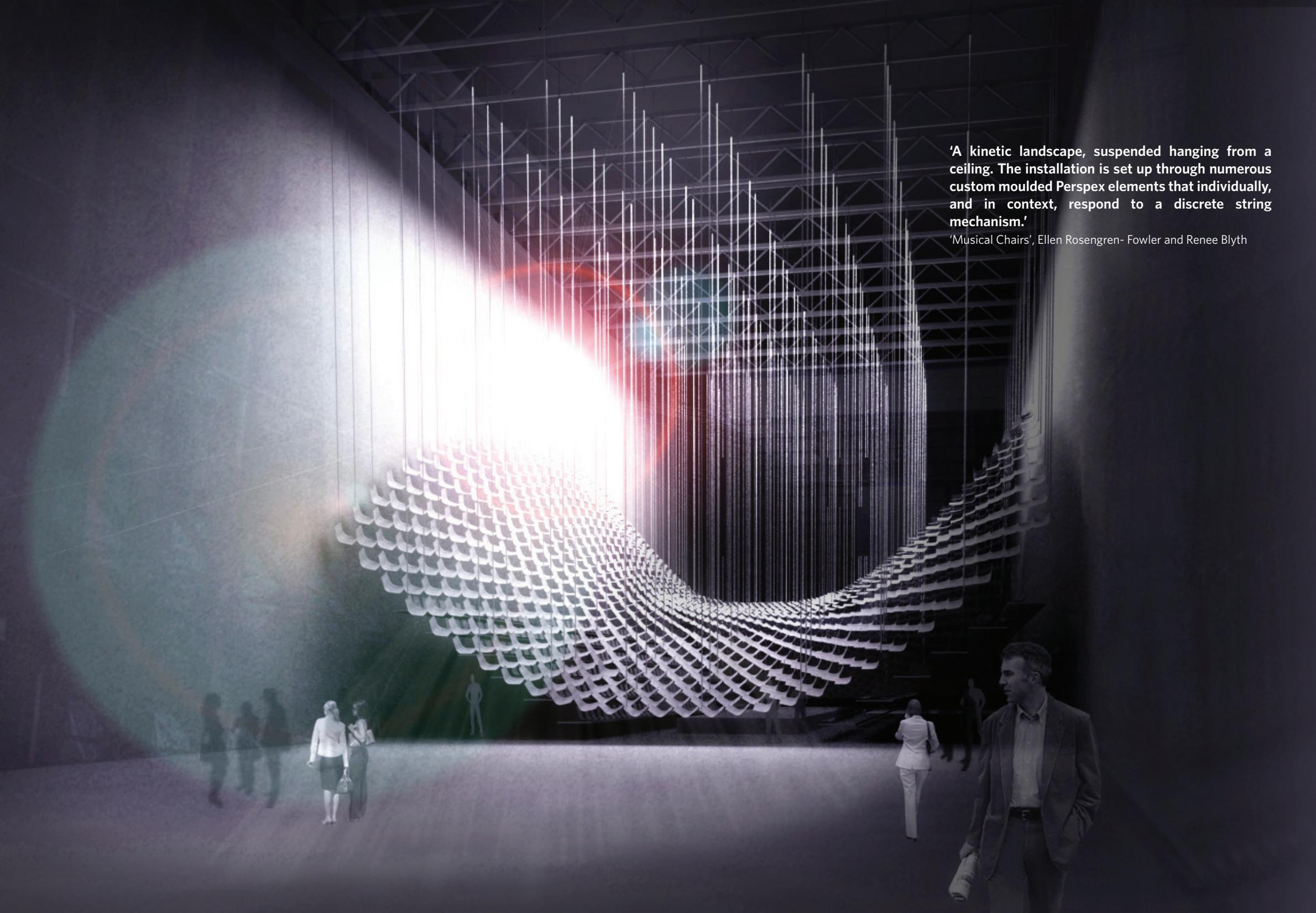
'The Spritz', Rachel Couper and Ivana Kuzmanovska





'A voxel study in the synthetic sublime, viewers are immersed in the glowing wake of simulated waves sweeping through the volume of the installation. The light mimics the bioluminescent behaviour of marine dinoflagellates, crustaceans, and bacteria which glow when mechanically disturbed, such as by a wave or a swimmer.'

'Phosphorescence of the Sea', Sean Bryen



'A kinetic landscape, suspended hanging from a ceiling. The installation is set up through numerous custom moulded Perspex elements that individually, and in context, respond to a discrete string mechanism.'

'Musical Chairs', Ellen Rosengren- Fowler and Renee Blyth



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26 **Theatricality and Architecture**
Sandra Kaji-O'Grady

14 **A Passion for the Dark**
Dagmar Reinhardt

28 **Our City in Summer - The DNA of a Festival**
Lindy Hume and Bill Harris

34 **On the Edibility of Theatres**
Simon Weir

48 **Defining (a) Theatre for the 21st Century**
Joseph Buch

89 **the body, the theatre and speech.**
Chris L. Smith

128 **The Clearing**
Phoebe Goodwin, Evan Gilchrist

43 **Moving Through Space**
Michael Scott-Mitchell

63 **Shifts in Code: Performative Geometries in Alice's Wonderland**
Dagmar Reinhardt

172 **Puppet Pavillion**
Raffaello Rosselli

120 **TimeWarp**
Roger Lee, Yon Salmat

174 **Puffscape**
Jessica Ngan, Andrew Short

162 **Flow**
Carly Martin

57 **Between Spatial Resonance and Emotional Response**
Patrick Nolan, Legsonthewall

118 **Swarm Entity**
Aya Kaneko, Xu Kai Wu

159 **Touch. Skin**
Cameron Hall, Benedict Torrefranca

Pleated Theatre
Wipawee Nitivoranant, Xina Meng

165 **Diegesis**
Robert Elcombe, Joseph Byrne

78 **TheatreScape**
Adam Higginbotham, Mark Hill, Kim Saggars

166 **Forest of Lights**
Alexandra Haage, Jonathan Combley

160 **AtmoSphere**
Keiko Hosado, Shang Gao

80 **Gothic Lattice**
Elizabeth Dalton, Kayla Browne

178 **Nomadic Pneumatic**
Lucian Gormley, Georgia Jarrett

180 **Practical Wisdom: About The Tactical Behaviour Between Two Points**
Alexander Jung

86 **Theatre of Fold**
Belinda Lee, Andrew Fong

98 **Playing The Room: One's Own Voice On Stage**
Densil Cabrera

121 **R Pavillion**
Benjamin Elphinstone, Yulun Zhang

105 **Acoustic Investigations for the Suspended Theatre Landscape Project**
Luis Alejandro Miranda Jofre and William L. Martens

84 **Concertina Pleat**
Deborah Hodge

114 **Musical Chairs**
Ellen Rosengren-Fowler, Renee Blyth

132 **Tri-Star Theatre: Tetrahedral Autopoiesis**
Tiffany Allan, Alice Chirculescu

146 **Towards a Unified Approach: Design and Analysis between Architects and Structural Engineers**
Harry Partridge and Dagmar Reinhardt

82 **Labyrinth Theatre**
Wina Heude, Monica Doive

122 **The Spritz**
Rachel Couper, Ivana Kuzmanovska

Tornado
Chun Sukh, Andrew Whiteman

134 **Through the Looking Glass**
Jiyoung Choi, Natalie Miles

176 **Performance of Play**
Scott Jackson

168 **Fireflies**
Sean Bryen

74 **Theatre of Erosion**
Iain Biampied, Oliver Hesslan

126 **Generic Landscape**
Ellen (Siyue) Sun, Chris (See Ming) Ho

136 **Design by Code**
Eduardo de Oliveira Barata and Dirk Anderson

130 **SeaScape**
Connie (Cuiting) Zhang, Betty (Na) Jiang

164 **Curtain**
Danny (Shu Rong) Sit, Katherine (Da Rong) Chen

163 **Transformers**
Mi Ran Kim, Sun Mingze

A Passion for the Dark

Dagmar Reinhardt

The summer and the Festival. Big Theatre - the shows, the light and the laughter. Landscapes of sound. Extreme, ephemeral, immersive environments. Champagne and slow music, popcorn and shuffles, the branding waves of applause. Mirrored multifaceted broken views. Generations of form finding, parametric variations of pulsating architectural objects. Processing architectural design through digital fabrications. Temporary objects set against the background of post-industrial sites, against the majestic and dominant spaces of heritage architecture. Arriving at the foot of sandstone rocks on forgotten islands. Arriving by state of the art digital design media.

Youtopia. A Passion for the Dark celebrates architecture at the intersection of Digital Processes and Theatrical Performance. 'Youtopia' pursues dreams: of other spaces and times; of outrageous and fascinating experiences; of the glamour and lights of Sydney Festival through a series of speculative design explorations. When the Digital Architecture Research Studio of the Faculty of Architecture received the brief by Sydney Festival Director Lindy Hume to develop a theatre | performance | stage project for the Sydney Festival 2012, immediately heads begun racing, ideas sprouting, imagination flying: for the design of an expressive temporary architecture that interfaces between theatre and architecture, digital design and structural engineering, cultural expression and the latest audio and light technologies.

The call was to address three distinctive sites, which varied considerably in program, materiality, atmosphere, size, and character: The Turbine Hall on Cockatoo Island, Sydney's post-industrial harbour site; the University of Sydney's Heritage icon, The Quadrangle; and in Hyde Park a complementary design to The Famous Spiegeltent. Postgraduate students of the Master of Digital Architecture worked closely with Sydney Festival Director Lindy Hume, Head of Programming Bill Harris and John Bailey of Sydney Festival on concepts that would develop these sites as potential expansions to Sydney Festival's already diverse program.

The Digital Architecture Research Studio approached this brief by investigating the potential of architecture as a temporal, dynamic system (assembled and dismantled within days); as a performative envelope; as a machine that mirrors a multiplicity of worlds: and innumerable other avenues and passages. This architecture is a cultural expression that derives its lifespan from the reflective ability to address a change in context and value systems - its ability to evolve. And while dynamic systems are no longer limited to adaptable, flexible, modular, or mobile approaches, we are looking for novel inventions within familiar structures, for new morphologies and architectural codes. In the design process we inhabit, performance refers to the contingencies of social, economic, material, technical, programmatic and geometric thresholds.

During the course of the semester, a research team of leading professionals guided students through the Studio's different design stages: Dagmar Reinhardt of the Digital Architecture Research, Dirk Anderson and Eduardo de Oliveira Barata of UFO Sydney, Marjo Niemelä of the Digital Fabrication Lab, Alexander Jung of reinhardtjung, Harry Partridge of Partridge Partners, and Robert Beson of AR-MA. In extension to this, the expertise of researchers from the Design Lab, Architectural Science and the School of Engineering of The University of Sydney encouraged transfers into and out of architectural practice, architectural theory, audio and acoustics, digital fabrication, interaction and mediation, structural engineering, theatre and performance studies, and cultural research. And further conversations included prominent stage and theatre designers of Sydney's vibrant performance culture.

Core to the Master of Digital Architecture Research are processes of form finding: the remodelling of typologies by continued exposure to context parameters, leading to transformations and evolutions of form. Advanced digital software was deployed as a base for development and analysis, the immediate work on space, and spatial performance, on audience flow, fabrication procedures and atmospheric effects.

Digital design methods act thereby as techniques and instruments to make the imaginative visible, and therefore available for processing, adaptation and communication. The studio shifted continuously between different territories of The Digital: digital history (contemporary precedents and theories); digital design (modelling, scripting, coding and animation); digital practice (calculating forces, material requirements, construction methods); and digital spacing (interactive and responsive mediation). The resulting design projects animate qualities shared by Sydney Festival and The University of Sydney: bold, progressive, adventurous, intelligent and excellent.

The present book reflects upon the design conversations and project passages. It contains transcript of conversations with festival and theatre experts: Sydney Festival Director Lindy Hume and Head of Programming Bill Harris reflect on the DNA of a Festival, the Head of Design NIDA Michael Scott-Mitchell reviews the movement of the body through space, and Artistic Director Patrick Nolan of Legs On The Wall discusses relationships between spatial resonance and emotional response. These conversations are paralleled and extended by a compilation of essays at the nexus of theatre, body, movement architecture, space, coding, structure, and sound. Sandra Kaji-O'Grady refers to notions of theatricality and architecture. Joseph Buch redefines theatre as modelled by audience engagement for the 21st Century. Chris L. Smith envisions theatre as a space in which language (both speech and architectural) prompt new and intense events. Densil Cabrera considers the acoustic experience of performers on stage in relation to affects of a theatre environment. In Simon Weir's essay, the theatrical environment is opened for digestion.

A number of essays also reflect the critical conversation and engagement with project design and analysis. Luis Miranda and William L. Martens examine different configurations of a spatial installation that

enhances acoustic properties and voice performance. Harry Partridge and Dagmar Reinhardt review self-forming organisations as shared grounds between architects and engineers, with the potential to reflect through bodily knowledge on algorithmic design, with case studies of structural analysis. Dirk Anderson and Eduardo de Oliveira Barata introduce a general reflection on contemporary digital design practices via script and code. Dagmar Reinhardt reviews shifts in code that relate to the performative geometries of spatial (and theatrical) sequences. Alexander Jung traces the parallels between musical notation and the interval techniques of digital architecture.

Embedded around centres of attraction are 30 research projects of the Digital Architecture Research Studio. Amongst these, Youtopia exclusively presents four key approaches towards performative spaces, which feature prominently in the exhibition at the Tin Sheds Gallery that parallels the publication (January 12-26, 2012): 'Phosphorescence of the Sea' by Sean Bryen, 'Eroded' by Oliver Hessian and Iain Blampied, 'Musical Chairs' by Ellen Rosengren-Fowler and Renee Blyth, and 'The Spritz' by Rachel Couper and Ivana Kuzmanovska. These architectural visions generate captivating performance spaces, mechanisms for immersing an audience into a heterotopian environment. Kaleidoscopic reflections of reality, unreality, performance, self and the immediate create a dreamscape where anything is possible.

Between the darkness of the theatre, moments before the curtain rises, and the darkness of the digital, where space exists devoid of time, a realm of imagination unfolds where we are challenged only by the boundaries of that which we dare to think.

We share this passion for the Dark.
Welcome to the Show.









(a curtain rises)

Theatricality and Architecture

Professor Sandra Kaji-O'Grady

In his 1967 essay 'Art and Objecthood', Michael Fried defines the relationship between artwork and audience as either theatrical or anti-theatrical.¹ Theatricality, for Fried, is that impulse in art that denies the separation between artwork and audience and thus compromises the uniqueness of art as a domain separate from other cultural spheres. Theatricality erases the distinction between art and forms of advertising, propaganda, entertainment and signage. To put it simply, Fried favoured work that "treated the beholder as if he were not there", work that he calls "anti-theatrical".² Fried attempts to maintain the legitimacy of art's autonomy and guard high modernism from theatricality. He was of the opinion that art degenerates as it approaches the condition of theatre.³ He also believed that theatre, or literalness, was the most pervasive mode of being or sensibility in contemporary society. Yet, while "we are all literalists most or all of our lives", art is that which releases us from the literal and theatrical ordinariness of daily life. Art transcends the everyday world.⁴

Fried's essay was written with a culprit in mind, minimalist sculpture. The Minimalist sculpture he rejects as theatrical includes or implies an audience, indeed, is incomplete without one. Minimalist sculptures by Morris and Judd make viewers more aware of their own location and movement. Morris made sculptures that were obtrusive, confronting and got in the way of the viewer. Morris and other minimalists were also attempting to make artworks that required the duration of experience, that were not wholly manifest in the single moment. In this, they departed from what Fried valued as the simultaneousness or perpetual present of modernist art.

What is at stake in modernism's battle against theatricality, Brockelman notes, is

"the authenticity of seeing itself . . . Modernism's battle against theatre spearheads a struggle to see the world as it really is".⁵

Fried's essay responded specifically to the art of the period, and the flaws and paradoxes of his argument have been pulled apart by critics ever since, yet, as Brockelman notes, "no other definition of aesthetic Modernism has proven as compelling as Michael Fried's notion of a war against theatre". Brockelman further observes that, "the arts, following the lead of architecture, have begun experimentation with an anti-theatrical Theatricality unforeseen in Michael Fried's battle".⁵ This anti-theatrical theatricality is perfectly captured by work that implies an audience, yet at the same time, dislocates that audience through shifts in scale or visual illusion.

If one was to find a common thread in the work presented here it is the continuity between the sensual apparatus of the viewer and the material proposition, in other words, theatricality. At the same time, the digital parameters that generated some of the projects have a solipsistic quality, in which the audience stands outside a closed system that performs for itself. What that means for the discipline and for the audiences of architecture is something I hope this exhibition and book will stimulate you to debate.

The design of a temporary architectural structure for theatre is the most intense site for enacting debates over the status of architecture in relationship to modernism and autonomy, to audience and seeing, to authenticity and simulacrum, to questions of theatricality and genre. In this program we confront head-on the myths and anxieties that continue to characterize the scene of architecture as it simultaneously laments and cannibalizes the modernist legacy. We are indebted to the Sydney Festival for the provocation and the audience.

Notes

[1] Michael Fried, 'Art and Objecthood', in *Art and Objecthood: Essays and Reviews* (University of Chicago Press, Chicago, 1998), 148-172, originally published in *Artforum*, no. 5, June 1967, 12-23.

[2] Michael Fried, *Absorption and Theatricality: Painting and Beholder in the Age of Diderot* (University of Chicago Press, Chicago, 1980), 5.

[3] Fried, 'Art and Objecthood', 164.

[4] Fried, 'Art and Objecthood', 168.

[5] Thomas Brockelman, 'Modernism and Theatricality', *Art Criticism*, vol.8, no. 1, 55.

Our City in Summer

The DNA of a Festival

Dagmar Reinhardt in conversation with Lindy Hume, Sydney Festival Director
and Bill Harris, Head of Programming, Sydney Festival

Reinhardt: Following our joint project on developing a contemporary performance structure for the Sydney Festival 2012, I would like to ask a number of questions that cross into and out of different realms: festival, theatre, architecture, space, the idea of the spectacle, digital technology, the production of festivals, theatrical spaces, the idea of time. Maybe first, by way of introduction for a general public - what does the job of a festival or program director entail?

Hume: In its optimum sense, the job entails developing a program for an annual festival that responds in a compelling way to the contemporary environment - which is a very particular animal. A program that is relevant in a national and international context, both in global and in a local sense, and relevant to the current Zeitgeist. In a more micro sense, we develop a matrix of narratives that are attractive for a range of audiences, or the journeys for people. In practical terms, that requires selecting keystones, which animate the journeys, and then building up the festival body.

Reinhardt: How do you build a festival matrix?

Harris: The matrix already exists in the Sydney Festival itself, as a structure upon which an artistic director builds up. You don't start with a blank canvas.

Hume: There is a degree of architecture to it: the festival concept develops from stakeholders and the organisation's need to deliver every year certain signature events, certain outcomes for the state, the city and the people of Sydney.

Reinhardt: As there is a preset matrix to the Sydney Festival, is that communicated - in other words, do you see Sydney Festival as a brand?

Hume: Sydney Festival definitely is a brand, with the slogan 'This is our City in Summer' and a global positioning statement that extends as 'The Most Wonderful Summer Festival', because it invariably has a mood of summertime energy.

Harris: If you went right back to Sydney Festival's creation, its purpose was to provide entertainment, predominantly over the summer, as a reason for Sydneysiders to stay in their city, to engage with their city and to enjoy it during the month of January. That became the genesis for the idea of 'lets put on a festival', the motor to formalize it. If you look at the festival in context, it is not derived from an intellectual base, but very much from a celebratory base.

Reinhardt: So the 'home zone', the departure of the festival is not a location, a where, but a when, a moment in time. In relation to Sydney itself, when you refer to the city, are you interested in its fabric, its cultural identity, or do you discuss it as a city of spaces?

Hume: Sydney Festival is for us a marker in a global landscape, but predominantly a city for people to live, for the citizens. The urban spaces interest us in relation to the human being, as spaces in the sense of 'meeting places'.

Harris: And sometimes we think of Sydney Festival as 'shared humanity', as a reason for the people of Sydney to gather, and celebrate themselves, the city and the community. We understand the festival as a mechanism allowing this to happen.

Hume: In fact the very idea of a festival refers to a symbolic frame, such as an annual celebration of harvest, or seasonal changes. A festival like ours has a strong relationship to climates and phases of the year, and its proximity to the holiday

season and because Sydney Festival is such an established event, there exists a huge expectation, similar to the advent of Christmas.

Harris: You could say the Festival is embedded in the city's DNA, yet there are naturally variations. The Festival every year comments upon and engages with what the city is at this point in time. 2012 is different from 2009. We are seeking artists and art that deliver a sense of what determines the city and its directions, on a base of tradition.

Hume: As a contemporary annual festival, we also review the significance of our work for each year. That includes the 'Knees Up Party' as one element of Sydney Festival. Yet a deeper significance is the indexing of new territories such as the cultural landscape of Parramatta this year, which we spent a considerable amount of energy and time in animating. That is significant because it reports back to a world the ways in which this city is changing, and to which we are responding. The evolution from a general DNA of festivals to the actual, specific Sydney Festival 2012 is also a reflection on our society.

Reinhardt: The DNA of Sydney Festival is thus emerging through variations and evolutions?

Harris: We continuously proceed from a platform or base and review key questions: 'Who and where are we, and where do we go from here?'

Reinhardt: Is this development the result of intellectual decisions? What are these new territorial changes for the 2012 Festival, and by which criteria do you develop them?

Hume: The criteria are straightforward: assessing the Festival brief in response to cultural potentials in different communities - that opened new relationships with

Carriageworks, The University of Sydney, and the Seymour Centre. The process answered both an instinctive and a statistical call, reflecting a critical mass as to where things should happen. As a curator you want to look to the audience and not the things you want to do, in isolation. You need to listen to what the city is telling you. Western Sydney physically needed more exploration, it seemed culturally hungry - there is a very dynamic community out there, such as Campbelltown Art Centre. Our other big focus is on Indigenous Sydney and these both represent directional changes that transport the Festival beyond its current shape. At the core of designing the Festival stands a combination of Festival Director, the organisation and the people of Sydney.

Harris: Our great strength is the ability to perceive the city and its framework, the structure of arts and culture, and to engage and transform the Festival towards a future direction - this defines our capacity to lead. Cultural hubs within the city may not possess the ability to develop, yet we invite them to come with us on a journey. We may help them to blossom into a persona they would not have had the resources or initiative to become on their own. Through Lindy's passion and leadership, we achieve a greater festival. That leaves a legacy; it empowers people; and strengthens communities.

Hume: As the Festival develops, we are creating social capital. A festival must leave footprints. Our creative team develops both long arches and short-term relationships that spark off other ideas. Our relationship with Carriageworks, sparked off from a change in management, and here our two organisations meet at the right time.

Equally, our relationship with The University of Sydney aligned at the perfect moment when both the Vice Chancellor and I were at the beginning of our terms. Other parts of the Sydney Festival portfolio develop through sponsors and collaborators. These are the times when projects begin to inform the differences between 2009, 2010, 2011.

Harris: The great skill of a festival team is to recognize and wherever possible, create these opportunities. I remember an early road trip through Greater Western Sydney, and there was an untapped energy that was quite palpable, a sense of "why aren't we doing more with that", of "here are the future voices of the city!" This ability to recognize and create is the underpinning strength of a good festival director.

Reinhardt: There seems to be a risk embedded in an approach to creativity that is recognizing the moment. Are you taking a risk of not knowing where potential projects will lead up to?

Hume: Yes, but we equally establish a balance between developing venues and events, and answering the financial need to fill theatres and venues with actors, staff and audiences. The goalposts are defined in terms of what can fill these spaces. We interpolate between such objective and more fluid events simultaneously each year.

Reinhardt: The goalposts you mention are headliners, artistic flags within a landscape or a multitude of different flags, able to attract huge audience numbers. If these are the financial motors, what resides at the heart of the Festival?

Harris: Sydney Festival is a multifaceted event, and requires detailed consideration. The heart of Sydney Festival 2011 was probably the 'Trocadero Dance Palace' in the Town Hall, which on a number of levels

engaged with the city and its communities. It looked back on the City's past with a contemporary twist with regards to production values, design aesthetics, and execution - a truly unique and special Festival event.

Reinhardt: You are creating from the community, for the community, so the audience you address is never objectified. How do you navigate such a personal approach?

Hume: You have to be personal. Trocadero Dance Palace revives the time my grandmother went dancing there. In this transaction, the exchange is vital. Sydney Festival embraces different cultural aspects, a consumerist culture, and an intimate exchange, and sometimes both are embedded in one work.

Harris: As does 'Food Chain', a work that provided an opportunity for two significant young Australian choreographers to bring their work back from Berlin to the artistic community of Australia, as a spurring on of creativity. Any show in the program will include these aspects on different levels.

Hume: The Festival allows us a wide range. We can be vulgar, we can be brash. We can do a Bollywood extravaganza with dancers and butterfly costumes, or feature Grace Jones, who delivers a perfect bridge between the gay community, people with nostalgia, and audiences taken by the presence. But at the same time, there is a double edged sword to this hysteria. Sydney Festival 2012 showcases three weeks of programmed activities, of multiple journeys. You can blow a festival with one bad experience - you need to consistently deliver on a range of different levels.

Harris: There exists a level of trust between the audience and the Festival.

There is a sense with the audience that whatever we advertise, we will deliver as we promised. For 2012, we are looking at a total of 85 events, of which the headline artist is just one.

Reinhardt: I was under the impression that you two were travelling the world, in preparation for, or selection of, invited acts – yet through our conversation I understand there is at least a similar amount of work created by conversation, in a dialogue that arises from a local context?

Hume: It is both, a combination. The travel is necessary for perspective, to establish a distance and look back with an objective viewpoint. It also enables you to remain in the currency of developments, to meet and exchange. Increasingly, people are looking at different places – and thank God for the Internet. My successor, Lieven Bertels, will naturally introduce a European perspective.

Harris: Part of my role as Head of Programming is to immediately capture a sense of the Festival Director's approach and vision, and that's a very personal exchange. I then ask the programming team to remain as fluid and flexible as possible, in order to respond to areas the Festival Director wants to pursue. The team is evolving with each festival. Ultimately, the programming department's task is to realize the visions of the festival director, fundamentally providing a response to the direction of the next four years. I am presently engaging in conversations that will open context, direction, history and relationships that the organisation needs to hang on to. But this is a dialogue – and the next director comes with a vision.

Reinhardt: You made the remark 'thank God for YouTube', which feeds back into my question regarding the impact of digital

technology on the identity of theatre and festival. Theatre is inherently performative – do you think that the availability of technology has had an impact on the world of the festival?

Hume: I cannot imagine anyone creating a festival without access to the Internet or YouTube nowadays. It is an incredible tool, we use it in office work, but also as a reference library; we Google and YouTube people all the time. It is part of the world we live in, and we embrace it with both hands. Sydney Festival's identity is strongly related to its digital identity, by YouTube, Facebook, Twitter, and FestivalTV – that is in itself our shopfront.

Reinhardt: So would you argue your mode of the digital is primarily as a means of communication?

Harris: Our audiences change the way they communicate themselves. As an international arts festival we try to be a leader, in that we act as a reference point. That's why Sydney Festival comes across as cool, cutting edge, looking ahead. A number of benefits come from that as it spreads out towards the relationships that we establish and maintain. There are different ways this may spread out through corporate partners, artists, our staff and ultimately our audiences.

Reinhardt: I would like to expand this question. Beyond the digital as a cultural platform or communication, is there an interest in digital technology via the performance itself, such as interactive media, video art, or screens?

Hume: Personally, I am drawn to works that have the human being, and specifically the human heart, at the centre. To feel something is better than to observe and admire it. When we do use technology,

such as Baldessari's 'Your Name in Lights' – that made you smile. It was social media, technology, and joyful. The interesting aspect of technology is not its application, but the conversations enabled by and through technology.

Harris: On another level, one of the interesting responses of the digital world is the ongoing need for people to leave their private lounge rooms and to engage with people face to face. We offer this community platform, providing interesting, engaging and accessible opportunities for people to come out and be part of an event or performance that they enjoy.

Reinhardt: Let's reflect our collaboration with a performance space for Sydney Festival 2012.

Hume: We transform the city, we create performance environments in places that are normally urban landscapes, so we look for the potential in the places people normally inhabit to gather people to share a cultural experience. I had wished the performance environment could become more sophisticated and integrated into the performance – so that seemed an ideal challenge for our joint relationship, and to position this as the brief for our collaboration.

Reinhardt: Our architectural interests have been in exploring fundamentally different locations: the Turbine Hall, The Quadrangle and the Festival Garden. Some of these called for provocative designs, the architecture of brand. Others called for discrete inserts, which acted almost as installation lounges. I wonder in which way the designs would have changed had we worked with a director.

Hume: Yet the brief was not set for design scenery – that's a whole different

story. Getting an architect to design scenery has been done before, through a range of experiments with stage designers and artists. The interesting projects from our collaboration walked away from the moment of scenery, or architecture – these students got the balance right between attracting the audience, the excitement of walking into the venue, and letting it sit as a frame, as a backdrop to the performance itself.

Reinhardt: That strength in expression combined with an element of (performance) performativity, was the real challenge at the Festival Garden site.

Hume: And that particular project, the 'Spritz', seemed the most relaxed, natural answer to both the question of brand and site. The project has that vibe of summer, of excitement, the sparkling of champagne. Equally, 'Puffscape' in the Turbine Hall had the same spirit, bordering on a whimsical statement, making people laugh – not that I would want to call that a clown of architecture...

(laughing)

Reinhardt: But that is a glorious achievement of architecture, making people laugh.

Hume: Making them feel something.

Reinhardt: We aim for that all the time in architecture.

Hume: And sometimes that's successful and sometimes not.

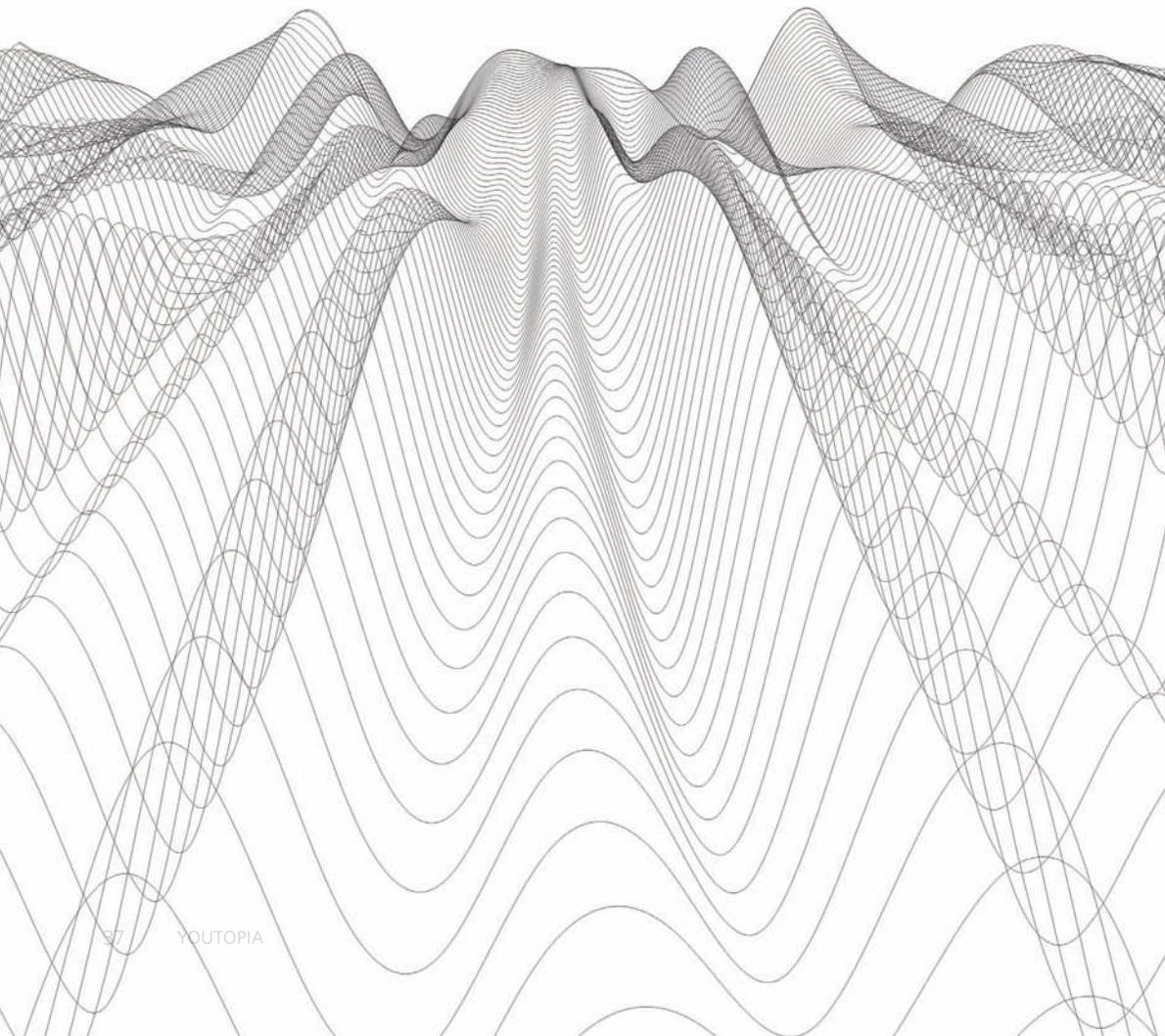
(laughing)

Reinhardt: Thank you for the conversation, and for the collaboration.

On the Edibility of Theatres

Simon Weir

It was late in the evening when K. arrived.
The village was deep in snow.
- Franz Kafka, The Castle



Edible architecture may sound like an over-reaching expectation but surely I am not the only one who has sat through a long lecture or theatre performance and wished the chair's armrest was a long loaf of fresh bread stuffed with blueberries, chocolate and hard boiled eggs. And I don't know how many of you have sat in front of a fire on a cold winter's night in a chair made of bread, wearing slippers made of bread, but trust me, it's toasty. Edible architecture is deliriously pleasurable, but the decadence, the morning after, can be rather messy.

The poorest among us will eat their own homes either out of necessity or lack of self control, and then enjoy the displeasure of sleeping outdoors on rainy winter nights. And no one will ever succeed in restraining random birds, possums, rodents, insects and probably even family pets and errant children from chewing through structural members. Perhaps the project would succeed if the edible parts of the architecture were alive, and the partially eaten building would regrow. Following the rhythm of the sun, a family could enjoy a large and spacious house at the end of summer and eat it down to a few rooms in winter while waiting for the regrowth and expansion of spring.

Until edible architecture is common even the most appetising theatrical architecture leaves us hungry. So here we are sitting in the theatre, sitting in a dome or a saddle, neither of which are edible, both of which could be edible, and after ninety minutes you start to get hungry. Since unfortunately you can't eat the chair, and there they are anyway, we think about which of the actors we'd like to eat. It cannot be forgotten that the actors are only the plates upon which the great meal of Theatre is served, but let us take an interest in crockery, and spend a quiet moment musing on the theatrical metaphysics of edible plates, cups with handles and all kinds of bowls.

Watching the Kitchen

As a child asking for food, waiting during preparation is one of our earliest lessons in restraint. Adults and children in the kitchen adopt reciprocal postures: the postures of performance, and the postures of audience.

As children we are often passive observers of complex human dramas. With an internally disciplined stillness of physical posture, we are politely ignored by the adults, and as we watch and absorb their words and actions, as they play, we learn what humans do. In this intellectually childish posture of open observation, we expect to see cause and effect, history and consequence.

This I intuit is the early condition that creates the postures of theatre and establishes audiences' expectations of performance: to most passive audiences, the performers are parents; to the most active audiences, the performers are competitors. In their exaggerated forms, the passive audience reverts to an infantile condition of full immersion into a theatrical world which is mannered, self conscious and self referential; the active audience calls out, criticises, resists and obstructs to the point of breaking the reciprocity of posture and ending the theatrical experience.

Something's Like This

We are always aware of more than we can put into words, so we use other means of communication, and make words mean many things. As a first level of analysis, we can say that each word refers either to something present or something absent, and from this there are three uses: exemplified here by three different meanings given to the word this. There are those sentences that reveal their contexts and conceal their particular e.g. all this came from Sydney; those that conceal their context and reveal only the particular e.g. this is the font; and those that reveal the context and the particular e.g. this is Simon's writing style.

This last usage can take the form of the aphorism - answers to both specific and general questions about history and consequence, like Heraclitus' hyper-transparent parental fragment: follow the common, which can also be rendered as an analogy of swimming in a river: float downstream, and the casual music of: go with the flow.

These double meaning phrases are of great use to children because of their deep simplicity; moral codes are best absorbed from musical aphorisms: do unto others... Their performative capacity coupled with their aesthetic complexity make them almost intellectually impenetrable and readily become items of basic belief and 'truth as premise': you should do as you're told.

These special phrases are of great use to dramatists because of their efficiency, or as Shakespeare might say, their pregnancy, (i.e. 'we are expecting triplets, but who knows, there may be more.') In the hands of a good dramatist, a single aphoristic opening or exchange will establish actors' anticipations, provide the appropriate interpretations of props, and offer the audience a glimpse into the psychology of the society.

Sophocles' King Oedipus opens with a question about the purpose of prayer, "My children, latest born to Cadmus old, why sit ye here as suppliants, in your hands branches of olive filleted with wool?"¹

Shakespeare begins Hamlet with a pair of requests that use the language of posture to describe the motion and emotion of the story: Bernardo: "Who's there", Francisco: "Nay, answer me: stand and unfold yourself".

Oscar Wilde opens The Importance of Being Ernst with Algernon playing the piano, then his butler, Lane, enters. Algernon asks, "Did you hear what I was playing, Lane?" Evasively, demurely and with an astute procedural intelligence, he replies: "I didn't think it polite to listen, Sir".²

Apparatus of Distraction

In our posture as audience we are typically undernourished, looking to the actors from the poverty of our inedible chairs, and yes we know it is socially unacceptable to eat actors, and only acceptable in friendly impolite company to say we would like to eat an actor, so we beg the actors to distract us. "Tell us a story of faraway place," "Rosy fingered dawn..." and with the first sentences we are transported toward something absent and present, toward something of history and consequence.

The actor anticipates the audience's hunger, wants to be eaten, and will want to enact partial rather than complete distraction. All the better.

As the apparatus of the consumption of distraction, the architecture of the theatre has different values than these plates, cups and bowls: being aesthetically coloured, of appropriate weight and size, and, if you are in that position, being easy to wash.

The architecture of theatre must please both actors and audience, but here in this Dionysian essay, since the chairs are inedible, and the selfish democratic nature of our polis guarantees that the audience's needs are already well considered, I will defend the minority, remain "on stage", and explore what makes a good venue for the performer. What are the best mirrors for reflecting pregnant sentences?

Theatrical Combat

The most intimate of these situations has only one performer: the speaker, the musician, the comedian. These performances are fragile operations, where the emotional and intellectual stakes are so high that expectations can rise to the level of confrontation.

Jerry Seinfeld's description of the difficulty of the art of comedy sounds remarkably similar to a contest of physical combat: *"You're completely alone, and there's nowhere to hide; and every aspect of the work has to be done by you... So any failing in your character, in your work, in your mood, any weakness is readily visible to the audience... It calls on a lot of different abilities all at the same time, so when you have a failing, unfortunately it can be fatal. You can tell the greatest joke but if you just trip over one word on the punch line - nothing".*³

In the introduction to his autobiography, Steve Martin revealed the violent private language of comedians discussing their work. *"The comedian's slang for a successful show is, 'I murdered them,' which I'm sure came about because you finally realize the audience is capable of murdering you".*⁴

The occasion of violence in theatre, the surge of adrenalin in the anger of a comedian, and in the fighter in the arena, has been long understood as having political significance. Jimi Hendrix explained the occasional violence in his performances as a strategy for mitigating social aggression. *"When you bring your girlfriend there and watch us play and so forth, you can get it out of your system by watching us do it; making it into a theatrics instead of putting it into the streets".*⁵

In this stressful situation, requiring errorless performance and a serious connection with the audience, overcoming unanticipated obstacles, those random interruptions, is a separate and necessary skill.

Steve Martin explains: *"Stand up is seldom performed in ideal circumstances. Comedy's enemy is distraction and rarely do comedians get a pristine performing environment. I worried about the sound system, ambient noise, hecklers, drunks, lighting, sudden clangs, latecomers and loud talkers... I suppose these worries keep the mind sharp and the senses active. I can remember instantly retiming a punch line to fit around the crash of a dropped glass of wine, or raising my voice to cover a patron's ill-timed sneeze seemingly microseconds before the interruption happened".*⁶

This Dionysian frenzy, this hyperconscious fluidity is necessary for the performer who listens to the audience as if their life depended on it. Jerry Seinfeld described the quality of the confrontation in a gentler way, as something of a dance between the performance and the audience.

*"The laughs and the comedy have to have a nice balance to it. And if the comedian pushes his act too much into the laughs it hurts them. So you have to let the laughs kind of breathe, then the comedy breathes. And every performer has his own organic rhythm and you just have to know it and be true to it".*⁷

Anecdotes about Venues

If the musicality of the interactive acoustic spectacle is an important quality of the performance, the architecture can contribute something vital to the life of the performer, and to the experience as a whole.

Steve Martin, writing of his early career explained the heart breaking difficulty of badly designed spaces that prevent the sound of the audience coming quickly and clearly to the stage.

*"I got a welcome job... at the International Hilton in Vegas, a huge unfunny barn with sculptured pink cherubs hanging from the corners of the proscenium. Laughter in these poorly designed places rose a few feet into the air and dissipated like steam, always giving me the feeling that I was bombing".*⁸

A similar condition was also reported by Woody Allen, “at the Americana Hotel, I find I’ll tell a joke, I’ll get the exact same laugh on the joke, but it comes back to you in a different way, it comes back in a diffuse muffled way, the walls are quiet, the room’s spread out... There’s an acoustical thing that happens at Hungry I in San Francisco and The Bitter End in Greenwich Village, they are so constructed, the people are packed in, sort of, the wall is brick, and when you tell a joke you hear a snapping high pitched return from the audience, it’s like you’re turning up the treble on your hi-fi set, there’s a definite, like, whip cracking when you hear that laugh”.⁹

Here Woody has identified two important factors for excellent performing conditions. First, the audience must be packed in. This is well known; speaking to three hundred people in a room made for two fifty is much more satisfying than speaking to them in a room made for a thousand. The effects of a too large room are both acoustic and social. The sound is thin, the audience can’t hear each other as easily, and no one can help but count the absences, which is an unwelcome distraction.

There is here an ongoing challenge for a performer’s career: bigger venues are better, but for each individual performance the venue needs to be slightly too small; better too small than too large; smaller is better. A venue that could maintain the ideal acoustic and social performance conditions would need to physically change to suit a changing crowd size.

The brick walls Woody fondly mentions are not susceptible to casual rearrangement. Hungry I and The Bitter End are on the lower floors of tall brick buildings, and subsequently are heavy structural walls several courses thick. The key benefit is sound: air seals and heaviness are important factors in acoustic isolation and reflectivity, and neither of them are easy partners of mobility.

The weight alone need not be a difficult obstacle, a brick wall a metre thick could be constructed as a brick shell around a steel frame with motors inside allowing the wall to be driven at very low speeds – a few metres an hour. The instantaneous aesthetic would be totally ordinary but the experience would be uncanny.

Against Edible Venues

Lighter weight constructions like walls made of dry bread, do not have sufficiently high acoustic reflectivity for surrounding performance spaces; perhaps we just have to accept that bricks are funnier. Large slabs of chocolate could be fitted with castors and wheeled around as a gnawable barrier. With the application of a small blow-torch, the base could be melted and made to flow out onto the floor, sealing the gap in such a way that can be easily removed by gentle chiselling and hot water.

If it is going to be made socially unacceptable to eat the walls – to show restraint before walls as before actors – they would ideally be coated in gold leaf, as it preserves the chocolate, clearly reveals discourteous contact, and reflects a beautiful shining light.

With the appropriate formwork, the entire venue could be made from a single mass of solid sugar, dry to the touch, but yielding sweetness when licked. It is revealing that the acoustically appropriate materials seem also to be tempting, and bad for one’s teeth – the teeth metaphysically representing one’s intellectual ability to break and press raw ideas into aphoristic nutrients.

There is a single famous precedent for sweet architecture, the 1812 fable by the Brothers Grimm, Hansel and Gretel. Here, the cannibalism is reciprocated: after the children, Hansel and Gretel, eat part of the witch’s house – temptingly made of candy and cake – she captures and prepares to eat them.

The discordance between these two situations – the plausibility of an edible theatre, and the witches’ edible house that Hansel and Gretel stumbled upon – is the ownership of the object. Who owns theatres? Either the players’ company or a third party, but in the reciprocal nature of commerce, each part owns the other. In theatre, performers and audience lure each other. Perhaps edible walls and ceilings would be a distraction from the distractors. Everything in the theatre could be made to be edible, but the absence of eating during theatre assists the transference of desire toward the actors, and spreads the contagious postures of the audience enhancing absorption into the theatrical world.

We should not expect that the edibility of the architecture would be perceived by the audience as an invitation to eat the proscenium during the performance; the decorum of our reciprocal postures would ensure it. On the other hand, a chair made of bread, blueberries, chocolate and hard boiled eggs would be sufficiently nutritive to help us endure a long performance and discreet enough to not distract other audience members. And there is no doubt that we are more than a little fond of the bread upon which we sit.

Another option could be a theatre-restaurant where the performance is absorbed in enraptured stillness by the audience and immediately afterwards they eat the theatre and the actors in a giant Dionysian, Oedipal, orgiastic banquet – simultaneously fulfilling infantile desires and destroying both the illusion and reality of the theatre.

Notes

[1] Introductory quote as published in the first lines of Franz Kafka, *The Castle*, (trans.) Muir (London: Minerva, 1926/1995), 9.

[1] Sophocles, *King Oedipus*, (trans.) F. Storr (London: Digireads, -429 B.C.E./2009), 7.

[2] Oscar Wilde, *The Importance of Being Ernst - a Trivial Comedy for Serious People* (London, Chiswick, 1898), 1.

[3] Larry Wilde, Jerry Seinfeld on Comedy, "The Art of Comedy" [Audio recording], (Tarzana CA: laugh.com, 2001).

[4] Steve Martin, *Born Standing Up* (New York, NY: Scribner, 2007), Introduction.

[5] Jimi Hendrix, *The Dick Cavett Show* [Video recording], (Los Angeles CA: CBS television, original broadcast 7 July 1969).

[6] Steve Martin, *Born Standing Up*.

[7] Larry Wilde, Jerry Seinfeld on Comedy.

[8] Steve Martin, *Born Standing Up*, Chapter 6.

[9] Larry Wilde, Woody Allen on Comedy, "Audience Response", [Audio recording], (Tarzana CA: laugh.com, 1966/2001).

Moving through Space

Dagmar Reinhardt in conversation with Michael Scott-Mitchell, Head of Design, NIDA

Reinhardt: Prior to this conversation at NIDA, the National Institute of Dramatic Arts, I had visited the End of Year exhibition of your students, which featured a wide scope of theatre projects. In contrast to architectural education, theatre design has a different priority, thus different teaching objectives. What is the nature of the course, the Bachelor of Dramatic Arts (design) taught here?

Scott-Mitchell: The course contains set design, costume design and prop design; with a particular focus on live performance in theatre, to a lesser degree in TV or film, and event. The prime teaching is done through direct application in theatre. In their First Year, students work halftime within NIDA's play production as part of the crew, and the other half in a studio environment. In Second Year, they engage with an intense program of theoretical and practical exercises. In Third Year, they return to the play production program. NIDA produces ten theatre productions per year in its play production program. The Bachelor of Dramatic Arts is an intense, specified and complex course - intense in its investigations with 27 assessments in year one of the design course; intense in its individual discussion with each student, and by the exclusive student numbers of eight students accepted per year, resulting in a total of 24 students. That is arguably a selective, luxurious take on teaching the profession to young designers, yet the industry would not be able to cope with more graduates entering the market.

Reinhardt: This market is varied - different modes of operation exist with the idea of a "spectacle" today, such as in performance, theatre and festival. Theatre

and performance strongly depend on the actual architectural space they are taking place in, so in which way does NIDA open architectural considerations to students?

Scott-Mitchell: NIDA's theatre projects, its primary work, are developed in and through our four 'internal', in-house venues. We have various forms of theatre architectures at hand: the Parade Theatre, the Parade Studio, the Parade Space, and the Parade Playhouse - different types of venues, all of which vary in audience seating, space, lighting, and so forth. The Parade Playhouse has slightly eccentric end stage seating. The Parade Theatre, a proscenium without proscenium, the Parade Studio is a small theatre space with flexible seating, and the Parade Space is a converted rehearsal room. The production of 8 of our 10 annual shows is undertaken here. In addition, we have opened up collaboration with Carriageworks, with whom we are embarking on a three-year agreement.

Reinhardt: The Parade Theatres provide an actual theatre environment in which the theatre design students conceptualize and produce their works. Would you argue that such a constant availability allows for an intimate knowledge of the spaces in which the performances will take place? Does this enhance the understanding of the performance quality and behaviour of theatre space, beyond its architectural expression?

Scott-Mitchell: The teaching is intricately linked to these theatre spaces. At the core of our teaching, we are dealing with very specific performance designs for specific spaces, which is opposed to the medium of film. The conceptual response the designer develops for a work is always in relation to

a performance space. That is, the designer needs to understand what that space is - architecturally, theatrically, performative; experientially - and how they can manipulate it. An integral part of the Studio subject is based on designing theoretical resolutions of performances for venues around NIDA. Students build a model box of the venue, and conceptualize the performance for that exact space. This is recurrent so after three years students will have designed a number of times in a theoretical context, and are familiar with the theatres through both the designing and having watched the shows in them.

Reinhardt: The different theatre venues NIDA offers could be described as a spectrum of typologies for theatre spaces. In that sense, do students encounter and develop experience and a spatial knowledge for their future profession, by being exposed to and being trained to produce experiences of performances within these spaces?

Scott-Mitchell: Theatre designers, and set designers particularly, have to work in the context of a given theatre space. More importantly, they need to respond to the characteristics and dynamics of that specific space. That is why students need to learn what elements are at their disposal to manipulate space, so as to bring it into accord with how they respond to a play in relation to the architecture.

Reinhardt: Youtopia investigated three different locations (The Turbine Hall, The Quadrangle and The Festival Garden) that shared the departure from a prototypical theatre space. Sydney Festival reaches beyond classical theatre, in the sense that regularly new spaces and places are adapted

towards performances, new locations are developed. What challenge does this entail for a theatre or stage designer?

Scott-Mitchell: As a designer, you are working within a specific space with a given audience and their interaction with one another. In the context of NIDA, the four venues are traditional theatres, but that is the only difference. As a general rule, you have to proceed through a number of design considerations, such as where the audience is in relation to a performer, and practical considerations such as power supply, stage placement. While elements differ slightly, these are shared considerations as to how the performers best connect to the audience.

Reinhardt: As is the case with the Sydney Festival, we are asking the audience, the actor and the stage designer to leave their expectations of theatre, to conceptually address space. Specifically the Youtopia project investigates aspects beyond performance: the iconographic architectural object, the interactive installation work, the theatre without narrative, and the site-specific vibes. Framing these critical instants as a design drive for production has required the architects to interpolate continuously between the headset of theatre and architecture. That is a mode very specific to your mode of operation - you have been trained both as an architect and stage designer?

Scott-Mitchell: You could say that as a theatre designer, I think architecturally. I am interested in the idea of bodies moving in space, the human figure being seated in space, and in which way you can manipulate a space to change the experience of a person within. Between the body, the

movement and space, there is a multitude of different alignments that creates sets of responses. During my architecture studies at The University of Sydney, I entered conversations with Robin Lovejoy (then Head of Directing at NIDA) on architecture as the construction of an immersive environment, the performer in theatrical context, on bodies in space. He invited me to join him at NIDA, and from that moment onwards I redirected towards theatre. Yet there is also a continued engagement with architecture, through for example my work with D4DESIGN. That company was an intersection of expertise and set up as an instant enterprise, a limited life company that explored a variety of design aspects: theatre, interior architecture and architecture.

Reinhardt: As designers, we pursue themes that reoccur in our work. Is there a signature or interest that invariably shows up in your work or otherwise defines it, such as your interest in the body moving through space?

Scott-Mitchell: The way in which space can produce an emotional dynamic out of the rearrangement of the elements, eliciting a response through shifting shape, form, colour, or texture – that is a major fascination for me. In theatre, there exists a rational theme, the play, and a landscape of music, but there is also an emotional underscore. My career deploys that expectation and excitement of feeling, in the emotional response towards architectural space.

Reinhardt: Classical theatre feeds from new interpretations, new narratives, to familiar stories. The emotional response you describe is a new experience for the audience. Would that be the product, the

result of your work? And so the question is, where is your point of departure?

Scott-Mitchell: My work is a very subtle exploration beyond words. Words are simply one version of how the brain works, but I commend a more intuitive version, and expression by patterns, shape, and colour, different languages. Some works begin with a conceptual driver, such as 'Rinaldo' that explores the notion of two-dimensionality transitioning into three-dimensionality. The design started with medieval imagery around the themes of love, seduction and betrayal. Through unfolding elements, such as mechanical devices, or trajectories of motion, the narrative develops. The visual aspect of this work are reflecting and commenting, at other times developing notions on the human body and motion. And specific aspects are being revisited in later works. My work starts with referencing, and, being a great believer in the idea that the subconscious mind is the engine that is driving the majority of design resolutions, my thinking process starts by both selectively collecting research, and freewheeling. When I am kick-started by imagery, I immediately go to CAD, and start drawing.

Reinhardt: As in most creative realms, the public shares the illusion of the artist sketching wildly, yet most of us employ a wide array of media, from analogue techniques towards digital technology to express our design concepts. What techniques and strategies do you embrace?

Scott-Mitchell: There exist different animals in this world. I have a natural affinity towards drawing freehand, or doodles, and then working immediately in CAD, because technical drawings enable layering

versions upon versions, precise descriptions and rough approaches, simultaneously. I understand space as a piece of sculpture. Architecture, by its very nature, is sculptural, and the sculptural exploration produces a response by the people travelling through that space, and a response by viewing people travelling through. We live and perceive and have an experiential interaction with three-dimensionality, and that is my love of what I do as a theatre artist. Opening up an investigation about the human condition.

Reinhardt: Let me set a final question. What would you want an audience to remember?

Scott-Mitchell: Theatre is a very dark art, in the sense that people are unconscious of the ways in which they are being manipulated. That is a good thing. I like people to think:

“This work has touched me, yet I cannot quite grasp the reason why”. Then I have done my job, and done it well.

Reinhardt: Thank you.

Defining (a) Theatre

FOR THE 21ST CENTURY

Joseph Buch

1st definition:
"Theatre is two planks, two saw-horses, (tréteaux), and two actors."

(1)

2nd definition:

Red Mole, a New Zealand performance group specializing in "children's theatre for adults", were unpacking their masks and props for a show in the Rotorua Art Gallery. A local mother and her two small children walked by. "Wot 'em people doin' mum?" "They're makin' tricky things."

(2)

3rd definition:

On a popular tourist laneway in Paris's Latin Quarter, a young man in a cape, red scarf, and broad-brim hat from Lautrec's cabaret poster was chalking circles and rectangles on the pavement, and labeling them "here", "there" "Grandma's house", etc. He had soon gathered a semi-circle of spectators, and announced: "maintenant, nous ferons theatre!". He quickly selected his cast, choosing a girl from the crowd to be Chaperon Rouge (Red Riding Hood), and so the show had already commenced: the audience knew what to expect. A man from the audience for the wolf, a woman for Grandma, and another younger man for the helicopter. (Helicopter? Now the audience weren't so certain...). He placed the "actors" (not all French-speaking), and commenced the play, feeding each two or three lines which they merely had to repeat. All went as per the traditional tale (albeit with much banter and by-play), until the final encounter with the wolf-as-Grandma. "Moi? I don't eat people — I'm a good Marxist wolf." At this, the helicopter arrived, rescued Red Riding Hood, the wolf announced he was becoming a vegetarian, and all lived happily etc.

(3)

20th century strategies, both directorial and architectural, can break down the barriers between performer and audience. Live theatre, relieved of the task of being a "realistic" teller of stories by the invention and development of the cinema, abandoned the illusionistic scenery and lighting effects which had been developed in the 19th century. Instead it developed new ways of best utilizing the presence of live performers by "breaking down the barriers" between performers and audience.

This began with bare stages and less rhetorical acting in modified conventional theatres, and led later in the century to new theatres being designed to bring audience and performer into closer physical proximity, to variable-format "flexible spaces", and to performances which completely intermingled audience and performer, encouraging direct interaction between them.

At the beginning of the 21st century, the development of another new set of technologies might find theatrical application by providing more direct interaction between performers and audience with devices already familiar to both.

The young French busker was addressing the theatrical manifestation of a basic difficulty made famous by one of his countrymen, Michel Foucault: classification = division = control. As soon as we denominate “actor”, we define “audience”, and they each have their place in that particular sort of building/space/facility we call a theatre.

Taking his title from Shakespeare,⁴ Richard Southern’s book on the development of the theatre (not, as was more conventional in his time, a “history” of theatre) listed seven “ages”: 1st, the costumed player; 2nd, the great religious festivals; 3rd, the rise of professional playing; 4th, the organized stage; 5th, the roofed playhouse with scenery; 6th, illusion; 7th, anti-illusion.⁵ Notable is how some of his categories bridge between or divide the “periods” of conventional theatre histories: for example, the theatre of pre-Roman Greece would span three of these ages, the 2nd, 3rd, and 4th.

This leads to a consideration of the link between theatre and festival. The Panathenaic procession was just that: all Athenians. But by 400 BC, the theatre in Athens had taken on the whole theatrical apparatus: actors, audience, chorus, producers, and most significantly, a permanent place to perform, with seating as rigidly replicating class structure as that of the Colosseum in Rome: VIP’s down front, women and slaves in the cheap seats. This seems a shortcoming to us, but consider the contemporary version of the same dichotomy: People who Go to the Theatre vs. people who go to the movies or watch TV.

But neither lounge room nor multiplex can replicate the social role of live theatre; the auditorium may be stratified by ticket price, but all can enjoy the mini-dramas taking place in the stairways and foyer — with a different cast and dialogue every night. The architect who designs a good theatre knows that this is where the real theatrical encounters take place, in public circulation areas, and allows for it. The grand stairways of 19th century opera houses, such as Charles Garnier’s in Paris, and the quirky and complex architectural incidents of Herman Hertzberger’s theatres are examples.⁶ This suggests the fundamental difference in practice between the stage designer (still called *der architekt* in many European languages), and the architect of a purpose-built theatre. Stage designers use their technologies to amplify and underline a specific set of occurrences and actions, provided by the script (even one using much improvisation). Architects, however, ideally use their technologies, not only to service a building’s nominated function, but also to accommodate and encourage a wide range of interactions and encounters, both deliberate and accidental.

Yet, without professional players, we are condemned to watching (un)reality shows. And professional players require places to play professionally; all that apparatus didn’t appear in ancient Greece for no reason, and what happened then keeps recurring. The development of theatre, especially in the 20th century, has continually included efforts to enhance the contact and intimacy between audience and performer, while still maintaining the awe of religious festival and the attention-holding skills of the professional theatre-worker. But note what has happened in the meanwhile to the idea of festival: in ancient Greece, or medieval religious drama, or the Soviet pageants on the anniversary of their Revolution, the festival was the reason for theatre; but in each case, the theatre broke off and became an independent entity. Indeed, now the theatre has become the reason for the festival.

Berthold Brecht struggled with this paradox in his efforts to use theatre to induce a political response in an audience without sacrificing theatricality. He made a conscious

effort to ensure that an audience was not deluded into a sense of illusionist “realism”. He spoke of this as the *verfremdungseffekt*; unfortunately, this first came into English as “alienation”, but this is not a good, or even correct, translation; better is “making strange” or “making unfamiliar”...“creating a sense of astonishment and curiosity”.⁷ Even a simple literal translation as “estrangement” better describes Brecht’s intention: to induce an audience reaction of “that’s strange — is this how it was meant to be...?”

Moreover, to translate it as “alienation” also suggests how his work is often misperformed: as an antagonistic stance by actors against audience. But the better translation suggests his real intention, that actors and audience together view events and develop the strange instant bond of people watching the aftermath of an accident, or even more, of strangers caught up in some disaster themselves. The suicide on the ledge may be seen as the ultimate performance. So Brecht, too belongs in the mainstream of 20th century attempts to break down the barriers between actors and audience, and yet, paradoxically, his bare stage and “epic” style were actually as theatrical as any 19th-century melodrama.

A great deal of 20th century theatre, and the buildings for it, was about devising new material ways to relate audience and performer more closely — to “break down the barrier” between them. The “two planks” phrasing was the mantra of a movement toward simplification, which began with Jacques Copeau, Adolphe Appia, Gordon Craig and others. They stripped the stages of conventional theatres back to simple steps and platforms, dispensing with the illusionist technology of the 19th century. This was soon followed by designs for new theatre buildings with a great variety of new configurations for audience and performing spaces. This tendency has lasted through most of the 20th century and continues today. Among the many versions were the non-scenic stage variations which Tyrone Guthrie designed for the Stratford, Ontario Festival, combining a plain platform and undecorated stairs and columns with the 5/8 thrust plan by which he hoped to revive the intimate audience-performer relationship of Shakespeare’s original theatres. Many other versions of this soon appeared around the world, some of them with Guthrie’s design input; two fine Australian examples are the York Theatre in the Seymour Centre at the University of Sydney (1972, by Allen, Jack, and Cottier), and the Octagon Theatre at the University of Western Australia (1969, by Peter Parkinson).

Concurrently throughout the century, many attempts were also made to design “flexible” theatre spaces, which could vary their configuration to suit differing plays and circumstances. etc. One of the most elaborate of these was a 1926 design by the architect Walter Gropius and the theatre director/producer Erwin Piscator which they called “Total Theater” (Fig. 1). It was an egg-shaped building with a movable circular centre section for either seating or stage:

“This theater provides a stage in arena form, a proscenium and a back stage...the 2000 seats are disposed in the form of an amphitheater...By turning the big stage platform...the small proscenium stage is placed in the center of the theater, and the usual set can be replaced by projecting scenery on twelve screens placed between the twelve main columns...”⁸

One notable feature of this design was that it proposed rapid shifts in configuration through mechanical power. In the long line of attempts at a “flexible” theatre space, continuing to the present, many relied on increasingly costly manual labor to change the seating/stage



Figure 1



Figure 2



Figure 3.1



Figure 3.2



Figure 4



Figure 5

Figures

- [1] Gropius/Piscator, 'Total Theatre' (1926), in: Walter Gropius, *The Theater of the Bauhaus*, Middletown (Conn: Wesleyan University Press, 1961), 13.
- [2] George Izenour, *Flexible Theatre Project for Yale* (1955), in: Richard and Helen Leacock, *Theatre and Playhouse*, London: Methuen, 1984), 209.
- [3] Two possible set-ups, Cottesloe Theatre, in: Amery, Colin et al. (eds), "Cottesloe Theatre", *Architectural Review*, CLXI, no. 959 (Jan. 1977), 40.
- [4] Richard Southern, sketch of a round, showing performance of *Castle of Perseverance*, in: Richard Southern, *The Seven Ages of the Theatre* (London: Faber and Faber, 1962), 101.
- [5] Cedric Price and Joan Littlewood, *Fun Palace*, 1960 fundraising sketch, in: Cedric Price, *Cedric Price (AA Works II)* (London: Architectural Association, 1984), 55.

configurations. George Izenour revived the idea of mechanical re-configuration in his unbuilt 1955 design for the ultimate “flexible theatre” for Yale University (Fig. 2).⁹

Another design response to the issue of the cost of changing formats has been to simply leave a large portion of the audience space without fixed seating. The Cottesloe Theatre at London’s National Theatre Complex (Denys Lasdun et al, 1967-76) has balconies with some seating and standing room along three sides of a rectangle, and a clear main floor area in which the playing area and easily variable seating can be intermixed freely (the Studio at the Sydney Opera House is similar; see Fig.3).¹⁰ The Cottesloe, however, has also placed standing spectators on the main floor; the success of the restored Globe Theatre in London also shows that contemporary audiences are willing to stand through a performance.

The Cottesloe’s popular Christmas productions of the “Mysteries” (medieval religious dramas) exemplifies another level of breaking down the audience-performer barrier: allowing the two to mix freely in the same physical space. A simple version of this occurs in many folk music festivals, as in the “Renaissance Fairs” now popular in the United States and elsewhere.

Richard Southern, in two of his books, describes medieval applications of this format, offering his interpretation of 15th century ‘theatre in the round’, performed at sites in Lincolnshire, Cornwall, and elsewhere. The ‘rounds’ for these performances still exist in the landscape; they consisted of a circular ditch surrounding a dike-like rampart formed by piling the earth from the ditch around its circle, immediately inside the ditch. “The inward side of this circular hill will offer an excellent grandstand, and if terraced for seats...would save the erecting of any audience scaffolds”.¹¹ His detailed description of the space is too long to quote here in full (but Fig. 4 should explain the layout). However, one important feature of the staging must be mentioned:

“[I]t is clear that when a big audience crowded inside, much of the free playing space in the centre might be overrun. To guard against this, the medieval manager ...appointed a number of ‘monitors’ to mingle with the audience in the Place, keep them back from the centre where important...action would occur, and also clear a passage...for those moments when a leading character left...the scaffold where his seat was...and descended to the ground...to journey to the scaffold of another character, or to meet him in the centre. The ancient name of such an official in England was ‘styteler’ or ‘stighteler’, from the verb to ‘stightle’ or intervene”.¹²

What is notable is that this professional (Southern emphasizes this) form of medieval European theatre had worked out a way for actor and audience to mingle at close quarters, safely and convincingly, without interrupting the flow of the performance, and to prevent any unwished-for interaction between them. By Shakespeare’s time, the ‘styteler’ was no longer used in outdoor theatres. Southern points out, though, that when the ‘interludes’ of the century preceding Shakespeare’s first public performances were played to banqueters in the main hall of an English great house, some of the audience would be standing or moving about the room, and the actors themselves had lines in the surviving scripts which are exhortations to move aside and make way for the play.¹³

Some late 20th-century attempts to mix audience and performers, however, were less successful; many of those attempting to do this, especially in the 1960s, discovered that ‘Street Theatre’ is not the same as ‘the theatre of the streets’. The Paris Situationists were

caught in this confusion, as were protest gatherings everywhere. The professional art theatre’s version was hardly spontaneous, — “Let’s go to a Happening tonight” — though it did lead to the sub-genre of ‘performance art’.

There were also attempts to introduce “spontaneity” into more conventionally structured performances, but these did not always have felicitous results. The Living Theatre’s technique of going among the audience in a conventional theatre (who were seated, and thus still ‘spectators’, not ‘participants’) often resulted in audience anger or fear; but to be fair, that was the purpose of their political theatre, and ‘alienation’ was indeed the intention.¹⁴ Another example was the audience reaction to Dionysus in 69: this version of Euripedes’s Bacchae included a ‘Bacchic orgy’ scene, in which the actors not only were themselves naked, but would ‘invite’ audience members to join them, by reaching out and touching them. (There was intentionally no spoken dialogue, merely lascivious sounds by the cast.) This resulted in two entirely opposite reactions: on the one hand, many repeat attendees, eager to join in the fun (and who learned to sit in the front row!), and on the other, audience members who became quite upset, even violent, or threatened legal action.¹⁵

In the 1960s, the British director Peter Brook continued Brecht’s aspiration to eliminate the ‘excrescences’ of what Brook called the ‘Deadly Theatre’: *“I can take any empty space and call it a bare stage. A man walks across an empty space whilst someone else is watching him, and this is all that is needed for an act of theatre to be engaged”*.¹⁶ This seems contradictory to Brook’s all-stops-out 1964-66 productions of Marat/Sade, but beneath the music and violent choreography, it was still on a ‘bare stage’. Brook seems to have found the balance, and like Brecht, understood that theatre must remain a heightening and intensifying of everyday experience. *“Brook...tried to find expression for the violence inherent in the play and to link it to the broader question of violence in our own society, but he did not attack his audience in the process”*.¹⁷

Brook’s 1970 production of *Midsummer Night’s Dream* was in what was more obviously an ‘empty space’, but though what the audience saw may have appeared empty, the backstage was not; its much commented upon ‘white box’ was actually a stage set constructed with a full kit of current technologies. Both productions illustrated the existence of a new 20th century set of conventions which are now so accepted as to be unnoticed by audiences; they are not surprised by bare stages, unconcealed lighting instruments, simplified costumes and props, and in general, a theatre where actors are the focus of attention. They have hardly known a theatre where scenic effects were meant to be ‘realistic’; that function has been taken over by the century’s new story-telling format, the cinema.

In 1960-61 a project appeared which suggested the idea that technology could be made not only visible, but an active part of the performance. Architect Cedric Price and theatre director Joan Littlewood proposed various versions of a ‘Fun Palace’.¹⁸ It consisted of a set of ‘matrix’ structures with changeable equipment and elements within it, but was never built (Fig. 5). However, its influence can be seen in the Pompidou Centre, or in the elaborate technologies of touring Rock spectaculars — was Pink Floyd’s ‘The Wall’ theatre, cinema, or concert?

Perhaps the 21st century will see a similar effort to break down the barrier between performer + audience and technology. Varied ways of doing this can be imagined: spaces

which are constantly but subtly changing configuration, cued by audience reactions; cyborg actors in bio-mechanical costumes, or even full-robot actors (R2D2 is a character role); audience participation via interactive technologies ("Macbeth: the video game with live actors!"). Of the future of theatre we might therefore ask, with Shakespeare's Brutus:

"How many ages hence...in states unborn and accents yet unknown..."¹⁹

Notes

- [1] Commonplace theatre saying, usually attributed to Jacques Copeau.
- [2] Alan Brunton, *Diaries*, Red Mole Archive, Auckland: unpublished, no pagination.
- [3] witnessed by author.
- [4] William Shakespeare, *As You Like It*, II.vii.139-166, Jacques speaks.
- [5] Richard Southern, *The Seven Ages of the Theatre* (London: Faber and Faber, 1962), 9-11.
- [6] eg: Vredenburg Music Centre, Utrecht, 1973-75; Spui, Den Haag, 1986-93; Chassé, Breda, 1992-97.
- [7] Peter Brooker, "Key Words in Brecht's Theory and Practice of Theatre" in: Peter Thomson and Glendyr Sachs (eds.), *The Cambridge Companion to Brecht* (Cambridge: Cambridge University Press 2002), 191-193.
- [8] Walter Gropius, *The Theater of the Bauhaus* (Conn: Wesleyan University Press, 1961), 11-14.
- [9] Richard and Helen Leacroft, *Theatre and Playhouse* (London: Methuen, 1984), 209-210.
- [10] Colin Amery, (eds), "Cottesloe Theatre", *Architectural Review*, CLXI, no. 959 (Jan. 1977), 40.
- [11] Southern, *Seven Ages*, 101; see also Southern, Richard, *The Medieval Theatre in the Round* (London: Faber and Faber, 1975), for detailed descriptions.
- [12] Southern, *The Seven Ages of the Theatre*, 101.
- [13] Richard Southern, *The Staging of Plays Before Shakespeare* (London: Faber and Faber, 1973), 53 ff.
- [14] Jinnie Schiele, *Off-Centre Stages* (Hatfields: University of Hertfordshire Press, 2005), 154-55.
- [15] Richard Schechner, *Dionysus in 69* (New York, NYC: Farrar, Straus and Giroux, 1970), x-xi (introduction).
- [16] Peter Brook, *The Empty Space* (London: Granada, 1968), 9.
- [17] Schiele, *Off-Centre Stages*, 154-55.
- [18] Cedric Price, *Cedric Price* (AA Works II) (London: Architectural Association, 1984), 56-61.
- [19] William Shakespeare, *Julius Caesar*, III.i.111-13, Brutus speaks.

Between Spatial Resonance and Emotional Response

Dagmar Reinhardt in conversation with Patrick Nolan, Artistic Director of Legs On The Wall

Reinhardt: What does the job of an artistic director entail, or to jump into the immediate present – what are you currently working on?

Nolan: We are currently working on a production for the 2012 Cultural Olympiad called *The Voyage*. As part of the production we are building a full size passenger liner, which will be our stage. It will be built in Victoria Square, in the centre of Birmingham – a ship in England’s most land-locked city. As an Artistic Director I steer, (if I can continue the seafaring metaphor), the artistic program of the company which involves generating new work, commissioning artists and performers, working with funding bodies, seeking sponsors and developing relationships with collaborating partners both here and abroad.

Reinhardt: Is this ship a travelling show, modelled after a circus that comes to town, into the traditional market place?

Nolan: In a way, yes – the ship acts as the stage for over 150 performers made up of a core company of twenty professionals, with the rest – including an all female marching band, a gospel choir and parkour crew – being drawn from the community. So we are a company of professionals coming to town but when we get there we work with the locals to put on the show. By involving the community in this way, one of our objectives is to create a resonance amongst the community participants, which leads to more work being created once the production is over. There is also some element of the “travelling show” in that the production is designed to travel and will potentially play in other cities beyond Birmingham, though the sheer size of the boat may make that interesting. Its length is

42m, with a height of 15m – that’s 4 storeys high.

Reinhardt: Your setting is three-dimensional, a spatial urban installation, which allows the audiences’ capacity to walk around. In a sense, you are dismissing the directionality of classic performances with established lines of vision? This multi-vision and multi-perception, is that embedded in the script of the performance?

Nolan: The show begins with the performers dressed as passengers arriving through the audience as they make their way to the ship. As I just said, many of the performers come from the community who will also be our audience, and so there is instantly a different dynamic between the audience and performer. In a conventional theatre the stage starts, more or less, as an empty space and very few of the audience will know the performers. *Legs On The Wall* often creates site-specific work, like the ship, or another current one we’re making on silos. In these contexts our spatial challenge is to work out where to perform, where to put the audience, where to project our images, where to put the musicians. The answers to these questions will emerge out of other questions specific to the history of the space, and are also more pragmatically dictated by access to power etc. With a silo there are questions around their being symbolic of the region’s wealth or not; their utility as a storehouse for food; their significance to the cities that depend on the grain they hold and so on.

Reinhardt: Your work is very contextual – where do you start, and how do you develop it? What are the collaborative partners, or team members you integrate – set

design/ stage design/ production design/ orchestra/actors?

Nolan: *Legs On The Wall* is well known for aerial performances, so the producer for the Cultural Olympiad approached us to do a co-production with an English dance theatre company by the name of Motionhouse, with the idea being that we would provide the aerial content of the production. It has in fact become much more than that but that is where it started. I met Kevin Finnan, the Artistic Director of Motionhouse, in Birmingham. Over the course of a couple of days, we walked around the entire inner city area looking for a space to create the production in – imagining different concepts as we walked and talked. Out of these initial conversations came a number of ideas, which over the last eighteen months have been refined and transformed a number of times. This particular creative process has been shaped around the people from the community who would be involved, the specifics of the site and the development of a shared artistic vision between Kevin, myself and our creative team – designers, (set, costume, video), composers and the head rigger. Our methodology – and I imagine it is a fairly common one – was to come up with an idea and rigorously question it. Everything was put under the microscope – what do we want to say, how will it look and sound, what are its textures, tempos, rhythms – everything! Once we hit upon something we thought worked we presented it to the creative team who further excavated the idea. This process is potentially endless and eventually you have to deliver a “finished” concept to the producer who has timelines to meet – funding deadlines, casting, set build etc. So, of course, the budget is also instrumental

in determining and hopefully refining your concept. Our projects usually take 1.5 to 2 years to create. A good idea can’t be rushed; it must have time to develop.

Reinhardt: What is the scope of this collaborative process? You take people beyond their comfort zone, exploring in collaboration the thresholds or boundaries of their expertise, and that’s a real challenge.

Nolan: From me the key question is always: Have we seen this before, and if we have, why would we do it again or how can we do it differently? Our work needs to be grounded in a strong foundation from which we can leap, sometimes into the Unknown. But if the foundations are strong, then more often than not something emerges out of that unknown which is illuminating. For the Silo Project, we will talk to people who live near the silos or work with the silos, about their relationships with them. Our projects are often state funded which necessitates a certain responsibility to develop a cultural capital, which is a very different model to commercial theatre. *Legs On The Wall* is a subsidised, not-for profit company, a model that allows a different span of creative freedom. Commercial projects need to put bums on seats, in our productions there are sometimes no seats and the audience doesn’t have to buy a ticket. A commercial producer will set the map of a work that, as much as possible, excludes financial risk and therefore the preference is often to produce works that have proved themselves elsewhere. The challenge and gift of the not-for-profit sector is to explore new territory and ask difficult questions. There has always been this distinction between the commercial and independent sectors; one is no better than the other, they are just different.

Reinhardt: Stage design and architecture work at the nexus of the human body, movement, and space – could you elaborate on your particular interests?

Nolan: My obsession with theatre is space – space works on us in a very powerful way. Sometimes I think this is conscious but most of the time I think it is unconscious. In theatre, where every element is a conscious choice, it is the responsibility of the artists to create space in such a manner that it evokes a specific resonance. Because of the dominance of the image in our society, I think our understanding of how space and narrative work is very complex. Creating a show in a public space means working with a layering of different contexts and narratives. In a theatre space there are certain assumptions that an audience brings to how it is read – the stage will be in a particular place, the audience will sit where they sat last time etc. A theatre space can have a very strong resonance – look at Belvoir Street Theatre, that corner has a mind of its own – however, every new show that goes into a theatre tries to create a new world to tell its story by transforming the performance space. When working in public space, spaces that are not designed for performance but for living in, you need to bring a different set of principles to the design process. For me the starting point of in these circumstances will be the history of the space – what has happened here before?

Reinhardt: What is your opinion on advancements of digital technology? In this digital age, do you think theatre/performance has changed?

Nolan: I often use video in my work in the theatre – a flat medium that creates the illusion of depth. I am interested in the depth

of theatre, and the flatness of screens/projection – the relationship between 2D and 3D produces a tension that I am interested in working with. To answer your question, yes I do think performance has changed as a result of digital technology. I think we are only at the very beginning of what this technology will do to the way we tell stories. That said, given the speed with which technology evolves, perhaps we will always be at the very beginning. These changes are happening on both sides of the performance equation – within the performance space we are able to do things with light, sound and video that we could only dream of ten years ago but perhaps the more interesting impact is in the way technology allows the audience to interact with the performance. I think this is the most profound impact digital technology will have on performance, it will transform the way the audience views and engages in a performance – the traditional model of the audience sitting in a bank of seats watching a well made play will always be around but it is going to become a subset of a much richer performance environment as a result of digital technology.

Reinhardt: Using video as medium of expression – would you consider that a style that defines your work, or is there a signature element or inner core that invariably shows up in your work or otherwise defines it?

Nolan: I like using video in my productions but I don't consider it a style that defines my work, it is part of a bigger picture. What drives me is a key interest in narrative and the way it unfolds in the context of a site. At the core, there is this question about the place of the human in relation to the space of the story. How do we relate to that space

– destructively, virtuosically, tenderly? That relationship is the foundation stone upon which the story is built. For me this is the first question in creating a performance – how do the characters/performers relate to the space they find themselves in? And every production reveals something new – the identity of a specific person, the particularity of a particular space, the cultural make-up of both the space and the performer, will all elicit something different from production to production. Whilst we may look for the universal in the big picture, ultimately nothing is universal, each individual brings his or her history and experience to the story, and the challenge is to honour that.

Reinhardt: I would like to discuss the particularity of theatre space in relation to architectural space. In which way do you understand theatre and what are its main characteristics?

Nolan: The more we immerse ourselves in the screen – TV, Smartphone, iPad, computer – the more everything becomes a reference to something else but theatre asks you to deal with the three dimensionality of existence – it is antithetical to the experience of watching something on a screen. You have to acknowledge that you are with a bunch of people whom you share the experience of the performance with. It is an act which asks you to acknowledge your humanity, and that's one of the most enriching experiences you can have. The contemporaneity of the theatre is also interesting – while we might strive for perfection, actors are only human and are as flawed as the next person, therefore each performance is a unique moment that will never happen again. It can only ever happen in the space of time

that is designated. A film, however, is a representation of something that happened long before the audience arrived. Reality television attempts to emulate this idea of a shared experience between audience and performer but the use of the cut and the continual manipulation of perspective means that the sharing happens in a somewhat distorted way. But that is another line of inquiry all together ...

Reinhardt: Could you talk about the way in which performances change in regards to the space in which they are conducted? In the line of: same performance, but different performance in different spaces.

Nolan: Every space has its own currency – this is what I was talking about with regards to Belvoir St. In my first years as a director I had the good fortune to take a number of productions on tour where I witnessed older actors entering each theatre on the tour and 'feeling' the space. They would then recalibrate their performance in relationship to suit the different demands of the space. These actors knew they had to shift elements of how they would play their part in these different spaces, in order to articulate their character in the way the production demanded. I guess the key to a space's currency or resonance is in the dynamic between the auditorium and the stage – we describe these variations as a generous space, a hard space, an unforgiving space, or even a dead space. Light is also vital – it completely changes our experience of space, precipitating illusions that cannot be created any other way. It's possible to talk about public spaces in similar ways but I've never toured an outdoor work so I can't talk about how different public spaces may change a production.

Reinhardt: For the Sydney Festival project, we have been investigating very different spaces: The Turbine Hall, The Main Quadrangle. Could you describe the potential for resonance in these?

Nolan: I like to differentiate between an individual's relationship to space, and the individual's relationship to the audience and the performance. The parameters of these relationships obviously depend upon the story being told. The inverse is also true; a story will also inform the way a space is used. The Turbine Hall is a grand space, where the human figure is set in relief against large industrial machinery. It is a space that has an underlying danger - everywhere you turn there are signs warning you off the machines and telling you not to trespass into certain areas, so there is immediately an interesting tension between the audience and the space. The Quadrangle is grand in a different way. It is all about learning and the past and a sense of knowledge that is tied to a continent on the other side of the world. Its four-entrance axis and its symmetry is a space to be inhabited, albeit in a somewhat reverential way. (Though I did spend nights in the Quadrangle when I was a student that weren't exactly reverential!) Unlike the Turbine Hall, the openness of the Quadrangle makes it possible to place the body very simply within it. Ultimately however, performances are not made by the relationship between performer and space, but by the performers, audience and story, in the context of the space.

(A train whistle blows)

Reinhardt: As a final question - Where do you want to take an audience? In the sense of leaving a trace - what is the legacy of your work?

Nolan: That is a vast question! Each production has its own trajectory and therefore its own trace. But if I have to bring it down to a particular idea, I think there are two things I want a production to do to an audience: prompt a sense of inquiry and questioning in an audience and create an emotional, feeling response. The questions are precipitated by the story and the total experience of the production. They ask the audience about their relationship with the world, with each other or with themselves. Perhaps there is a tension between the thoughts prompted by the questions and the feelings they precipitate. These feelings don't have to be all positive, hate is also welcome - an impassioned, visceral response is the goal ... that's all.

(laughing)

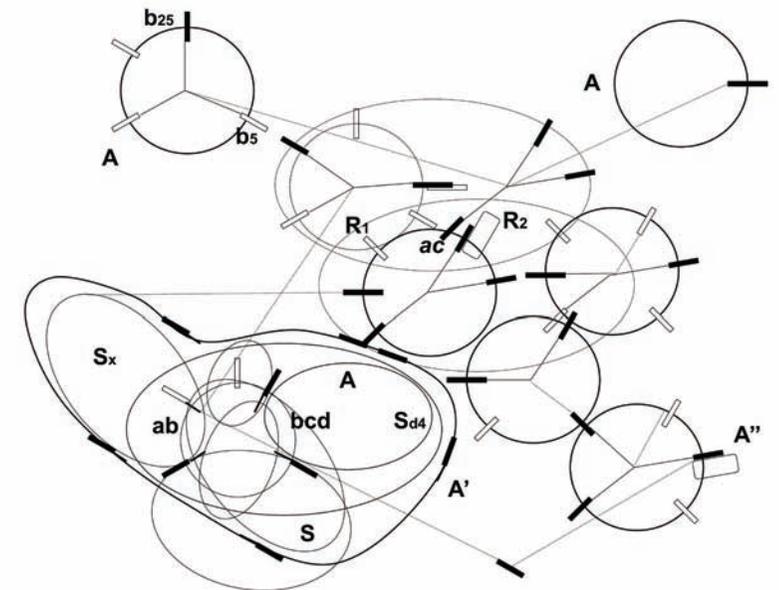
Reinhardt: Thank you. And now I immediately want a spectacle.

Shifts in Code

Performative Geometries

in Alice's Wonderland

Dagmar Reinhardt



Emergent Interactions in Different Networks

“Begin at the beginning,” the King said gravely, “and go on till you come to the end: then stop”.¹

Theatre is the space of the spoken word, of worlds arising through gestures, glances, interactions. Space in theatre can be understood as a trajectory, through narrative and spatial territory, with numerous different animate and inanimate components that construct its reality. Worlds are unfolded in the procedural act between audience and performer; in the human interaction, response and resonance that outlines temporal, interactive, responsive, ephemeral formations of space.

Theatre may be described as the movable articulations of a social performance and communication, in which space is an interaction with and through different audience members, and actors; a transaction space.² In the organisation of interactions and responses, the underlying geometry of these spaces, worlds and stories is of interest. How can they be structured or coded so as to unfold and enhance the story, the communication and interaction between humans? This essay reviews Lewis Carroll’s ‘Alice in Wonderland’, in which organisational or generative geometries establish the communication and interaction between a number of ‘performers’ or ‘interactants’ in the ephemeral spaces and times. Here, non-sense, reversal, discontinuation and passage are inflicted on matter, space and body.

‘Alice’ is interpreted as a geometry as interaction and spatial embodiment that establishes a paradigm of the unforeseen. Several shifts in code take place: of spatial formations, of the body and its perceptual experience, of interactions between different entities.

Performative Geometries: Producing Spatial Narratives

Narratives translate between places and spaces, establishing spaces before space; and in that define a territory that precedes architectural space. In a sense, words and stories generate space; in ritual, based on storytelling and listening, through tribal mechanisms in nature more ancient than the fleeting, shifting environments that we travel today. Michael de Certeau argues that stories ‘traverse and organize places; they select and link them together. They are spatial trajectories’.³

This emergence through temporal interaction is a shared notion between the theatre and the digital: the emergence through process or performance, the potential formation of the architectural object or space. While the digital pursues the expression of the object through a framework of parameters and fitness criteria, the performative (theatre) space pursues the expression of relationships of its audience/actor members in and through the framework of the performance. With the advent of digital and computational design techniques, architecture as that which is both the process and product of a number of considerations that combine the design, construction and perception of form, space and social environment can be rethought. Parameters and algorithms determine mathematical instructions for a process solution, yet in which relationship do these algorithms stand when the body becomes part of the equation, when the soft bodies become part of the software? What does the code, beyond endless variations in formal gestures, do for communication, the resonance and response to space?

We have been thinking code as that which organizes space. It may be time to think code as that which organizes movement and interaction in and through space. Beyond process characteristics, the endless imaginary realms of contemporary digital architecture and theatre question what we are and who we are, both in relation to ourselves, and others. Theatre and digital architecture create interactions through their factual or procedural geometries (or protocols, rules, parameters, and frameworks). These geometries range from determined to ephemeral. More importantly though, by generating formations of space or performance, they generate identity. As Maurice Merleau-Ponty remarks, ‘being is synonymous with being situated’.⁴ A single entity has to position themselves in relation to their own body identity, to a space or environment, a cultural context, and to other beings. This is a complex undertaking that combines a diversity of layers, from primal unconscious reflexes to the most intellectual considerations.

'Alice in Wonderland', and its sequel 'Through the Looking Glass', were written in 1863 by the Oxford Mathematician Charles Lutwidge Dodgson under the pseudonym Lewis Carroll for children's entertainment.⁵ These narratives have been discussed in and adapted by various contexts from biology,⁶ cultural theory,⁷ sexual ethics,⁸ neurophysiology,⁹ semiotics,¹⁰ and music.¹¹ The present essay expands on the mathematics, geometry, sequences, figures and narrative impulses potentially delivered by 'Alice in Wonderland'.

'Alice in Wonderland' employs complex strategies where the key figure experiences architectural conditions that emerge by movement and interaction of multiple players. 'Alice' departs from a Cartesian system to employ discontinuations of geometrical and sequential organisations that result in phenomenal, interactive and transactional changes. Sequential descriptions are used in the narrative that, as may be argued, construct a geometry of human interaction that develops through mathematical rules. In the following, the essay reviews sequences of the narrative for geometries of interaction that are characterised by shifts: shifting geometries per se; shifting the body; shifting a reference point; shifting a behavioural pattern or logic; and shifting participant groups.

Positioning Oneself: Shifting Spatial Codes

In 'Alice', Carroll constructs an indeterminate and unfinished articulation of matter in time and space, in which relationships between two or more actors proceed on a perceptual plane, on a defined field, and are connected through a motif both shared (at times contradicted) by its actors. The initial

performative geometry (or landscape of networks) is set in the opening sequence of Alice following the White Rabbit into a tunnel that she encounters in a slow fall:

Either the well was very deep, or she fell very slowly, for she had plenty of time as she went down to look about her, and to wonder what was going to happen next ... she did not like to drop the jar, for fear of killing somebody underneath, so managed to put it into one of the cupboards as she fell past it.¹²

The tunnel establishes a transitory space, an emergent spatial condition. It is siteless, scaleless. Its logic follows a directional vector that extrudes a basic

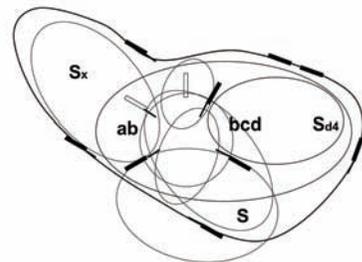


Fig 1: Network and Spatial Flow

circle into space, thus producing a pathway. The tunnel equals a directional network of channels, in which spaces are engineered by motor behaviour, and depend on speed and duration of a body moving through. This infinite spatial system is 'purely dynamic and as devoid of tangible matters as a piece of music written for no instruments in particular'.¹³ The continuous, flowing boundaries of such an endless space do not reveal edge conditions or visual markers or reference points that would allow a

situating of the body. Carroll deploys here what might be argued as a shift in spatial code: the body without reference towards context or environment. This performing body is devoid of an audience, or is the audience becoming the centre of action?

Interacting with the Pack: Shifting Behavioural Codes

Space in 'Alice' can be also considered dynamic because it emerges as an instantaneous configuration; it exists as the consideration of directional vectors, velocities, and time variables. Conversational areas morph and transform in configuration and thus influence the logic of perception and experience. While the previous sequence discussed a literal spacemaking via extrapolation of a circular geometry, Carroll also uses circle geometries to dissolve space in time, as the 'Caucus Race' scene suggests:

First [the Dodo] marked out a race-course, in a sort of circle, ("the exact shape doesn't matter," it said,) ... However, when they had been running half an hour or so, and were quite dry again, the Dodo suddenly called out: "The race is over!" and they all crowded round it, panting, and asking, "But who has won?"¹⁴

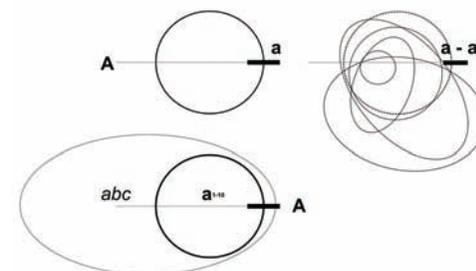


Fig 2: Circle, Game Field, Condition

'Caucus Race' is set in the experiential milieu of a field game, whereby roles and operations follow a logic, form and structural procedure. Its code develops as an interactive geometry in a procedural frame: from an abstract elliptical racetrack (space), and approximate race duration (time), towards a different logic and code. Instead of a factual geometry, 'Caucus Race' is coded as a virtual, performative space. It unfolds the figures and their stories, similar to Deleuze's operative field that 'renders the figure[s] sensible in a kind of progression, [as] an exploration of the figure[s] within the place'.¹⁵ The race field is enacted through the participants' uncontrolled run, that is, by a shared experience between participants of different capabilities and speed (Alice, Dodo, Mouse).

The Caucus Race exemplifies an organisational geometry that develops as a (temporarily) agreed interaction between provocateurs or agents, audience, and performers. In a sense, the behavioural code of the standard game is shifted, from a circle that describes a geometrical figure on a two-dimensional plane, towards a cycle (Fig 2). The game terminates not with a singular participant reaching a race mark but with all participants reaching a condition. In that sense, the race is experiential, both a spatial sequence and a sensation of becoming other: 'becoming-dry' is the closure moment and goal of the game, and everyone has won, because they were all dry in the end. Carroll deploys here what might be argued as a shift in behavioural code: from a positioning of the body towards a conditioning of a number of interacting bodies.

Body Transformations: Shifting Perceptual Codes

The body, as Merleau-Ponty argues, is the mechanism by which space is experienced, and by which corporeality is established. Carroll further uses the non-Cartesian architecture of the tunnel as background for a series of body transformations that Alice endures, and which are crucial for her positioning herself in relation to objects or people, space, and narrative. An instant growth or decrease is initiated by the digestion of various substances, leading to transformations of her body that redefine her individual perception and spatial references. This body, unfamiliar in size, is then no a longer perceptual mechanism, but causes Alice to reposition/reconsider herself:

She had forgotten the little key [to the passage], and when she went back to the table for it, she found she could not possibly reach it, ...and she tried her best to climb up one of the legs of the table, but it was too slippery.¹⁶

Alice's transformations are described by a rapid proportional shift of her body margins, and while commonly species undergo slow processes of shape or growth transformation as part of their genetic programming, Carroll instrumentalises here a spatial embodiment that entails a deformation, transformation, adaptation, or variation of a system of co-ordinates. Alice experiences these body transformations in the tunnel scenes primarily in relation to a reference point that enables her to recognize shifts in scale, a recoding of her perceptual body by details (such as furniture, doors).

In extension of resizing the body code, thus unsettling experiences of perception

and corporeality, Carroll further expands the concept by repeating similar body transformations in a different setting. The scalelessness of the tunnel is set in contrast to White Rabbit's home, a prototypical vernacular architecture. Here, Alice literally collides with the architectural setting when her body, again changing size, becomes 'unfit' to the domestic environment, which confines her limbs in restricting boundaries. Actor, stage set, space and the shifting relation between these elements produce a geometry of interaction. Carroll repeats these shifts in perceptual codes, albeit number of interacting elements (animate entities, audiences, actors) continuously.

Reference Point, Saturation and Pivot Hinge: Shifting Realms

Body transformations that define interaction with an architectural setting are equally described by a scene that pairs growth processes of Alice's body with the continuous geometry of a sphere, and the temporal sequence of a cycle:

"One side will make you grow taller, and the other side will make you grow shorter."

"One side of what? The other side of what?" thought Alice to herself. "Of the mushroom," said the Caterpillar... At last she stretched her arms round it as far as they would go, and broke off a bit of the edge with each hand.¹⁷

Dividing two sides of a sphere dependent on the reference points become the instruction for interaction in this scene. The geometrical operation can be calculated as circle division either by diameter or by circumference, depending on the viewpoint from which the operation takes place.

The Caterpillar on the mushroom sphere, centred on the highest point through gravity, determines two sides by diameter. Alice in contrast stands in front of the sphere, and is forced to apply an approximate system of circumference: to define two sides precisely, her outstretched arms would have to equal half the circumference for division (Fig 3).

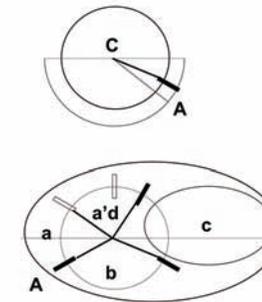


Fig 3: Division Systems: internal, external

Yet it may not be that the geometrical operation is key to this scene. Carroll uses a logical shift here; from geometry to process. Neither Caterpillar's nor Alice's position can identify the side that will make her grow larger because the reference point is unknown, or unidentifiable. A body scaling may instead follow the repeated consumption of the substance: once a critical amount has been absorbed, the reference point shifts from external relations to space towards internal conditions; saturation. The edibility of scenery is specifically entertaining as this echoes the Situationists' conversations around the tactile, olfactory, gustatory criteria for a culturally strong architecture.¹⁸ Alice as the audience eats the scenery, the theatrical narrative environment which she has become part of. The performative geometry develops not through form, dimension, materials or

structure, not even through movement, but through its phenomenal, experiential, nourishing, stimulating attributes.

In opening up towards a different condition or cycle, Carroll continues a theme of interaction that connects different dimensions. In a similar manner, the encounter between Alice and the Cheshire Cat performs as a hinge between contexts, times or actualisations.

'All right,' said the Cat; and this time it vanished quite slowly, beginning with the end of the tail, and ending with the grin, which remained some time after the rest of it had gone. 'Well! I've often seen a cat without a grin,' thought Alice; 'but a grin without a cat!'¹⁹

The Cheshire Cat's grin remains while the body disappears and vanishes into an invisible realm. In a sense, the grin hinges between the real and the virtual, between different conditions of becoming other, around which the cat shifts into and out of existence (Fig 4). Separated from its context (the cat's body), the grin is both a detail fragment of a conversation, and indicates the opening of another narrative reality (to wherever the cat disappears).

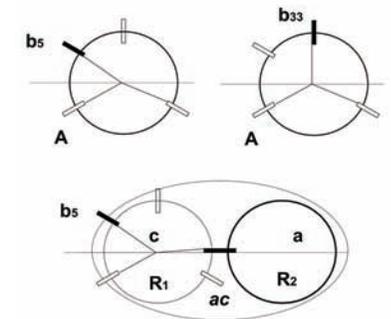


Fig 4: Programmatic Protocols of Linkage to Realms

The grin may be read as a code that link between actualisations; an entity between the perception of a present (actual) an memories of the past (virtual).²⁰ By shifting the reference point to a condition of the sel Carroll thus connects to other realms, othe planes of existence.²¹

Closed Banquet: Locked Code

Formations of narrative space, as may be argued, evolve or emerge in time in 'ranges' or 'phases' or 'gradients', depending on characteristics and conditions of contextual forces. Such sequences of moments, singular processes or emergences reflect conditions and relationships between actors, stage setting, audience, and inanimate gadgetry; by associating different protocols to the elements over time.²²

While 'Caucus Race' develops on an infinite field, Carroll also describes 'locked' interactions in the spatial setting of a closed component group. In the 'Mad Hatter' scene, different species interact with different auxiliary instruments, with unexpected character properties, in variations of numbers, and in different organisations, yet with a programmatic protocol that allows minor variations but no major changes.

*The table was a large one, but the three were all crowded together at one corner of it: "No room! No room!" they cried out when they saw Alice coming.'.... "I want a clean cup," interrupted the Hatter: "let's all move one place on."....The Hatter was the only one who got any advantage from the change: and Alice was a good deal worse off than before, as the March Hare had just upset the milk-jug into his plate.*²³

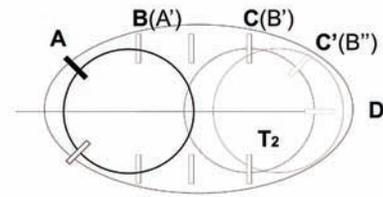


Fig 5: Banquet - Closed Component Group

Operations are based here on a fixed spatial setting (the table) in a seemingly infinite interval (ritual tea ceremony) with numbered participants and an auxiliary instrument (Mad Hatter, Dormouse, Rabbit, Alice, tableware). Though merely three seats are occupied, the arrangement is strictly following a turnover in seating order. The order of performance for the tea table caricatures the logic of economy and resources. Alice encounters here the circuit arrangement of a closed component group.

The system follows a high level of control, in which a cyclic rotation around the table (seats can be changed), but not a change of seating order, that is, no spatial or behavioural range, is permitted. This leads to a system of general disadvantage that merely privileges the person first in line (while everyone else encounters the condition previous users have left, Fig 5).

The Tea ceremony is the code run wild; it resembles an endless loop that runs until system failure, or new resources are opened. Its relationships develop as intervals between two determined boundaries (seating), of material substance or shifting stoppages or points (persons or animated matter). Alice, Mad Hatter, and White Rabbit follow behavioural rules that connect them on the same field, in the same space, in one organisation; yet render them unable to perform, communicate, or depart.

Open Source Code: Opening Pandora's Box

Formations predetermine performativity. Formations inform matter, in the shape of the whole, but also between segments and articulations of solid bodies, spaces, materials, or elements. Lynn describes these as component systems that are neither ideal nor finite, but undisclosed, defined by 'intricate stable connections of previously disparate components'.²⁴ Alice encounters the dynamic organisation of several component groups in the Croquet Game scene:

Alice thought she had never seen such a curious croquet-ground in her life; the balls were live hedgehogs, the mallets live flamingos, and the soldiers had to double themselves up and to stand on their hands and feet, to make the arches.

*The hedgehog was engaged in a fight with another hedgehog, which seemed to Alice an excellent opportunity for croquetting one of them with the other: the only difficulty was, that her flamingo was gone across to the other side of the garden, where Alice could see it trying in a helpless sort of way to fly up into a tree.*²⁵

The Croquet Game describes different species and their relationships to agents of the same and others. In this scene, different formations emerge as swarms from different species that interact with each other (Fig 6). These swarms (Card Soldiers, flamingos, hedgehogs) become both game characters and animated equipment: the Mallet-Flamingo bends and twists, distracting the player with facial expressions and subversive behaviour. The Card Soldiers form arches, yet change their positions to interact with others (mallet and ball). The final deconstruction of the open component

group through the consequences of their interaction: the game terminates when all participants are removed from the playground by royal death sentence.

While swarms operate at the edge of control, they are emergent systems that follow a 'logistics of context' that establish coherence through flexible internal relationships, multiple pathways and fluid hierarchies.²⁶ Carroll's swarms disintegrate by identity changes (soldiers), by adopted behaviour (hedgehogs) and continuously formed relationships within the overall rule set (croquet).

This abandoning of a capacity for processing change, in contrast, could be reversed by a number of principles; simple parts in a network of dense interconnection; random encounters; meta-information about behaviour accessible to the group.²⁶ Carroll describes a shift in code that opens Pandora's box: a multitude of different scripts unfolds, the programmer's nightmare of simulating behaviour.

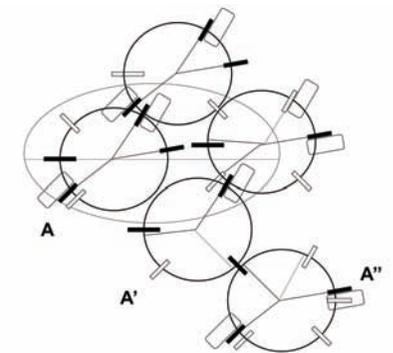


Fig 6: Swarm - Interaction between diverse Species

A Continuation

Carroll's 'Alice in Wonderland' has been associated with performative geometries, sequential and transactional conditions and a resulting shift in perception, spatial experience and logic. As has been argued, geometries of the narrative establish an architectural territory before architecture, in a context of continuous change that frames temporal encounters and unforeseen interactions between various numbers of participants in indeterminate spatial settings.

Architecture interacts here as a responsive system in unstable matter, unset by continuously changing vectors and durational sequences: a user's manual for moments of the unforeseen. The 'Alice' sequences reveal performative geometries through shifts in spatial and procedural formation; shifts of the body; shifts between points of reference and conditions; shifts in behaviour; and shifts in participant groups. These shifts change the code of the narrative, but also the code of operation between that which makes an enlivened, inhabited environment; body, movement, space.

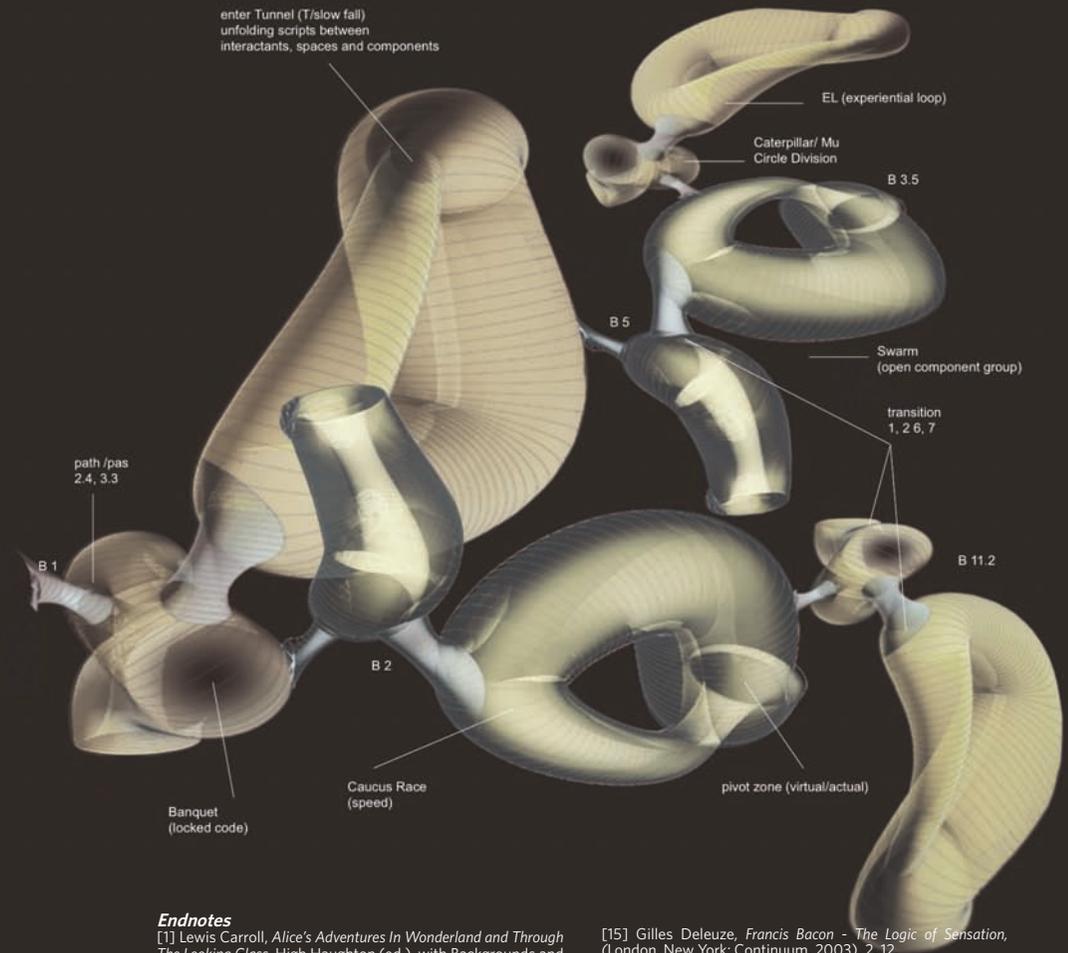
The narrative spaces of 'Alice' emerge as an instantaneous articulation of unstable matter in time, played upon by changing configurations. These performative geometries may then also administer thinking through tectonics; from an architecture filled by interaction, towards an architecture constructed by interaction.

The realm of theatre, as much as the realm of digital architecture, shares a consideration of different codes that correspond and inform each other. Theatre thrives by deploying innumerable elements to create new worlds. The space

of performance and of the Digital share a realm of exploration, of speculation, of the game, they are what Kwinter describes as a 'worldmaking in the absence of verification'.²⁸

In this line, digital architecture may retrace into the narration of space, into the communication space between people to establish formations of response, immersion and interactivity, beyond privileging its orchestrating architectural matter, thus opening perceptual experiences. Transferred to an architectural context, these geometries may deliver impulses for strategising program, duration, and matter differently in order to address aspects of transaction, interaction and communication.

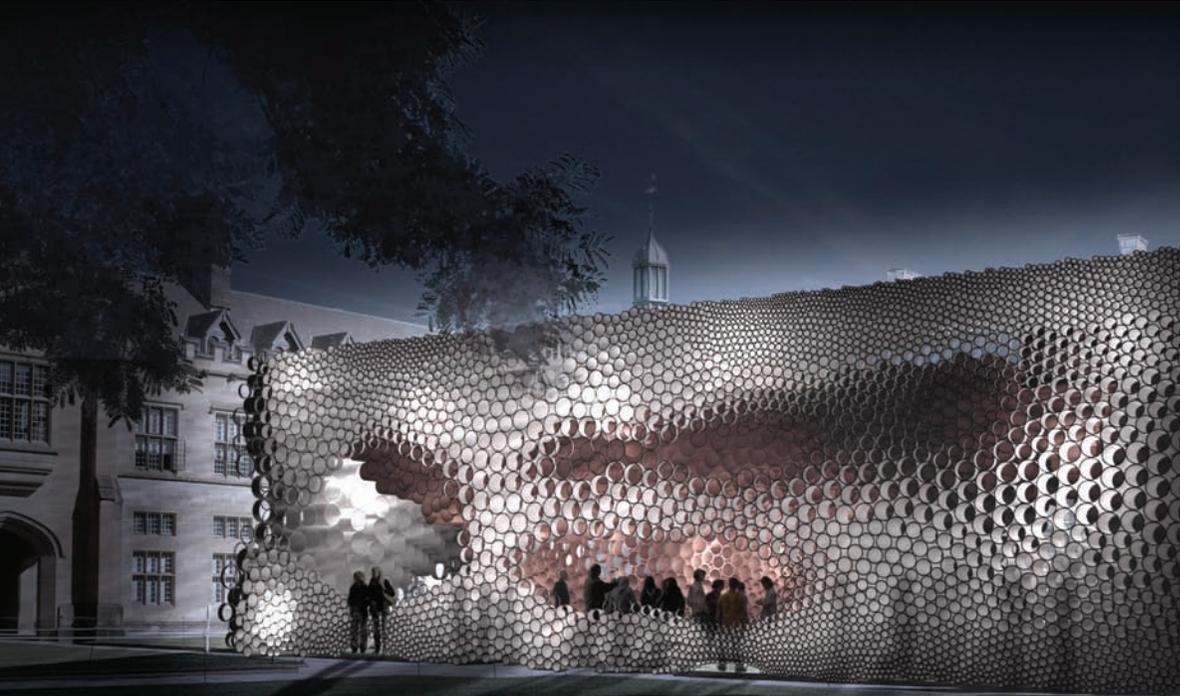
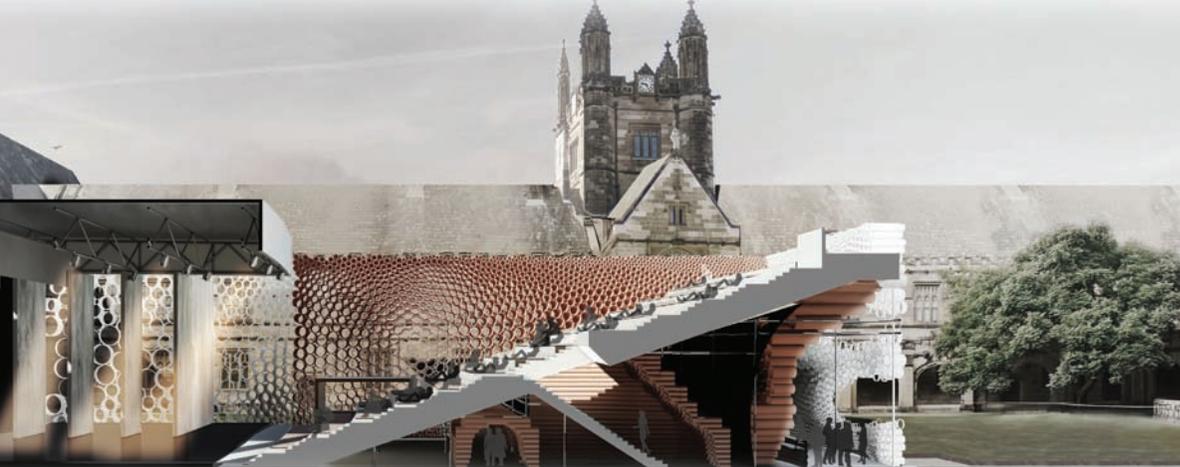
Towards the unforeseen, the surprise and suspense that theatre shares with the world: the characters, their encounters, their transfer and transactions form the primary mechanism of spatial narrative that establishes and administers a dynamic social territory.



Endnotes

- [1] Lewis Carroll, *Alice's Adventures In Wonderland and Through The Looking Glass*, High Haughton (ed.), with Backgrounds and Essays in Criticism, (London: Penguin Classic, 1998), 105.
- [2] Constant, 'New Babylon', in: Lucay Andreotti and Costa (eds.), *Theory of the Derive and other Situationist Writings on the City* (Barcelona: Actar, 1996), 162.
- [3] Michael de Certeau, 'Spatial Stories', in: *Practice of Everyday Life* (Berkeley, CA: University of California Press, 1984), 117.
- [4] Maurice Merleau-Ponty, 'Space', in: *Phenomenology of Perception* (London: Routledge and Kegan, 1962), 294.
- [5] Lewis Carroll, *Alice's Adventures In Wonderland and Through The Looking Glass*, High Haughton (ed.), (London: Penguin Classic, 1998), illustrations by John Tenniel.
- [6] John Tyler Bonner, *Why Size Matters: From Bacteria to Blue Whales* (Princeton: Princeton University Press, 2006).
- [7] In relation to nonsense and metacommunication discussed by Gabriele Schwab, *The Mirror and The Killer-Queen: Otherness in Literary Language* (Bloomington, IN: Indiana University Press, 1996).
- [8] Ira L. Reiss with Harriet M. Reiss, *Solving America's Sexual Crises* (Amherst, NY: Prometheus Books, 1997).
- [9] William H. Calvin, *How Brains Think: Evolving Intelligence, Then and Now* (New York: Basic Books, 1996).
- [10] Rachel Fordyce and Carla Marello (eds.), *Semiotics and Linguistics in Alice's World* (Berlin: W. de Gruyter, 1994).
- [11] Tom Waits, *Alice* (album), released in 2002 on Epitaph Records.
- [12] Carroll, *Alice*, 10.
- [13] Rudolph Arnheim, *The Dynamics Of Architectural Form* (Berkeley, CA: University Of California Press, 1977), 149-151.
- [14] Carroll, *Alice*, 26.

- [15] Gilles Deleuze, Francis Bacon - *The Logic of Sensation*, (London, New York: Continuum, 2003), 2, 12.
- [16] Carroll, *Alice*, 12.
- [17] Carroll, *Alice*, 46.
- [18] Lucay Andreotti and Costa (eds.), *Theory of the Derive and other Situationist Writings on the City* (Barcelona: Actar, 1996).
- [19] Carroll, *Alice*, 59.
- [20] Elizabeth Grosz, 'The Future of Space: Toward an Architecture of Invention', in: *Architecture from the Outside, Essays on Virtual and Real Space* (Cambridge, MA: MIT, Writing Architecture Series: 2001), 117.
- [21] Gilles Deleuze, *The Fold: Leibniz and the Baroque*, transl. Tom Conley (Minneapolis, MN: University of Minnesota Press, 1993).
- [22] Emergent formations follow an embedded logic, a latency of matter becoming that can be considered a time delay between the moment a process is initiated, and the moment its effects begin or become detectable. See Michael Weinstock and Michael Hensel, *Emergence-Morphogenetic Design Strategies* (Chichester, UK: Wiley-Academy, 2004).
- [23] Carroll, *Alice*, 60.
- [24] Composite bodies that form organisational entities are discussed by Greg Lynn in "Body Matters", published in: Greg Lynn, *Bodies, Folds, and Blobs: Collected Essays* (Brussels: Books-by-Architects, 1998), 139.
- [25] Carroll, *Alice*, 73.
- [26] Stan Allen, 'From Object to Field' (London: Architectural Design No.127 - *Architecture After Geometry*, 1997), 24-31.
- [27] Steven Johnson, *Emergence: The Connected Lives Of Ants, Brains, Cities and Software* (London: Penguin, 2001), 78-79.
- [28] Sanford Kwinter and Jonathan Cray, *Incorporations, Zone Books* (New York, NY: Zone, 1992).



Transition Stages

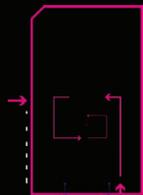
Focus 1:
Sculpture in Quad

Focus 2:
Quad

Focus 3:
Spotlights

Focus 4:
Performance

Focus 5:
Stage



Enter Quad +
arcade



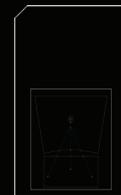
Enter Venue to
framed views of
Quad from bar



Space tightens
with skylight
relief



Enter the low
cave and lose
touch with Quad

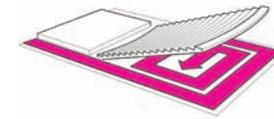


Up stairs to
emerge in
seating bank

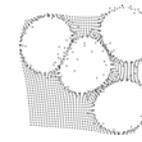
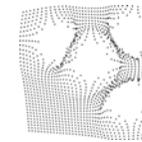
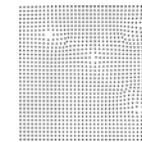
Theatre of Erosion

Iain Blampied

Oliver Hessian



The eroded walls begin to unfold and open to frame views towards the Hall, inspiring a strong relation to The Quadrangle. Inside, oblique views and skylights chandeliers engage the audience in an ethereal atmosphere



'Theatre of Erosion' explores a passage from space to place; the transition of an audience from reality to intrigue. Set inside the monumental stone presence of The Quadrangle, the project takes as its departure point the movement of an audience as a force that erodes away the remaining volume surrounding a performance space.

Through various digital explorations, the project investigates a geometry based on stages of transition, modelling the external and internal volumes of an abstract mass according to parameters that control the intensity of inner theatre space; establish transparency; orchestrate key views to the main space; and respond to fabrication criteria. The project simulates natural landscapes of erosion, thus creating a dynamic sequence of spaces where views continually changed as part of a slow removal of the audience from their daily concerns. The journey takes an audience around the periphery of the venue, traces a path through the grotto of the bar spaces, leading inside and ultimately past the stairs to the centre of the seating bank.

The erosion geometry is generated using a metaball definition to define the path and volumes of the spaces, over a field that varies according to length, radius and density of cylinder elements, and with sine curves applied to the proposed sections. The form is constructed by a multitude of differently sized cylinders of plywood, from which panels are formed, that can be assembled in a relatively short time. Cylinders are both stacked and hung from the scaffolding of the theatre seating underbelly.

The theatre's elevations read continuously from outside and inside, in density and size of the cylinders complementary to the mood of the transition stages, and the relationship to the host building in which the theatre is embedded.

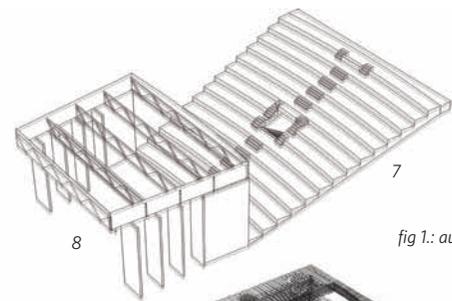


fig 1.: audience space

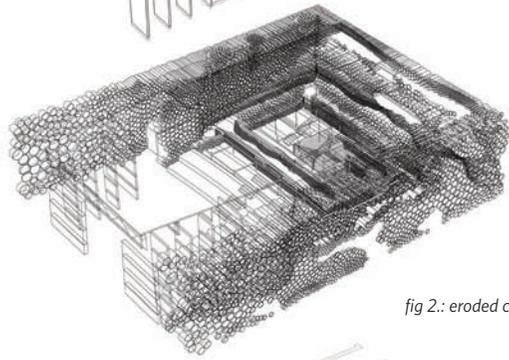


fig 2.: eroded construction

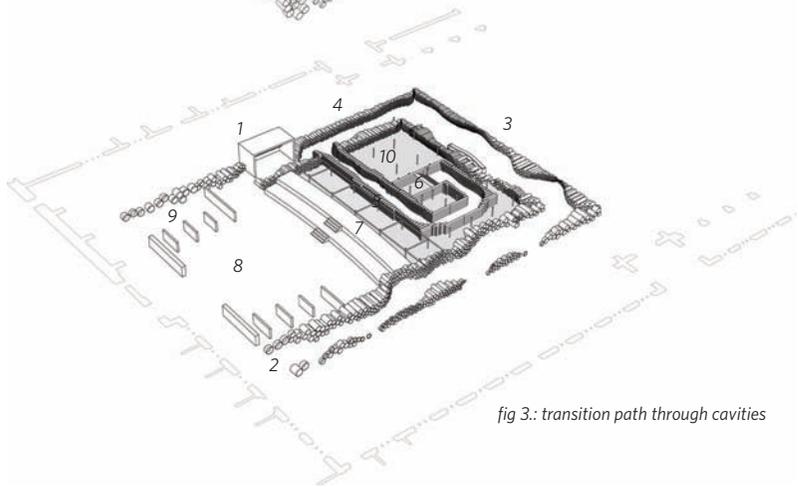
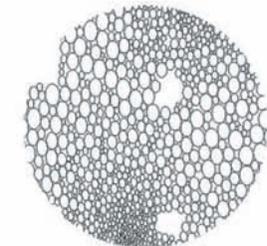
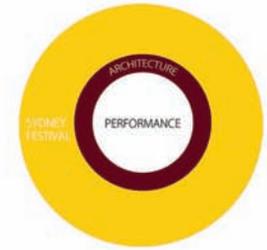


fig 3.: transition path through cavities

- [1]Box Office
- [2]Entrance
- [3]Bar
- [4]Spotlights
- [5]Cave
- [6]Auditorium Entrance
- [7]Seating
- [8]Stage
- [9]Side Stage
- [10]Void



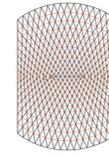


TheatreScape

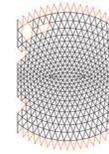
Adam Higginbotham

Mark Hill

Kim Siggers



The structural requirements are separated into steel elements that hold up the bridge, while the canopy is suspended by two cranes. Canopy and bridge structures are made of ply wood cut according to the length specified in the fabrication key plan.

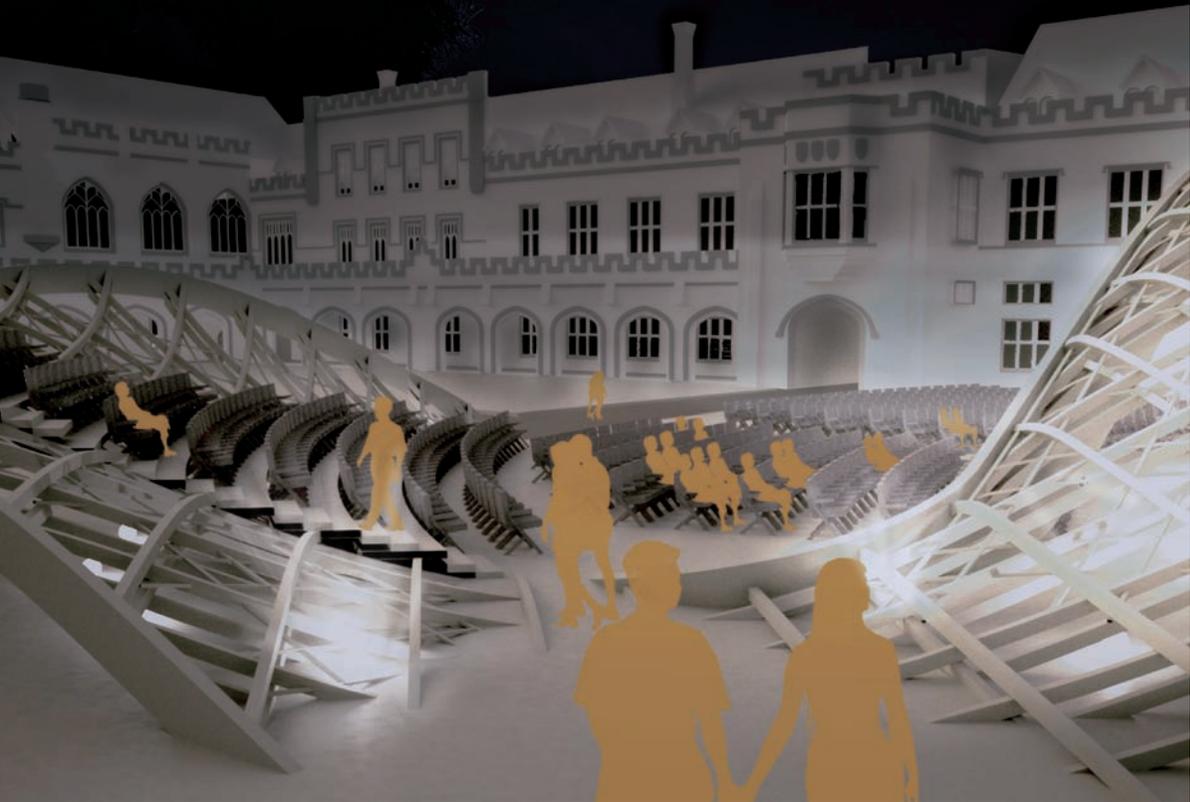


Timber panel inserts are placed between each joint, and lined with a thin rubber for comfort. Steel hollow sections prop up the structure. Light-PVC panels are inserted into a number of panels to illuminate the space.

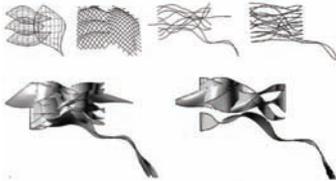


The project addresses a sense of the theatrical on the journey to the theatre. It suggests a landscape of theatre designed as a canopy suspended by two cranes, held by a series of steel cables. 'TheatreScape' is a theatrical space that is created through a tension between two elements, that of transition (bridge) and disbelief (suspended surface). Its canopy hovers over the bridge and creates a sense of spectacle, a place for the audience to pause and observe. An audience enters the theatre through the Quadrangle's Southern façade, ascending the landscape bridge, until they reach the ridge of the undulating bridge structure and descend into the seating area covered by a floating canopy.

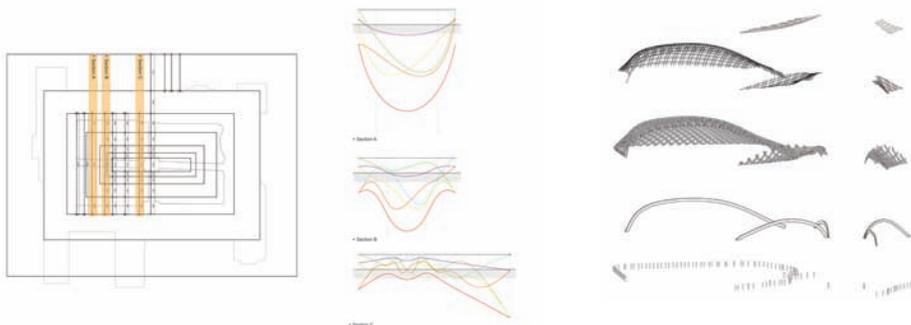
The project's structural investigation outlines two driving elements: a surface grid and crane members. A grid was developed with forty lines spaced equally in a 90 degree radius on a 60m x 40m plane, responding to two points of radiation which centre in the cranes. The resulting surface plane is then cut in half and mirrored down the centre line of the plane. Its vertical connections are then extended along the short axis of the plane between each point. This grid is then further manipulated to program and circulation requirements, and the existing landscape of the Quadrangle.



To determine the 'visible' component of the structure, the project adopts the Gothic ornamentation - modelling an existing ceiling decoration.



Within this pattern, two main grids were identified; one in the X-Y direction, and the other on its diagonal axis. The diagonal axis defined the rigid primary structure, and the X-Y axis the skin.



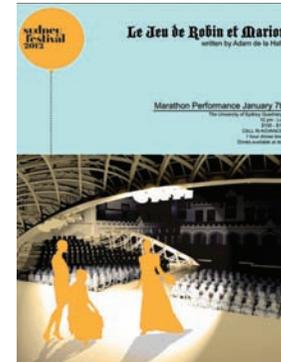
Gothic Lattice

Kayla Brown

Elizabeth Dalton

The Quadrangle of The University of Sydney is a heritage landmark, characterized by Gothic Revival. The present concept investigates the rules of proportion and parameters that define this architectural typology. The Quadrangle follows a Gothic planning rule with a proportion of 2:1 for the plan, which in turn defined the height in relation to its width. The external and/or internal height of the building resulted in a proportion of the width of the plan consistently divisible by the number 2.

The project produces a lattice that expands on these rules of Gothic proportioning in that it follows the 2:1 rules governing the present structure. By offsetting the existing rectangles, two layers of construction grids were devised that inform the potential space for a theatre. Both layers relate to structural and proportional rhythms appearing in the Quadrangle, and are used as a base for devising the design. The design grid of 'Gothic Lattice' departs from the ground surface, and is set in relation to a series of second floor windows on the Northern façade, the second grid. At the intersection of these two grids, points and widths are defined that determine the structures height.



The structure is divided between timber members, each 200 deep by 75, and a skin defined as 35 x 35. To quickly model this and manipulate the member size (if required) a Grasshopper script was used in order to place member sizes into. The structural depth is achieved through woven timber construction coupled with the skin that sits within the structure.



L'abyme Théâtrale

Monica Dolve Basulto

Nina Heude

In Western art history, 'Mise en Abyme' is a formal technique in which an image contains a smaller copy of itself, the sequence appearing infinitely. This technique is also used in literature and theatrical context, having a story within a story. The temporary structure for the theatre takes this idea into the architectural realm where the structure represents a smaller reinterpretation of The Quadrangle itself.

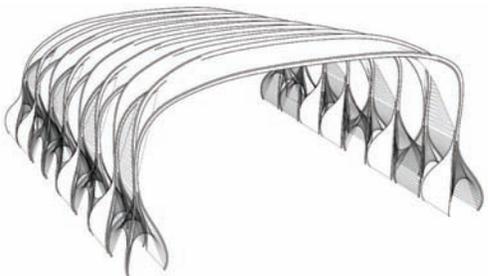
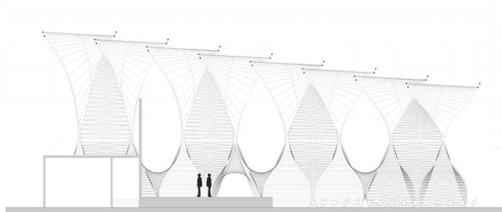
To create a dialogue between the performance structure and The Quadrangle, the design strategy subtracts the lines of the original arches, and then morphs the mass of the arcade into a lighter version, using light materials and textures to create a contrast, yet deploying a similar rhythmic quality.

The structure consists of extruded aluminum rods, tensile fabric and ropes. The lightness of the selected materials and the articulation of the structure itself, enhance the structural attributes, having a minimum impact on the site.

Between the arches, a system of weaving is taking place, bridging between the arch modules and producing complex and overlaying patterns. Taking into account that the brief called for a Middle Eastern play to take part in this space, the project deploys different weaving patterns used according to location in closing or opening perceptible lines, and public and infrastructural access, in close relationship to Islamic tradition, where patterned screens are used to hide women from public view. More importantly though, these surfaces provide a visual threshold where boundaries between inside and outside performance space become blurred.

The result is a new archway with covered, semi covered and open arches that are theatrical in acting as a disguise for the structure itself, repetitive arches with non-repetitive surfaces, harmony and disharmony, creating a transitional space that complements the structural and ornamental logic of The Quadrangle.

'Mise en Abyme' describes the visual experience of standing between two mirrors, seeing an infinite reproduction of one's image. This concept is translated into the development of a decreasing series of arches that shift between formal expressions.



01. Polyethylene, single sheet assembly, welded and sewn



03. Synthetic textile, double layers lasercut simultaneously (welded together), sewn



02. Chiffon, laser cut, sewn Chiffon not structural enough, sewn seams affect surface behaviour but do not create volume in assembly.



Junya Watanabe, fall/winter 2000 collection.



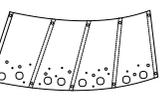
04. Tissue paper, laser cut, glued No distortion in Z-direction. Distortion of grid in X & Y direction results in structure no longer fully retractable due to differing member lengths. Flexibility of material means structure lies flat - assembly is not inherently volumetric.



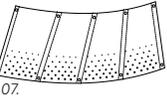
09. White 0.8mm Polypropylene, laser cut, tied assembly



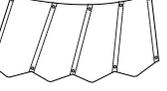
05. Translucent 0.8mm Polypropylene, laser cut and perforated, tied assembly



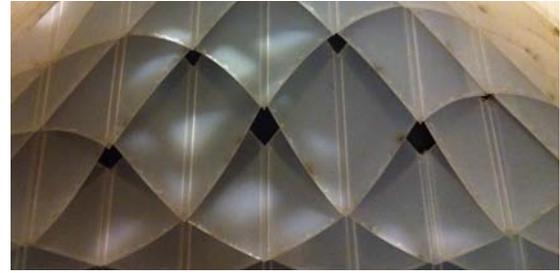
06. Translucent 0.8mm Polypropylene, laser cut and perforated, tied assembly



07. Translucent 0.8mm Polypropylene, laser cut and perforated, tied assembly



10. Translucent 0.8mm Polypropylene, laser cut, tied assembly



Distortion of grid in X & Y direction results in structure no longer fully retractable due to differing member lengths. No distortion of grid in Z-direction.



Concertina Pleat. A Study in Digital Material Fabrication

Deborah Hodge

Shared between theatre, fashion and architecture are relationships to the body. 'Concertina Pleat' explores ways in which textile architecture can wrap around, hover over, or enclose a single body, create an intimate setting, or relate to multiple bodies as a collective. The project proposes an installation on the scale of the body; delicate and transparent, flexible and moving, through a study of ruffles in detail, structure, in the alignment of processes and material treatments between fashion and architecture, and in the alignment of structural considerations.

The concept of the fold has received considerable attention in architecture and fashion due to: its structural propensity; its ability to create the three-dimensional out of the two-dimensional; and its use of single sheet material. Concertina Pleat explores the fold through the notion of the ruff, a Shakespearean costume element that became specifically of interest due to its folded and retractable nature, whereby a volume is created by expansion of a textile.

The work deploys a process of material investigation through numerous analogue and digital test models: modelling a concertina grid in 3D modelling, morphing it in specific ways, and unrolling for fabrication, laser-cutting and perforating the surfaces, folding and sewing the material to create a volumetric model from a planar material. The layering of material creates varying transparencies, transmissions of light and degrees of enclosure, and the pleating gives structural surface behaviour to the material. The resulting foyer installation in the Turbine Hall generates a complex spatial composition through the carving out of material, creating sensuous and temporal material insertions of soft textile into the industrial character of the Hall, through which the audience wanders.



Study for Ruff Theatrical Ruff (Shakespearean and Elizabethan Ruff)



Theatre of the Fold

Andrew Fong

Belinda Lee



fold: analogue model study series



The Theatre of Folds and its bar are situated adjacent to the Spiegel tent, and address the site's natural restrictions; the ambient noise, restricted vehicle access to the site and the main entry points to the site. The project's cantilevered reception space aligns with the audience entry points, engaging them immediately upon arrival and redirecting spectators towards the emergent shared public foyer between the old and new performance spaces, thus bridging between two worlds of theatre.



'Theatre of the Fold' suggests an architecture that encases performances by using triangulated folded modules for a spatial structure that provokes a feeling of belonging and enrichment. The main focus of the performative space is to play on the relationship between audience and performer. Unforgettable performances for both the audience and the performer stem from a particular bond created as a performance unravels. There is an action and reaction produced by cues inspired from each persona. The architecture attempts to capture this interaction and to intensify the experience for this purpose.

The project investigates the architectural theme of the fold and encases the performance space using triangulated modules to envelop the audience allowing them to occupy the structure three dimensionally. The immersion of the audience in the space and geometry attempts to provoke a feeling of belonging and enrichment, by the means of allowing the audience to become part of the performance space and performance. Following this notion of belonging, the experience is enriched and intensified, creating a sublime atmosphere to laugh, relax and experience a great performance.

Technical aspects of the space make use of a repetition of triangular modules that fold together in rows, are lowered and locked onto one another to create a rigid structure. Repeated folded modules were chosen as the digital system for simplicity and its inherent ability of self-support. The materiality of Plywood and Polycarbonate for the folded panels enhance the projects structural ability (withstanding axial forces that occur within the fold), translucent characteristics, and allow for the interior of the performance space to be naturally lit. Acting merely as bracing and framing for the plywood and polycarbonate folds are thin steel flanges and bolts. The focus on rows of folded modules is to satisfy the brief of a short construction time frame, container transportation and low costs.



the body, the theatre and speech

Chris L Smith

To consider language as passive is to sanction without thought the political and pleasurable practices that a language fosters. Theatre expresses this clearly. Philosophy reminds us of this. But it is, I think, architecture that articulates this point directly in the concrete and bodily realm. Manfredo Tafuri's essay 'L'architecture dans le boudoir' (1990) goes a long way to expressing this idea most clearly.¹ Tafuri's brilliance is an ability to articulate the issues of linguistics in architectural theory. 'L'architecture dans le boudoir', navigates around the problem of words and things, endeavouring as Tafuri suggests "to do violence to the object under analysis".²

A lament is that he does so around a stable notion of 'meaning' and a particularly qualified idea of 'production'. His analyses of the 'relations of production' are not concerned with process itself, but rather with the result: a bleak and labyrinthine articulation of collective meanings. What is engaged in the present chapter is also a form of liberating violence, however, it is not a violence to the object under analysis but rather to the thought that produces it.

The aim is to look for the political orders within language, to articulate forces, to incite an experimental violence related to the architecture of the theatre that might offer what Michel Foucault refers to in 'Theatrum philosophicum' as a point of resistance to Reason.³ The aim is to envision the theatre as a space in which language (both speech and architectural) prompt new and intense events.

Speech

Jacques Lacan argues that the child originally inhabits a pre-Oedipal 'imaginary', characterised by speechless identity with the mother, and acquires subjectivity only by entering into the symbolic order of language (mother-tongues) and only at the price of the imaginary.⁴ This followed his central proposition that the unconscious is structured like language. That is, though there is no 'word made flesh' as in literal rationalism, the incorporeal word and corporeal consciousness are, for Lacan, structured in the same way: linguistically.⁵

The first collaborative work of Gilles Deleuze and Félix Guattari, *Anti-Oedipus* (1972) is an attack on this particular notion, positing a liberation of meaning, structure and desire, from the mother-tongue through an alternative actualisation of the relationship of words and things. Deleuze and Guattari focus on the *speech-act* and the role of the verb to emphasise the performative potential of meaning and events. In this way meaning and event are less 'bastard concepts' than a productive bastardizing of reason: "[t]o think is to create—there is no other creation—but to create is first of all to engender 'thinking' in thought".⁶ When an actor falls, when a scenographer constructs, when a curtain is raised and an audience inhales, there is what Deleuze and Guattari call an "intermingling of bodies".⁷ However, the statements, "she is falling", "I am constructing", "the audience is inhaling", express incorporeal transformations that are of a completely different character.⁸ They are, by Deleuze and Guattari's definition, *events*.⁹

Speech acts

Deleuze and Guattari diverge from the course charted by Jacques Derrida that is relevant to the present chapter. The distinction is the social and political prominence given to linguistic notions. Deleuze and Guattari see language as political in the sense that it is a site of power struggles and also in the sense that it presupposes a materialism: language gives orders, establishes an order (of values), and maintains order (for the State).¹⁰ This privileging of the social role of language derives from a developed exploration of the speech-act; what Deleuze and Guattari refer to as the 'order-word' [*mot d'ordre*]. This is an advance of the findings of speech-act theorists who, since John L. Austin, have directed attention to the idea that saying something is doing something.¹¹ When an Ulster loyalist says 'no' or the media says 'dirty', each, in so speaking, performs an action.¹² Even when a specific formula is not involved,

statements in specific situations constitute specific acts. Speech-act theory demonstrates that incorporeal transformations are interpretive and yet yield definite corporeal impacts.¹³ In Deleuze and Guattari's text *A Thousand Plateaus* (1980), these linguistic fragments "do not concern commands only, but every act that is linked to statements by a 'social obligation'. Every statement displays this link, directly or indirectly".¹⁴

Oswald Ducrot questions the notions of linguistic information, code, communication and subjectivity in *Dire et ne pas Dire* (1972) by developing a theory of 'linguistic presupposition' or non-discursive implicitness, as opposed to concluded and discursive implicitness (reference to a code).¹⁵ He assembles a pragmatic covering - all of linguistics and moves toward a study of '*assemblages of enunciation*' considered from a political point of view.¹⁶ To ask what a speech-act consists of, Ducrot turns to the juridical assemblage:

To qualify an action as criminal (theft, fraud, blackmail, etc.) is not, in our sense of the term, to present it as an act since the legal situation of guilt, which defines a crime, is supposed to derive from other given consequences of the activity described: the activity is considered punishable because it is harmful to another person, to order, to society, etc. The judge's statement of a sentence can, on the other hand, be considered a juridical act because there is no intervening effect between the speech of the judge and the transformation of the accused into a convict.¹⁷

The operation of the order-word is explained by relating it to a theory of incorporeal transformation. Body constructs are an 'infecting' of words and things and words and things have an 'abstract but real' incorporeal dimension;¹⁸ words are related to sense/meaning and things to attributes/events.¹⁹ Language, therefore, may be seen as the vehicle through which an incorporeal attribute is assigned to a thing. Language, in this logic, is the vehicle of incorporeal transformation. The function of words and the fundamental function of language, according to Deleuze and Guattari, is to affect such '*incorporeal transformations*'.²⁰

Incorporeal Transformations

In a theatre one can describe what happens before and after a performance in terms of bodies (the body of the actor, the director, the audience, the theatre architect, the critic, etc.) but the transformation of the actor into the character, the actor into the director, the audience into the critic, are the assignations of incorporeal attributes to those bodies. Accordingly, the passage of script, the stage directions, the occupation of a theatre, are all incorporeal transformations of bodies effected through language.²¹ The transformation of the architect into the audience is differentiated from the occurrences surrounding the purchasing of a ticket in that the transformation is instantaneous.²² Following Ducrot, Deleuze and Guattari suggest the simultaneity of the speech-act and the transformation of bodies concerned:

In an airplane hijacking, the threat of a hijacker brandishing a revolver is obviously an action; so is the execution of hostages, if it occurs. But the transformation of the passengers into hostages, and of the plane-body into a prison-body, is an instantaneous incorporeal transformation, a 'mass-media act' in the sense in which the English speak of 'speech-acts'.²³

The Stoics were the first to distinguish between the bodily corporeality and the bodily incorporeal: the corporeal as content and the incorporeal as the expressed.²⁴ Incorporeal events and expressions are applied or attributed to bodies. That is, they are actualised, felt, in bodies. There is a distinction made between the incorporeal expressed 'performing' and the corporeal 'perform'. In expressing the incorporeal attribute and attributing it to the body one is not representing or referring but is intervening in a way; the conclusion being that it constitutes a speech-act.

The Event

Deleuze and Guattari's philosophy is intimately related to their conceptualisation of the event.²⁵ Following the Stoics, Meinong and the speech-act theorists, Deleuze and Guattari's perspective promotes the role of language and other forms of representation in the actualisation of everyday happenings, habits, the state of affairs and the State.²⁶ It also points to a critical role for political philosophy in relation to the 'common-sense' interpretation of events. Deleuze and Guattari approach events (or what Deleuze also refers to as the 'surface effects' of things) through notions of problems and simulacra.²⁷ A problem is characterised

in a mathematical model as a single point that defines a domain of equations and solutions.²⁸ That point may be specified only after the various equations of its domain are solved. Hence, the single point appears as the mere result of the solutions, a residue or after-effect. The singular point, however, precedes all solutions and is immanent within them, for it defines a virtual field of possible equations within which various specific equations may be actualised: simulacra. The theatre can be thought of in this way. A specific occurrence that is defined by the flows of actors, audiences, architects and critics. No theatre building absolutely dictates its mode of operation; it can however, more or less foster or harbour possible events and occurrences; but cannot be reduced to these. According to Brian Massumi, for Deleuze "[t]he simulacrum is less a copy twice removed than a phenomenon of a different nature altogether: it undermines the very distinction between copy and model".²⁹ The problem for architecture, then, may be understood in two ways: in terms of its manifestation as a secondary effect, and in terms of its immanent but virtual presence as a ground of possible *actualisation*.

Counter-actualisation

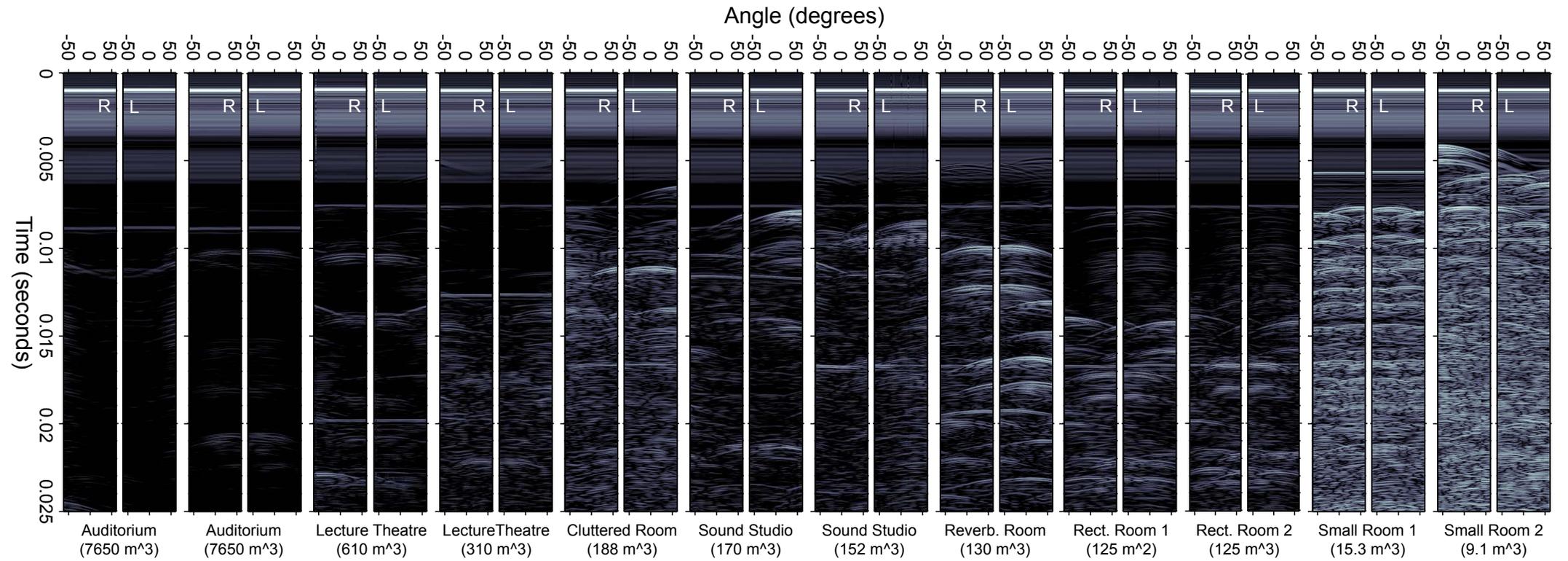
The realm of the theatre, I would argue is to at once prompt events and not to delimit the event to the habitual or traditional types of event. Deleuze and Guattari see 'the invention of concepts' as a means of breaking with the normal, of breaking with the self-evident.³⁰ In *Difference and Repetition* (1968) Deleuze differentiates an 'actualisation' from notions of the representation (copy and model), stating that "[a]ctualisation breaks with resemblance as a process no less than it does with identity as a principle. By this logic, actualisation or differentiation is always a genuine creation".³¹ Deleuze and Guattari contrast the actualisation of a given 'pure' event in particular circumstance with the '*counter-actualisation*' that occurs when a concept is extracted from things: "the event is actualised or effectuated whenever it is inserted willy-nilly into a state of affairs; but it is counter-effectuated whenever it is abstracted from states of affairs so as to isolate its concept".³² In *The Logic of Sense* (1969), Deleuze refers to this doubling (of actualisation/counter-actualisation) as a process of 'miming' what effectively occurs; "to the extent that the pure event is each time imprisoned forever in its actualisation, counter actualisation liberates it, always for other times".³³

To counter-actualise everyday events is to relate them back to the pure event or problem (the virtuality) of which they appear as only one particular determination or solution.³⁴ In counter-actualising an event, one attains and expresses the sense of what happens, thereby dissociating the pure event from the particular determinate form in which it has been actualised and pointing to the possibility of other determinate actualisations. The practice of counter-actualisation may generate a means of conceiving of alternative potentials of concepts.³⁵ For this reason, Deleuze and Guattari refer to concepts as “the contour, the configuration, the constellation of an event to come”.³⁶ To counter-actualise an event of theatre is to dissociate it from the dominant force of theatre; and the work under consideration in this book is about this very experimental violence. There is no attempt here to dispel traditions of theatre or the habits by which an actor might occupy a stage or by which a scene or set may be constructed, but rather; the task of counter-actualisation aims to suspend the existing dominant force for an instant to allow other forces to become active (or invade habit). According to Massumi “[b]ecoming is a mode of synthetic thought whose relation to analytical thinking and the ego is less a counter than a counter-effectuation—a change in mode striking habit, [...] even reactivity itself”.³⁷ Counter-actualisation takes as its beginning a specific individual case and ends in a category coherent enough to take its place in a pre-existent system of what Massumi provocatively calls ‘good/common sense’.³⁸ It is in this way that a new way of ‘performing’ might emerge or by which we might find ourselves projected violently beyond ‘L’architecture dans le boudoir’.

Notes

- [1] Manfredo Tafuri, ‘L’architecture dans le boudoir’, in *The Sphere and the Labyrinth: Avant-Gardes and Architecture from Piranesi to the 1970s*, translated by Pellegrino d’Acierno and Robert Connolly, (Cambridge, MA: MIT Press, 1990), 267-90.
- [2] Tafuri, ‘L’architecture dans le boudoir’, 284.
- [3] Michel Foucault, ‘Theatrum Philosophicum’, *Language, Counter-Memory, Practice*, edited by Donald F. Bouchard, (New York: Ithaca, 1977), 165-96. Translation of ‘Theatrum philosophicum’, *Critique*, (26/282, 1970): 885-908, by Donald F. Bouchard and Sherry Simon.
- [4] This concept corresponds to the mirror stage (4.03) and marks the movement of the subject from primal need to what Lacan terms “demand.” As the connection to the mirror stage suggests, the “imaginary” is primarily narcissistic even though it sets the stage for the fantasies of desire; Lacan, ‘The Mirror Stage as Formative of the Function of the I as Revealed in Psychoanalytic Experience’, *Écrits*.
- [5] This led Lacan to the notion that language and sexual identity are acquired simultaneously.
- [6] Gilles Deleuze, *Difference and Repetition* (New York: Columbia University Press, 1994), 147. Translation of *Différence et Répétition*, (Paris: PUF, 1968), by Paul Patton.
- [7] Gilles Deleuze and Félix Guattari, *A Thousand Plateaus* (Minneapolis: University of Minnesota Press, 1987), 90. Translation of *Mille plateaux*, volume 2 of *Capitalisme et Schizophrénie* (Paris: Les Éditions de Minuit, 1980) by Brian Massumi.
- [8] Deleuze and Guattari, *A Thousand Plateaus*, 86.
- [9] Gilles Deleuze and Félix Guattari, *What is Philosophy* (New York, Chichester: Columbia University Press, 1994), 158. Translation of *Qu’est-ce que la philosophie?* (Paris: Les Éditions de Minuit, 1991), by Hugh Tomlinson and Graham Burchell.
- [10] Deleuze and Guattari, *A Thousand Plateaus*, 100-1.
- [11] John L. Austin, *How to do Things with Words* (Oxford: Oxford University Press, 1962).
- [12] Stephen Levinson, *Pragmatics* (Cambridge: Cambridge University Press, 1983), 1.
- [13] Deleuze and Guattari, *A Thousand Plateaus*, 80.
- [14] Deleuze and Guattari, *A Thousand Plateaus*, 79. Deleuze and Guattari call such words order words [mots d’ordre]. As Deleuze and Guattari tend to suggest the capacity of all language to act as the transmission of ‘order-words’ it seems unnecessary to clarify the term.
- [15] Oswald Ducrot, *Dire et ne pas Dire* (Paris: Herman, 1972), 70-80.

- [16] ‘Assemblages of enunciation’ is not a definition of Ducrot but a descriptor of Deleuze and Guattari to describe the same linguistic circumstance; Deleuze and Guattari, *A Thousand Plateaus*, 85-8.
- [17] Ducrot, *Dire et ne pas Dire*, 77. Translation is by Brian Massumi, *A Thousand Plateaus*, n11, 524.
- [18] Brian Massumi, *Parables for the Virtual: Movement, Affect, Sensation* (Durham, NJ: Duke University Press, 2002), 21.
- [19] Deleuze and Guattari, *A Thousand Plateaus*, 85.
- [20] Deleuze and Guattari, *A Thousand Plateaus*, 108-9.
- [21] Deleuze and Guattari, *A Thousand Plateaus*, 81.
- [22] Deleuze and Guattari, *A Thousand Plateaus*, 108-9.
- [23] Deleuze and Guattari, *A Thousand Plateaus*, 81.
- [24] Roland Bogue, *Deleuze and Guattari*, (London: Routledge, 1989), 67-8.
- [25] Deleuze and Guattari, *What is Philosophy*, 160. They go so far as to suggest that “[p]hilosophy’s sole aim is to become worthy of the event, and it is precisely the conceptual persona who counter effectuates the event”.
- [26] Deleuze and Guattari, *A Thousand Plateaus*, 85.
- [27] Gilles Deleuze, *The Logic of Sense*, edited by Constantin V. Boundas, (New York: Columbia University Press, 1990), 7. Translation of *Logique du Sens* (Paris: Les Éditions de Minuit, 1969), by Mark Lester and Charles Stivale.
- [28] Gilles Deleuze, ‘Plato and the Simulacrum,’ *October*, (27, winter 1983): 52-53. Refer also to Deleuze, *The Logic of Sense*, 54. Elsewhere, he writes, “problems are of the order of events”; Deleuze, *Difference and Repetition*, 188.
- [29] Brian Massumi, ‘Realer Than Real; The Simulacrum According to Deleuze and Guattari,’ *Copyright* (1, 1987). Cited at: http://www.anu.edu.au/HRC/first_and_last/works/realer.htm; 12:45, 27 December 2002.
- [30] Paul Patton, ‘The World Seen From Within: Deleuze and the Philosophy of Events’, *Theory and Event* (1/1, 1997): 16-9.
- [31] Deleuze, *Difference and Repetition*, 212.
- [32] Deleuze and Guattari, *What is Philosophy*, 159.
- [33] Deleuze, *Logic of Sense*, 161.
- [34] Deleuze and Guattari, *What is Philosophy*, 157-8.

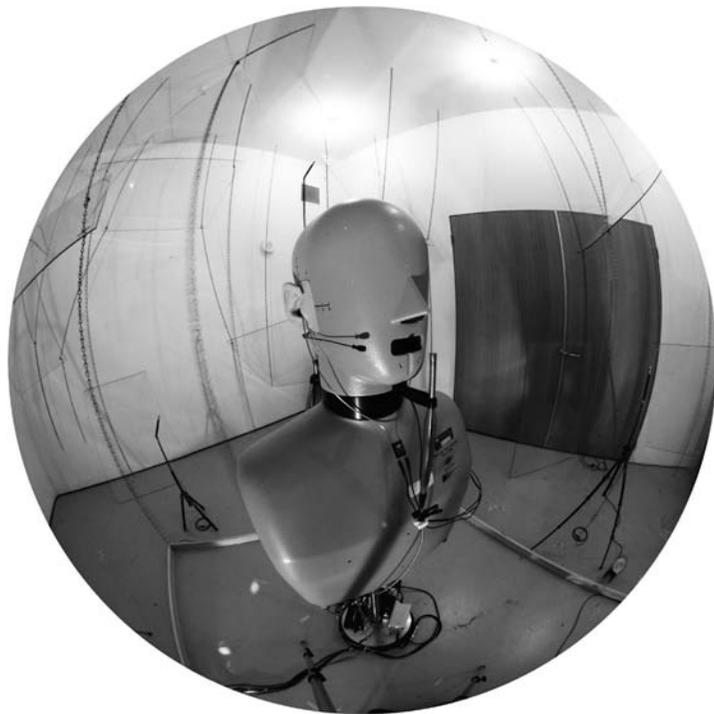


The pattern of early reflections from mouth to ears (left and right) measured using an acoustic manikin in a variety of rooms (from large to small). The pattern of reflections changes as the manikin is rotated to face different directions (Playing The Room: One's Own Voice On Stage, Densil Cabrera).

Playing the Room

One's Own Voice on Stage

Densil Cabrera



As a person speaks into a room, they hear their voice, along with the room as the sound of their voice explores the room and then returns to their ears. Throughout our lives, as we talk in countless rooms, we learn what the sound of a room means from our own voice and from the voices of others: for example, whether the room is large or small, hard or soft.¹ Such sounding out of a room is usually subconscious, but highly reverberant rooms can provoke exuberant vocalizations.

At the other extreme, in a highly absorptive room (an anechoic room being the most extreme) it feels as though one's voice does not leave one's head. How we hear our voice affects how we speak: the lack of 'sidetone' in the earpiece of some telephones reduces the amount of sound returned to the occluded ear, leading to unnecessarily raised voice production.² Similarly, the lack of acoustic support in classrooms and lecture theatres (in the form of useful room reflections) has been shown to result in a raised speaking level by teachers, with long term consequences for voice strain.³

It might be thought that a highly absorptive room is desirable for speech clarity, but in fact such a room can be just as detrimental to speech as a highly reverberant room. Because of the typically large room volume, the spoken word theatre poses even more of a challenge for voice projection than classrooms, and yet significant appeal remains for theatrical performance without electro-acoustic amplification. This essay considers the acoustic experience of performers on stage, and how the theatre environment can affect this, especially in the context of unamplified performance. An approach to conducting research on studying stage acoustics is outlined.

The actor Peter Carroll commented on the experience of performing without radio microphones on a stage with an acoustically designed theatrical set (in the 2006 production of Moliere's *A Bourgeois Gentleman* at the Sydney Theatre).⁴ Without microphones, an actor can "be their own conductor"; they can "play the auditorium". By contrast, if radio microphones are used, the actor may have little sense of what the audience is hearing, and is essentially at the mercy of the audio system. The design of an auditorium, including the theatrical set, affects on-stage clarity (whether actors can hear and interact with each other well). Too much on-stage reverberation reduces on-stage clarity, but an effective set can strengthen the early acoustic reflections (reflections that immediately follow the voice, within tens of milliseconds) while reducing the strength of the late (reverberant) reflections, thus significantly enhancing on-stage clarity. The importance of these early on-stage reflections has also been observed in a study of performance in an opera theatre, where it was seen that performers struggle to hear each other (singing by "dead reckoning") on a large non-reverberant stage lacking in strong early reflections.⁵ In set design, the strength of on-stage early reflections can be increased through the choice of set materials, the size of the working stage area (greater support is associated with smaller stage areas), the introduction of acoustically reflective surfaces in otherwise unused (and unseen) spaces (e.g., for a proscenium stage, on the wings and above the stage), and perhaps also through the shape of the set surfaces (although it is unlikely that acoustical considerations would influence decisions about that).

Room size affects the sound in the room in several important ways. One aspect of this is that small rooms are 'louder' than larger rooms - because the reflected sound in a room is concentrated (or diluted) into the room's volume. In room acoustics, this room characteristic is known variously as 'strength factor', 'stage (or voice) support' or 'room gain'. Combined with acoustically reflective surfaces, a small room can provide very great voice support - which presumably is part of the appeal of singing in the shower. By contrast, a theatre is a large room, with at least one major sound-absorptive surface (the audience). Although unamplified performance in theatres has appeal, there are limits on what a room can achieve. An auditorium should have a volume no greater than 4500 cubic metres, otherwise it is near-impossible to provide sufficient acoustic support for an unamplified actor's voice.⁶ Theatre design can be optimised for intelligibility in several ways. Most obviously bringing the audience close to the stage optimises sightlines and the strength of the direct sound from the actors: raked seating and well-designed galleries are used to this effect. Being able to see the actor clearly (including their lips as they talk) improves intelligibility. Surfaces in the theatre (walls, ceiling, and gallery fronts) can be designed to reflect sound onto the audience, rather than reflecting it where it would be needlessly absorbed, or would add to detrimental reverberation. On some surfaces, absorption might be used to control reverberation or unwanted reflections (although, typically the audience is the most sound-absorptive part of a theatre), and profiled surfaces can also break up unwanted reflections (known as 'scattering').

Notoriously, the rear wall of a theatre can reflect (and focus) sound back onto the stage. Because of the relatively long time taken for sound to travel from the actor's mouth to the rear wall and back to the stage (typically more than one tenth of a second), this acoustic reflection is detrimental, sometimes making it difficult even to maintain speech because of the strange acoustic distraction. Reflections with shorter time delays are usually supportive, but occasionally can also produce unwanted interference. If there is just one strong reflection, instead of a multitude of reflections arriving from a wide range of directions at slightly different times, the effect can be disturbing because the 'color' or 'timbre' of the voice changes dynamically as the actor moves towards or away from the reflecting surface. If there are two strongly reflecting parallel surfaces (e.g., on either side of a small stage), the result can be a strange 'twang', as particular frequencies ring when excited by the voice. Fortunately, in order to optimise sightlines and provide access to the stage, such parallel walls are usually avoided. Notwithstanding these particular acoustic phenomena, the general concepts of support and clarity are key to providing a good environment for speaking. In room acoustics, clarity is found when a significant amount of room-reflected sound follows the direct sound within a short period (typically, one-twentieth of a second is taken as the limit of reflections that support the direct sound) and the subsequent reverberation is not excessive. While most studies of acoustic clarity are concerned with the experience of a passive listener, the importance of clarity has also been observed for its role in minimising 'speaking difficulty' in rooms.⁷ In an environment that is too reverberant, an

actor must speak slowly to be understood - speaking more loudly does not improve comprehensibility. The acoustic concept of support is similar to clarity in identifying the importance of early acoustic reflections, except that it is concerned with the sense of how loud one's own voice seems to be as one speaks - primarily through reinforcing the sound of one's voice by early acoustic reflections. In a supportive acoustic environment people intuitively speak with a more relaxed voice, and support is also likely to enhance the projection of an actor's voice to the audience.

Intimacy is one of the most powerful contributors to engagement between audience and performer. Intimacy can be defined as the "feeling of closeness to the performer". In theatre design, visual intimacy can be achieved most obviously by bringing the audience and stage close together, but also through many other factors such as illumination and set design. From the performer's perspective, intimacy with the audience is, of course, enhanced when the audience is closer. However, intimacy is not a purely visual experience and it is also possible to consider it in auditory terms, which combine with the visual in the overall impression of intimacy.⁸ Factors that contribute to auditory closeness include: loudness, direct to reverberant ratio (similar to clarity), the relative strength of high and low frequency components in the sound, and voice projection (i.e., the range comprising: whisper, conversational speech, raised voice, stage voice, and shout, etc).⁹ Voice projection is particularly interesting, because it is under the actor's control to the extent that the theatre supports the voice projection range. Hence an actor will modulate intimacy, through their position on the stage (or indeed off the

stage), their facial expression and gaze, and through voice projection. Part of the appeal of electro-acoustic reinforcement of the actor's voice is that acoustic intimacy can be artificially enhanced: the voice is louder for a given projection, the direct to reverberant ratio can be increased (using directional loudspeakers and/or loudspeakers near the listeners), the high frequency sibilances (which would normally only be heard when very close to the talker, and are lost at a distance due to dissipation in the air) can be reinforced, the low frequency sound of the voice (which similarly is relatively weak at a distance, due to the combined effects of radiation impedance and auditory insensitivity to low frequency sound at low sound pressure levels) can also be reinforced, and the actor can whisper and be heard. However, sound reinforcement to such an extent yields an unrealistic sound, and despite (or because of) its limitations, the 'real' unamplified voice remains an attractive alternative. Projecting one's voice is not simply a matter of speaking with greater sound power, although that is part of it. Actors and singers concentrate some of their voice energy into the part of the spectrum in which human hearing sensitivity is greatest (around 2-4 kHz, because the ear canal produces a substantial boost in the sound delivered to the eardrum in this frequency range). This allows their voice to stand out – and in the case of opera singers, allows their voice to be heard above orchestral accompaniment. More generally, raising one's voice involves both greater sound power and a shift in the overall spectral envelope to higher frequencies.

On a given stage, acoustic support varies with position. There is a tendency for support to be greater as the performer

approaches acoustically reflective surfaces (possibly at the sides or upstage), with less acoustic support in the middle of the downstage area. Yet downstage is where intimacy is likely to be greatest, simply because the actor is almost in the audience. Hence acoustic support through early reflections can be thought of providing a degree of compensation for reduced intimacy upstage. In a study of musicians, it was found that singers prefer downstage acoustics, whereas instrumentalists prefer upstage acoustics in a proscenium hall with an orchestra shell.¹⁰ In a drama production, an actor may need to use the whole stage, but is likely to engage with other actors and the audience differently over the stage area – and perhaps, like the singers, will communicate most comfortably downstage.

In acoustics, the principle of reciprocity applies – and in approximate form, this means that if sound travels well from A to B, then it will also travel well from B to A. Hence, if an actor's voice is projected well to the audience, then the audience's sound will be well transmitted back to the actor. Audience laughs, gasps, murmurs and applause are among the important contributors to interactivity between performers and audience. However, when an electro-acoustic sound reinforcement system is used, this interactivity is diminished, as the microphones are used to amplify the actors but not the audience. Of course, for a large highly responsive audience, amplification is needed to allow the actor's voice to avoid being overwhelmed by the audience response – in such circumstances it can restore the balance necessary for effective interactivity.

In the discussion of room acoustics, the more mundane topic of background noise is easily overlooked. In a theatre there are

many sources of noise, including the air-conditioning system, theatre lights (some of which have fan cooling), electrical components such as transformers, audio amplifiers (which often are fan-cooled), electrical noise emanating from loudspeakers, theatre equipment such as winches, external noise sources, and the sound of the audience. These miscellaneous sources of noise add together, and so while any one of them alone may be unproblematic, as an ensemble they can seriously limit the effectiveness of unamplified performance from the stage. Apart from the sound of the audience, ameliorating these miscellaneous noise sources comes from a combination of good initial design and layout, selection of components, maintenance, and being alert to how modifications in the theatre over the years will affect background noise. In a series of measurements of an unoccupied theatre by the author and colleagues, merely turning on the air conditioning, lighting and audio system increased the background noise level by up to 10 decibels (which is a substantial increase) and degraded the speech transmission index (an objective indicator of intelligibility) from 'fair' to 'poor'. Hence, while good room acoustics is important for unamplified performance, the advantage given by supportive acoustics is only fully available when background noise is kept under control.

Research on stage acoustics involves some difficult challenges. In the theatre, one issue is that acoustical conditions change between productions, and sometimes between acts within a production, because of set changes – and so it is scarcely possible to characterise the acoustics of a given auditorium. The acoustic measurements used to characterise stage conditions for speech are still being

developed, with techniques borrowed from studies of orchestra platforms, as well as novel techniques using an acoustic manikin (with a loudspeaker in its mouth and microphones in its ears). Indications from such research emphasise the importance of strong early reflections, and show that more early reflected energy is beneficial for actors than for musicians on orchestra platforms.¹¹ Considering that the optimum reverberation time of drama theatres is considerably less than for symphonic halls, this suggests that there is considerable benefit in acoustic design of a stage and set – so as to optimise the acoustic reflections of surfaces around the performance area.

Simulating stage conditions in a laboratory – essentially creating an acoustic virtual reality for any given stage – provides a powerful tool to systematically examine how stages and theatres can influence the experience that an actor has (albeit, without audience interaction and the visual experience). The author and colleagues have developed such a system.¹² Real stages can be measured (using an acoustic manikin) or modelled (using a computer model of the theatre), and the pattern of reflections that occurs as sound leaves the mouth and is returned to the ears is obtained (for many orientations of the manikin around the measurement location).¹³ This pattern of acoustic reflections is known as the 'oral-binaural room impulse response' (OBRIR). The simulation system is situated in an anechoic room (a room without echoes, which is important because the simulation is of the acoustic reflections of the theatre). Using a small head-mounted microphone, the actor's voice is captured, processed (convolved with the measured OBRIR) and returned to the actor's ears using small loudspeakers near the ears.

These loudspeakers do not interfere significantly with the direct sound from mouth to ears). Hence the sound received at the ears is nearly identical to that which would have been received in the real theatre. It should be borne in mind that the voice projected from the mouth is somewhat directional, especially at high frequencies; and the sensitivity of the ears is also direction-dependant. Hence as an actor moves their head, the acoustic experience of their own voice may change in a real theatre, and this dynamic experience may be important. The simulation system deals with this by tracking the actor's head as it moves, and selecting the corresponding OBIR from the measured or synthesised set.

Such a system greatly facilitates research into room acoustical conditions for speaking - because it removes non-acoustical factors from the study, it allows room acoustical conditions to be instantly changed (e.g., from one theatre to another), and it allows the artificial manipulation of room conditions (to test new ideas or hypotheses). This is not to say that there is no benefit in research based on questionnaires about real theatres (which may rely on the respondents' memory) or in situ experimental work - but such work should be complemented by the laboratory method outlined here so that purely acoustical effects can be isolated from the rich experience and memory of real theatres. What can one do with such a system? Most obviously, for a set of acoustical conditions, actors could be asked to perform, and then describe the sound experience by answering open or closed questions, or using rating scales, or indeed using other techniques commonly applied in experimental psychology of perception

and cognition. Physical measurements of the voice can be made - do different stage environments lead to different ways of speaking (e.g., the speed of the speech, the sound power level of the voice, etc.)? Results from such (currently envisaged) studies can contribute to guidelines on theatre and set design. Nevertheless, it is already clear that the acoustics on stages have a strong effect on how performers act, and that decisions made in the architectural design of the theatre, theatre maintenance and renovations, the theatrical set design and in other aspects of the production all influence the quality of sound on stage for better or for worse.

Notes

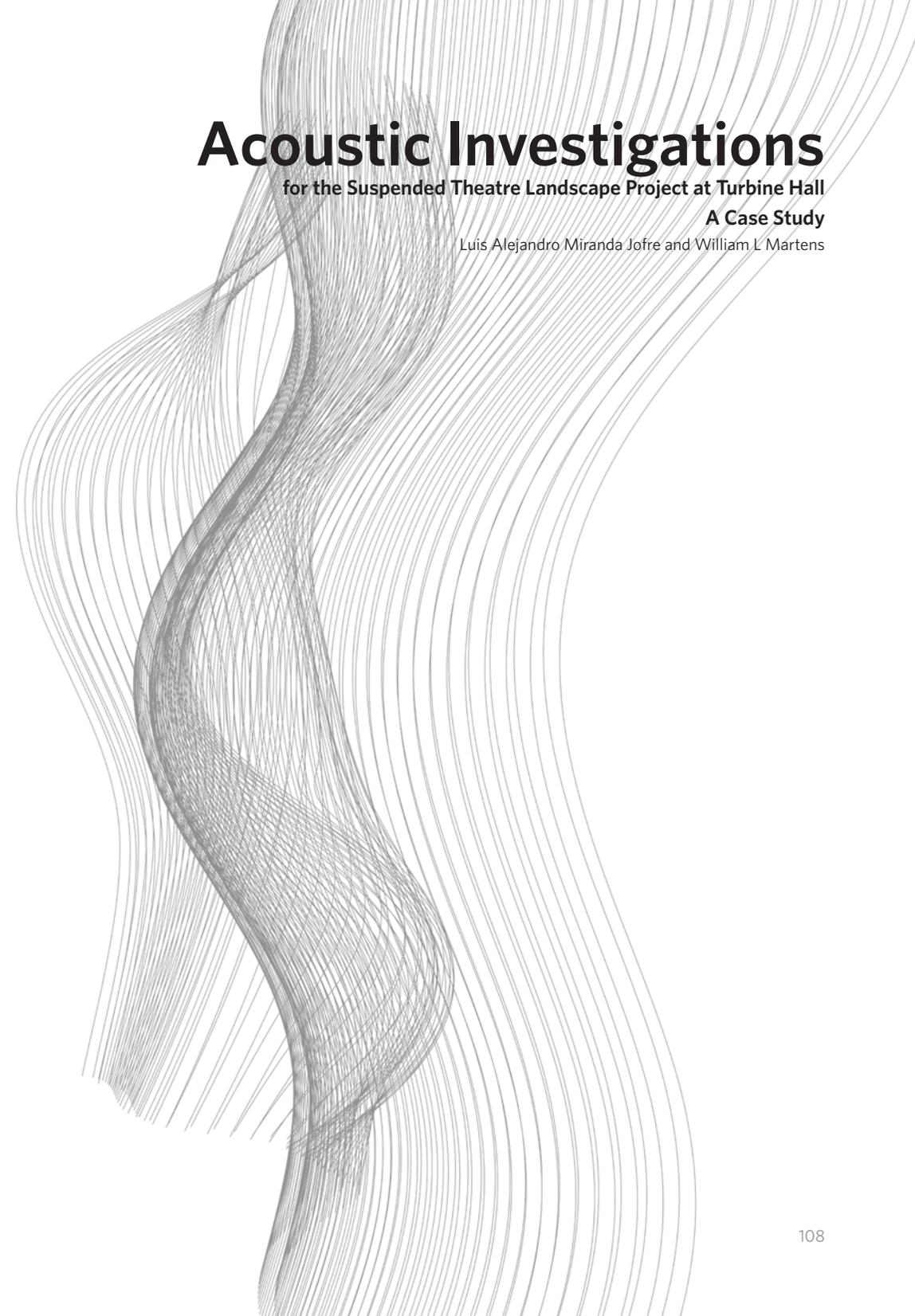
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Acoustic Investigations

for the Suspended Theatre Landscape Project at Turbine Hall

A Case Study

Luis Alejandro Miranda Jofre and William L. Martens



One of the main channels of communication between performers and audience in a theatrical play is the spoken word. The ability of the audience to understand the lines delivered by the actors is essential to the theatrical experience, and so this factor should be considered in the design of a theatre space. What may not be obvious here is that performers rely on the acoustics of the theatre space to listen to each other and listen to their own voice reflected back at them from the surfaces of the stage and from the surfaces enclosing the audience; this in turn influences the way actors will project their voice adapting to the space. Thus it becomes clear that acoustic design is of paramount importance in the success of a theatre space.

As part of the 2012 Sydney Festival, students of the Master of Digital Architecture at the University of Sydney have been invited to design a temporary structure to serve as a performance space for theatre, to be installed within the Turbine Hall at Cockatoo Island. One of these projects serves to illustrate the acoustic design process at various stages. Several key concepts in the acoustics of performance spaces will be introduced to the reader of this report by following the acoustic investigations of the model proposed for this temporary structure.

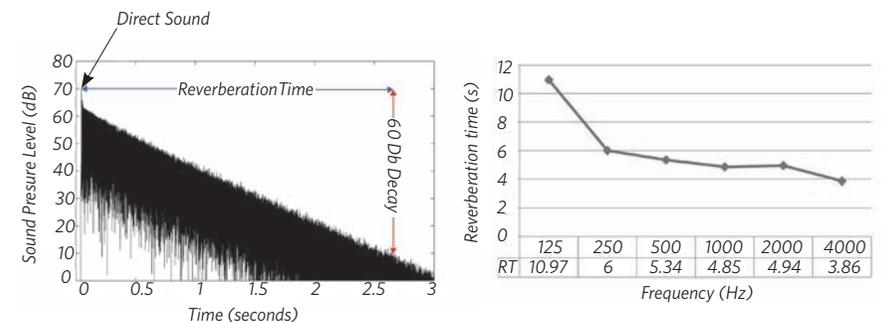
This acoustic design report is based on the project entitled "Suspended Theatre Landscapes" that was prepared by Renee Blyth and Ellen Rosengren-Fowler. The proposed performance space would be suitable for just under 600 attendants, in an ally theatre configuration. In this project a structure made of individual panels is suspended over the stage and audience area, providing a sense of an enclosed space. One of the characteristics of their project was that the proposed hanging structure could vary in shape.

This report focuses on voice support via the acoustics of the space itself, without the addition of an audio system for sound reinforcement (i.e., no microphones or loudspeakers would be employed). By examining different configurations, an overview of a typical acoustic design process is presented. The process is presented as a progression, starting with an empty shell that provides less than optimal acoustic properties, and finishing with a theatrical space that better supports voice performance.

A Stage and an Empty Shell

The acoustic parameter most often used to describe any space acoustically is *Reverberation Time*. Reverberation time is defined as the time in seconds required for a sound to drop in level 60 decibels from its initial value[1]. As an example, think of a loudspeaker in a room. If the loudspeaker plays a relatively loud noise that suddenly stops, the sound of the noise in the room will not disappear immediately, but will decay gradually away over time. The time the sound takes to decay is highly dependant on the room configuration (i.e. partition positioning, room finishes, etc.). In rooms with softer finishes (e.g. cinemas) sound will decay rapidly; in a room with harder finishes (e.g. cathedrals) sound will decay slowly. The 60 decibel value can be considered as the level that sound heard at a medium sound pressure level must fade to become inaudible.

In this project, one of the design provisions is the Turbine Hall building in itself. In order to understand the acoustics of this underlying space, calculations were performed using the proposed stage configuration and a model of the Turbine Hall. The proposed floating structures have the characteristic of not completely enclosing and isolating the stage and audience areas. As an outcome of this, the acoustic characteristics of the enclosing room will influence the acoustics within the performance space. Reverberation time averages within the audience area with a source on stage are presented below.



To put these numbers in perspective, the *reverberation time* average for mid frequencies at a number of English theatres is presented below (Table 1).² Mid frequencies (500-2000 Hz) are typically considered to be the most important range for speech signals, as they contain the majority of the speech spectral content.³

Theatre	D ₅₀ 500-2000 Hz
Festival Theatre, Chichester	0.65
Crucible Theatre, Sheffield	0.72
Olivier Theatre, London	0.71
Barbican Theatre, London	0.77
Roundhouse, London	0.61
Royal Exchange Theatre, Manchester	0.70
Turbine Hall	0.48

Table 1

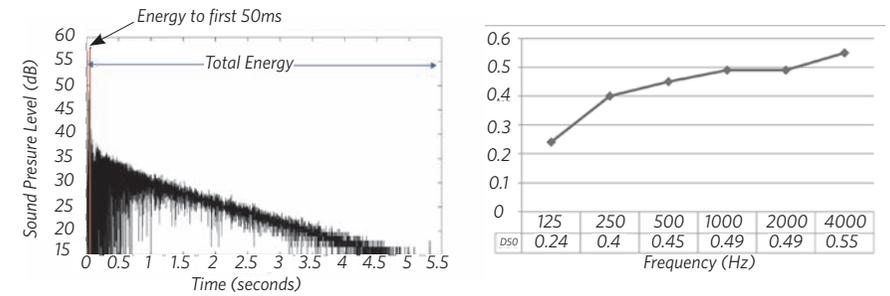
It is obvious that the *reverberation time* in this space greatly exceeds established reverberation times of theatres. Excessively long reverberation times will have detrimental effects on *Speech Intelligibility*. Speech intelligibility is the ability of a listener to understand the words being transmitted either directly by a human source or over a sound reinforcement system. Over the years several subjectively-defined metrics have been developed to characterise the speech intelligibility in a room. Such metrics are based upon estimations of human performance in the space. In this type of estimation a talker in the room in question reads from a list of words or sentences and listeners write a transcription of what they hear. The number of phrases correctly transcribed then provides a quantitative evaluation of the speech intelligibility in the room (e.g. AS 2822 – 1985 Acoustics – Methods of Assessing and Predicting Speech Privacy and Speech Intelligibility).

Subjectively-defined metrics based upon such estimations yield good results but can be time consuming, are not easily repeatable, and are heavy on resources. Therefore evaluations based upon objective (i.e., physical) measurements have been developed to overcome this. Such objective measurements of speech intelligibility are calculated from the distribution of reverberant decay. The direct sound path taken from source to receiver would usually be the shortest path and therefore arrives quite quickly. Then, as the few first surface-reflected sounds arrive at a listener's ears, the direct and indirect sound are integrated into one perceived sound event. The reflections add up constructively, increasing the level of the sound. As more reflections arrive later in time, the sounds start to get smeared together, making subsequent sounds become lost in the reverberation. Of course, if later-arriving reflections arrive at a high enough level, they can be heard as distracting echoes. These late, discrete reflections have detrimental effects on speech intelligibility previous utterances can mask or "cover up" current utterances.⁴

An objective metric widely used to describe the intelligibility of a room from measurements is *Early Energy Fraction* or D_{50} . D_{50} is based on the distinction between reflected energy that is considered to be useful and the energy contained in detrimental reflections. This metric expresses the ratio of energy arriving within the first 50 milliseconds divided by the total reverberant energy. The minimum D_{50} value for acceptable speech intelligibility is 0.5 in the frequency bands between 500 and 2000 Hz. Numbers above this value will increase speech intelligibility.⁵

$$D_{50} = \frac{\int_0^{0.05} p^2(t) dt}{\int_0^{\infty} p^2(t) dt}$$

Where p is the sound pressure and t is time.



The figure above shows the predicted decay in the Turbine Hall, derived from the computer model of the space. This figure plots reverberant decay values, and reveals that the reverberation time is very long. Also, we can see that there are not enough early reflections arriving soon after the direct sound, so there will not be enough energy fused with the direct sound to provide reinforcement. These two characteristics of the decay in the Turbine Hall, reverberation time and early reflection density, are combined in the D_{50} metric (explained above). The adjacent chart plots for six frequency ranges the average D_{50} values that could be observed in the audience area (calculated with a source at the centre of the stage).

D_{50} values were measured in the theatres for which the reverberation time values were shown in the previous table. The following table lists the average values observed in these spaces over the 500 to 2000 Hz range (Table 2). In the final row of the table the D_{50} value for the Turbine Hall is also given, again predicted from the model (as in the previous table).

Theatre	D_{50} 500-2000 Hz
Festival Theatre, Chichester	0.65
Crucible Theatre, Sheffield	0.72
Olivier Theatre, London	0.71
Barbican Theatre, London	0.77
Roundhouse, London	0.61
Royal Exchange Theatre, Manchester	0.70
Turbine Hall	0.48

Table 2

It is apparent from the table that the Turbine Hall, when empty (i.e., without the influence of any additional surfaces), has a relatively low average D_{50} value, and so will not support vocal performance as well as the other spaces listed. In order to increase the speech intelligibility in the Turbine Hall, it would be beneficial to increase the density of early reflections. A solution to this problem is examined in the following section.

Two Shell Configurations

We have identified that there will be a real problem for vocal performance in the Turbine Hall due to the lack of early reflections supporting the direct sound for the audience, and this will be a problem for acoustical stage support for the performers as well. The inclusion of reflectors in performance spaces closer to the areas of interest is a common solution to this problem, and this is the motivation for the design of a shell structure to be added to the Turbine Hall's empty space. Two envisioned shell configurations can be compared in advance of construction via a computer simulation of sound propagation, as described below.

In the proposed project, floating panels are placed above the audience and stage area. A good way of understanding the consequences of adding reflectors in such a hall is by visual inspection. Given a three-dimensional model of the space, an acoustical model can be constructed for examining what will happen to a virtual sound source located on the stage. To simulate sound propagation, the source is made to emit a number of sound particles. Each sound particle behaves as a ray, reflecting specularly from surfaces, in the same manner as light rays reflect from mirrors. The number of sound particles is specified by the user and distributed randomly within a spherical radiation pattern. With enough particles (usually in the thousands), an approximation to a spherical radiation pattern is achieved.

We first examined the structure in the 'Dome' configuration. In the images on the right hand side we see the sound rays as they expand in time. In this configuration, the rays reflected from the panels arrive at a very similar time as the sound reflected from Turbine Hall shell. Also, as the panels are spaced apart, large amounts of rays escape to the Turbine Hall. This 'Dome' configuration does not provide much benefit for the audience or performer as the introduction of early reflections by the panels is minimal.

We then conducted the same investigations on the 'Saddle' configuration. In the images on the right hand side we see the sound rays reflecting from the panels and reaching the audience earlier than in the previous configuration. Also, the panels in this 'Saddle' configuration are closer together, allowing less sound to escape, and dissipate uselessly with the larger Turbine Hall enclosure.

There are other potential benefits of installing the suspended structure in the Turbine Hall. Every building material will have sound absorption properties, even if they are minimal. Sound will decrease in level every time it hits one of these surfaces, hence decreasing the reverberation time. The following table presents average D_{50} and *reverberation time* values at the audience area for the three configurations examined so far (Table 3).

Configuration	RT 500-2000 Hz(s)	D_{50} 500-2000 Hz
Turbine Hall Empty	5.04	0.48
Dome Configuration	4.40	0.59
Saddle Configuration	4.45	0.66

Table 3

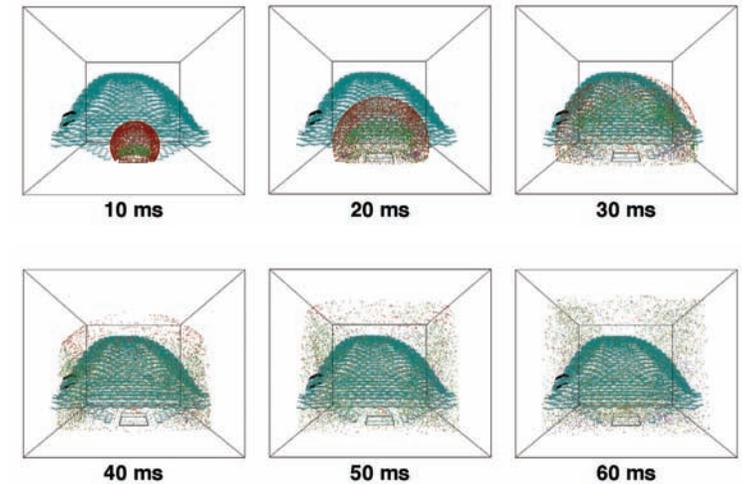


Illustration 1: 'Dome' Configuration

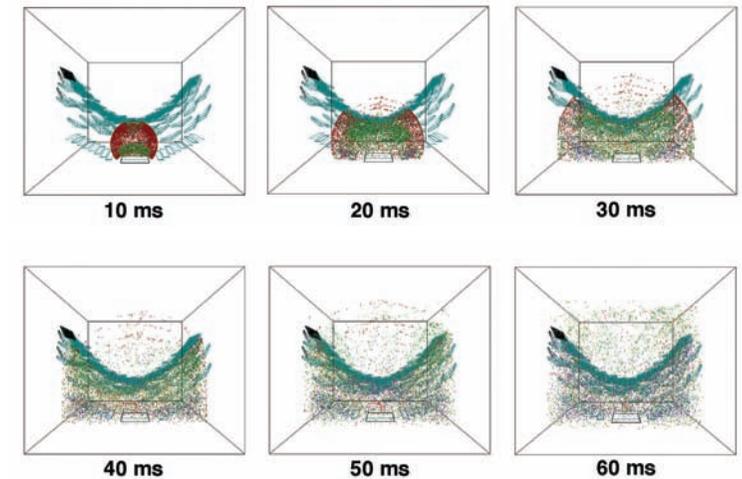


Illustration 2: 'Saddle' Configuration

If we look at the early to late energy ratio, captured in the average D_{50} values as before, it is clear that the values increase from the initial low value of the empty hall configuration, to more adequate values in the two other configurations compared here. Thus, it would be predicted that changing from empty to the 'Dome' configuration, and finally the 'Saddle' configuration will give progressively better acoustical support for performers. However, we still see very long reverberation times. To transform the Turbine Hall into a performance space with similar characteristics to established performance spaces, additional treatment would be required.

Final considerations towards a better performance space

So far we have used reverberation time as one of the main descriptors of the acoustic characteristics of a room. The reverberation time is directly related to the characteristics of the internal room surfaces. As sound travels within a room it will encounter surfaces. When sound encounters each of the surfaces in an enclosure, some of the sound energy will be reflected back into the room and some energy will be absorbed by the surface. Of course, the amount of absorption that is observed depends upon the frequency of the sound in question.

To describe this material property a standard metric has been developed: the *Absorption Coefficient* (α). The absorption coefficient of a material describes the ratio of sound energy that a material absorbs and reflects. Values range from 0 to 1 (although under some extraordinary measuring circumstances values greater than 1 can be obtained). An α value of 0 indicates a completely reflective material and a value of 1 indicates a completely absorptive material. For example, a material finish with an absorption coefficient of $\alpha=0.5$ would reflect half of the energy of incident sound, and absorb the other half of that energy. Naturally, it follows that a relatively large surface with a certain finish, will have a relatively larger effect on the reverberant characteristics of the enclosure.⁶

In order to bring reverberation times down towards preferred values for performance spaces, absorbent materials need to be introduced to the space. Reverberation times within the room are far greater than customary values; therefore, the extent of room treatment needs to include a large amount of material, effectively extending the room surface area with more absorptive materials. For this example, 100 mm acoustic ceiling tiles are included in the model. Additionally, the posterior side of the hanging panels are fitted with acoustic cloth to aid in decreasing reverberation times. The changes in average reverberation times and D_{50} values with the addition of these option treatments are presented in the table below (Table 4).

Configuration	RT 500-2000 Hz(s)	D_{50} 500-2000 Hz
Turbine Hall Empty	5.04	0.48
Saddle Configuration – No Additional Absorption	4.45	0.66
Saddle Configuration – Absorption only on Panels	4.19	0.67
Saddle Configuration – Absorption only on Ceiling	2.73	0.75
Saddle Configuration – Absorption on Ceiling and Panels	2.67	0.77

Table 4

It is obvious that the inclusion of an acoustic ceiling would have the greatest acoustic impact as it includes the greatest variation in area. The inclusion of absorption in the ceiling panels presents a minor improvement, and the inclusion of absorption in the panels when the ceiling is treated, again only presents a minor improvement.

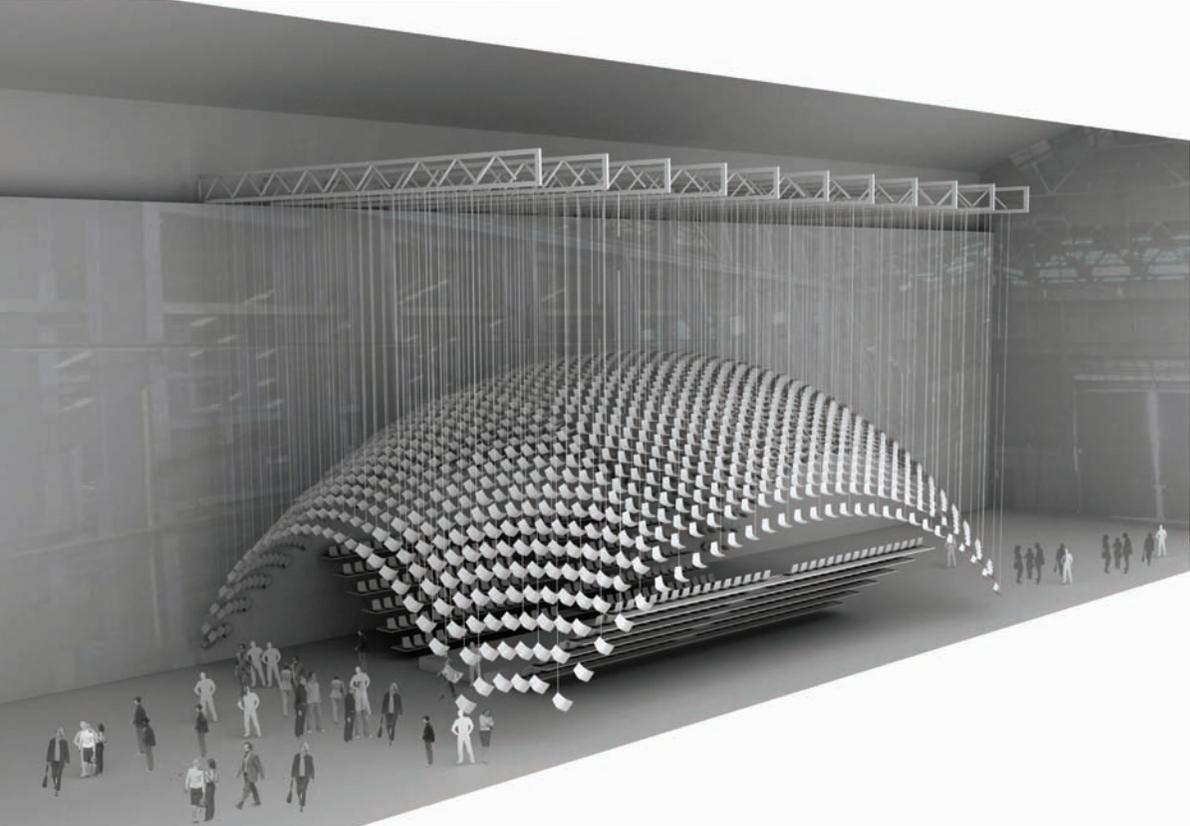
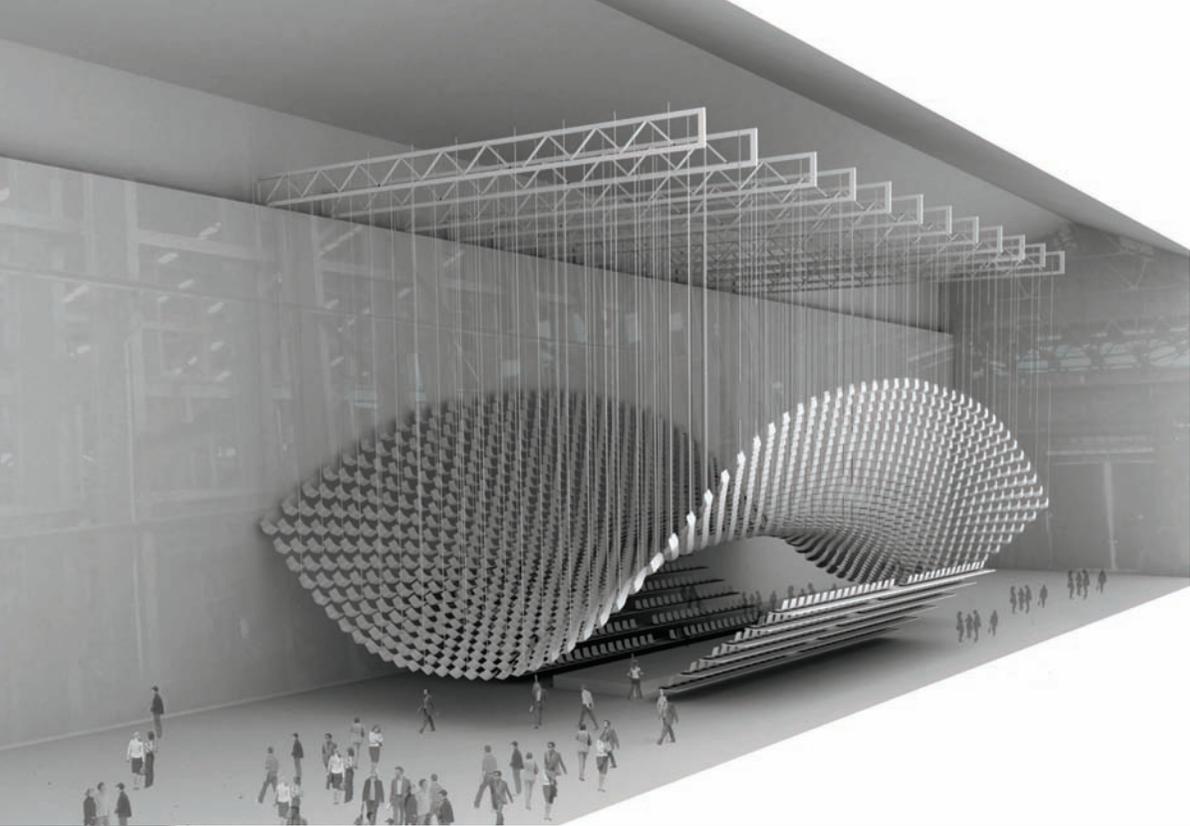
It should be noted that even though the reverberation time has greatly decreased, it is still considerably higher than established theatre spaces. However, it could be argued that the unusual acoustics for the space are a complement for the unusual theatre space. As high as the reverberation time is, it should be expected from the D_{50} results that the intelligibility in the space should be satisfactory. Additional absorption could be added to the space to further reduce the reverberation time; however, this would come at the expense of architectural decisions regarding the overall appearance of the space.

Conclusion

The present text has presented a typical acoustical design process for a problematic space that required more optimal acoustics for its intended use. In fact, in most cases the acoustics of a space will not inherently support its intended purpose. Through iterations in the design process, improvements in the acoustics of the space can be made, underscoring the importance of carefully considering the design intentions of practitioners from multiple disciplines. It should be noted that the design process for a space is a group endeavour and the requirements of several disciplines are often needing to be taken into account, to achieve the goal of delivering a rewarding human experience.

Notes

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Musical Chairs - Suspended Landscape Theatre Project

Ellen Rosengren - Fowler
Renee Blyth

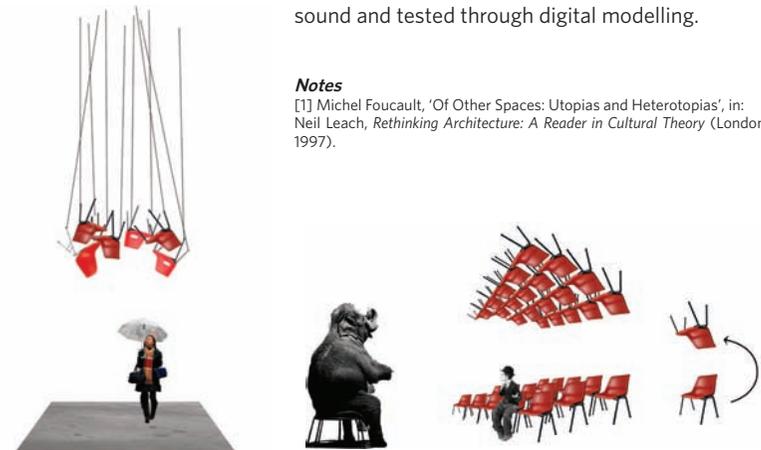
The project explores the phenomenon of the theatre. A place which sits between the real and fiction, where one's disbelief is temporarily and willingly suspended. A place of otherworldliness within the ordinary. A tension is at play between connection to and disconnection from the everyday and the 'heterotopic' space of the theatre-between the completely immersive theatrical environment and the super normal. Ideas of suspension, connection/disconnection, disorientation and immersion are explored.

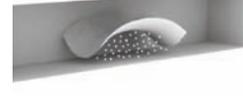
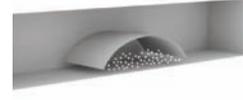
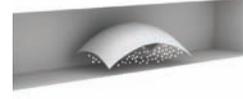
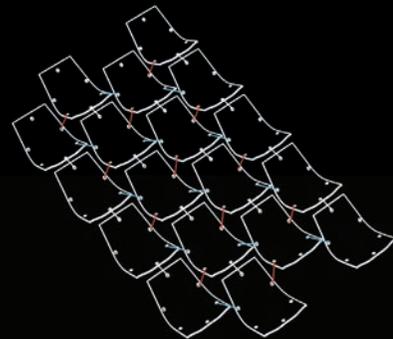
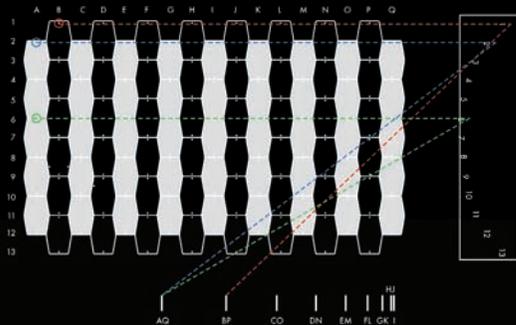
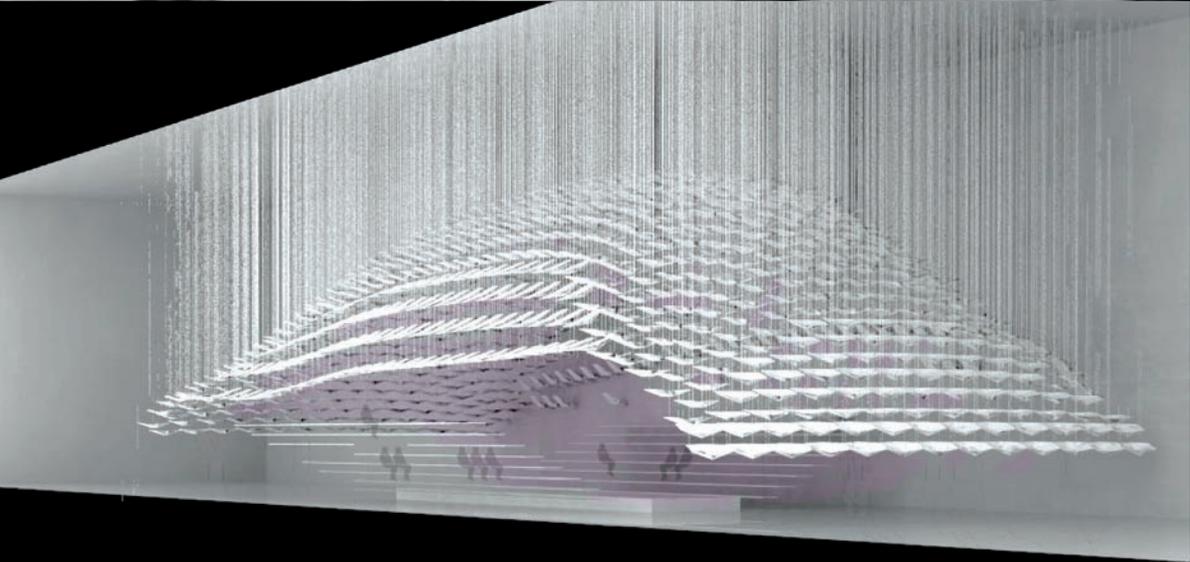
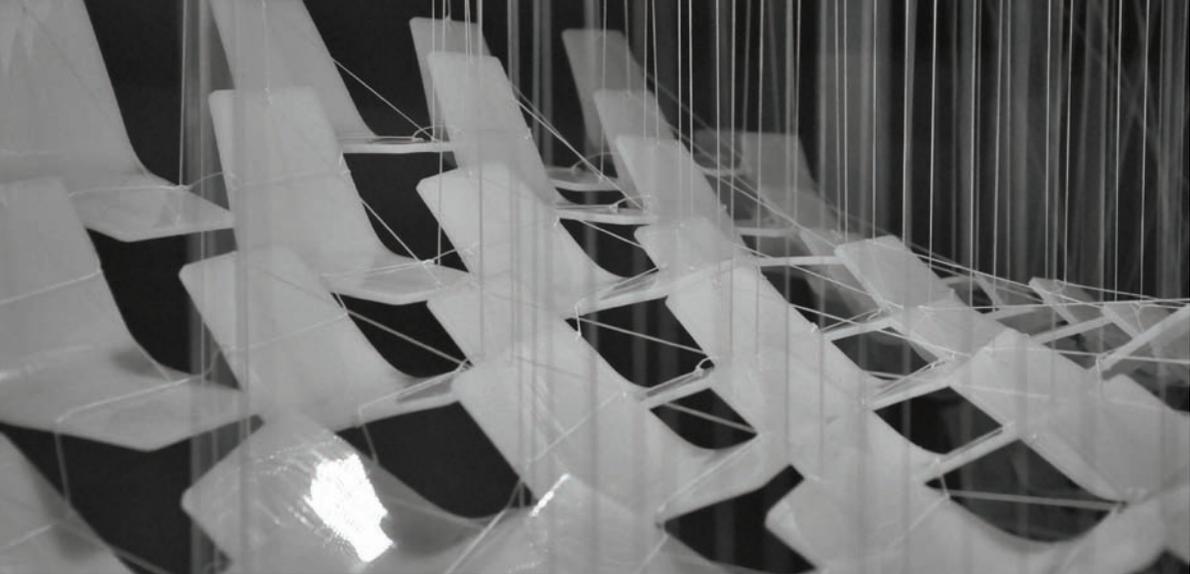
Within the expansive volume of the Turbine Hall a secondary smaller volume is inserted, formed by a multitude of suspended elements. A more intimate space is created for performances and can be manipulated into various forms due to the vertical movement of each element which collectively forms a 'performing canopy'.

This repeated suspended element is the chair, an ordinary mass produced object which is inverted in space and contributes to the mystery and disorientation theatre evokes. En masse, the swarm rises from the ground plane to hover above, enveloping an audience within a volume of chairs and hazy strings. Yet one experiences a connection to the world beyond, as the broken shell of chairs reveals the Turbine Hall through acoustic and visual cues. Acoustically the performance space references both the closer canopy of chairs with quick reverberation and the Turbine Hall with longer reverberation, a strategy resulting in deeper, richer sound and tested through digital modelling.

Notes

[1] Michel Foucault, 'Of Other Spaces: Utopias and Heterotopias', in: Neil Leach, *Rethinking Architecture: A Reader in Cultural Theory* (London: Routledge, 1997).





Modes of movement were derived through analogue means and generated a set of parameters for the creation of form and possible scenarios of the performing canopy. Digital modelling complemented a series of calculations to create an intricate kinetic machine operable through analogue modes. Nine main forms and everything in-between can be created due to a complex system of lacing and mechanisms all responsive to simple hand held levers. Analogue models of movement emphasize the dramatic relationship between body and machine.

An intricate machine was derived to interact with the body. Synchronized movement of performing bodies and performing chair canopy can be used to create dramatic emphasis; levels of acoustic and theatrical intimacy can be formed through movement; altering compression and expansion of space welcomes and farewells guests.

Left side, illustrations:

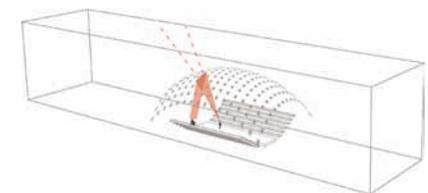
Mechanical analogue model. System of threading mechanical model, photographic detail. Pattern of chairs are threaded through two mechanisms which each control the curve in the x or y direction.

Chairs are suspended from trusses, spaced at three metre intervals to be inserted into the existing structure of the Turbine Hall.

Pattern of connection of chair elements.

Right side, illustrations:

The canopy can form nine main shapes for acoustic and theatrical uses. Acoustic performance was measured by digital modelling- the strategy references both the immediate chair canopy and the greater Turbine Hall.



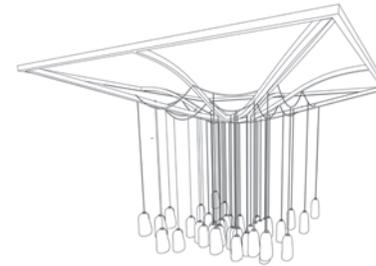


Swarm Entity

Aya Kaneko

Xu Kai Wu

Imaginative, responsive spaces arguably support the stories told of and for people. The project addresses the importance of transitional spaces by inviting the audience to respond and participate - to become part of a swarm. It takes its inspiration from Jacques Perrin's *Ocean* (2009) and its journey with a Medusa swarm into the mystical depths of the ocean. 'Swarm Entity' aims to enhance an audience's theatrical experience by creating an interactive environment that engages and excites its audience before a performance.

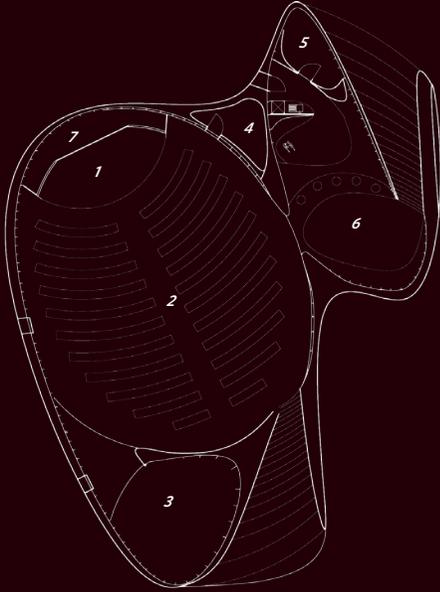


The project takes a snap shot of the collective movements of the deep sea animal and reinterprets it via digital simulation. In the Turbine Hall on Cockatoo Island, the interactive installation hypnotizes the audience before a performance, and diverts the audience from a daily routine to a sensual underwater world composed of lighting, sensors and audios. The installation consists of two major parts; a serial arrangement of translucent bottles, organized as a canopy of clusters above the bar area, and a comfortable lounge topography that visually and sensually inspires an audience. Both swarms are animated by sensory and LED lighting equipment, fostering sequences of diverse theatrical narratives. Through these experiential spaces, 'Swarm Entity' investigates both a collective audience sensation, and shared experiences of translucent bodies glowing in the dark.



The soft glowing surface of transparent modules reacts to gestural stimulus by slowly changing colour ranges of their light emissions.

- 1. Stage
- 2. Seating
- 3. Media Room / Lounge
- 4. Technical Area
- 5. Storage Room
- 6. Bar
- 7. Backstage



Time Warp

Roger Lee
Yon Samat

Festival culture reflects the transformation of unregarded sites or space into catalysts for the celebration of Culture, Art and Music. 'TimeWarp' proceeds by producing a theatrical wormhole that acts as a collector of people and energy, by absorbing an audience through a darkened entrance. This initial concept is used as a metaphor for the design of a shell structure, with a sweeping gestural object that reveals no identity of the hidden space and time zones within.



R Pavilion

Yilun Zhang
Benjamin Elphinstone



Sited in one of Sydney's most significant urban parklands, 'R Pavilion' dissolves the curtain between the spectacle of theatrical performance and the city beyond. Similar to the ancient Greek theatre of Epidaurus, it appropriates its context as a backdrop in order to enliven the experience of the performance on stage. Importantly, the form also establishes a strong visual presence in its busy urban setting, and stands as an announcement of the life of the Festival for the entirety of its duration.

Operating with two distinct streams of programming, firstly the hosting featured stage shows of an evening and secondly a line up of Sydney's street performers throughout the day, 'R Pavilion' builds upon the ideas of accessibility and inclusion that exist as a core ethos of the Sydney Festival. With a schedule stretching from morning to late evening and being capable of hosting a variety of performance genres, ranging from single person stand up shows through to small theatrical and contemporary dance performances, the Hyde Park site emerges as not just an important place for the continuing success of the Festival but also as a vital location for Sydneysiders during summer.





The Spritz

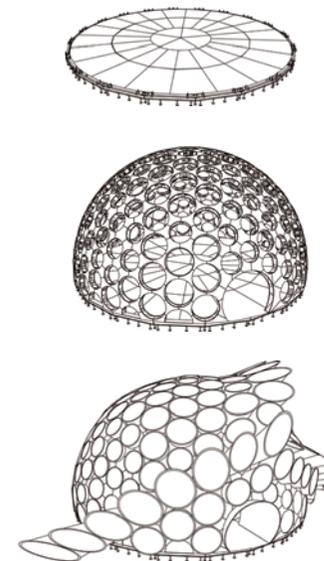
*Ivana Kuzmanovska
Rachel Couper*

The design of 'The Spritz' explores Foucault's idea that theatre is a heterotopia. Foucault proposes that a heterotopia is an 'other space', both real and unreal at the same time. Differing from utopias, which, by definition, can never be real, heterotopias have an immediacy, presenting one place and another place simultaneously. Like a display in a museum, for example, a heterotopia can be then and now. There and here. Real and fantasy. Foucault explains that theatres, fairs and festivals are heterotopias because they have the power to combine in a single real place, a series of different spaces and locations that are incompatible with each other.

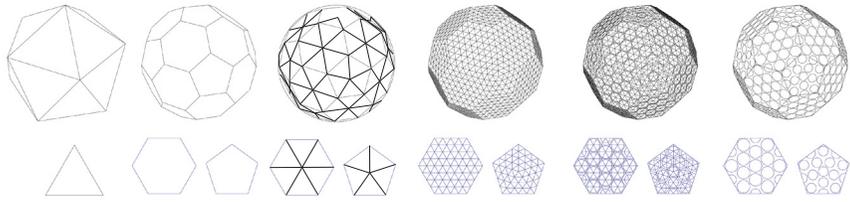
Theatre and performance are by nature ephemeral and transitory. They are time-bound, centring on the creation of a representational illusion for the audience, inviting them to temporarily suspend disbelief and lose themselves in the performance. The moment an audience loses their awareness that none of what they are witnessing is real is the moment the theatrical heterotopia comes alive, opening beyond its surface. Theatre's ability to transport an audience beyond their immediate reality is a key concept of the Spritz.

Foucault refers to the mirror and reflection as the key metaphor for heterotopia - it is reality and unreality simultaneously. An 'Other' world exists in the reflection of a mirror, but it is inaccessible: you can't touch it, you can't go there. 'The Spritz' explores this duality by rolling the reflective surface of a mirror into the continuous form of a cone and repeating it across a performance space. Reflection becomes a key mechanism for immersing an audience into the heterotopian environment of the theatre.

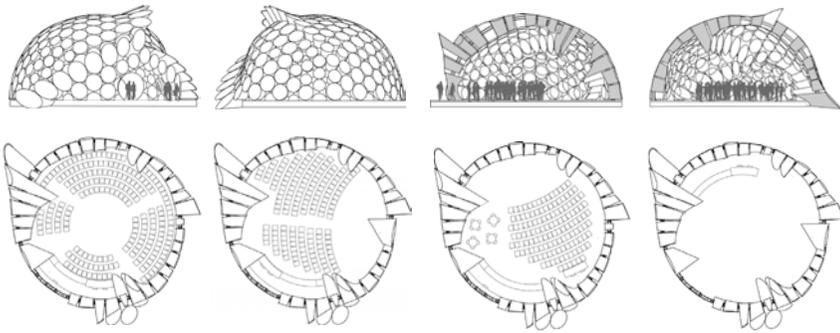
Kaleidoscopic reflections of reality, unreality, performance, self and the immediate create an other-space, a spectacle where anything is possible. Perceptions are challenged, expectations elevated and both the audience and the performers are primed to be transported beyond their reality, to lose themselves in the moment. The cones seem surreal, suspended in space, frozen in a moment. The reflections of reality shift and dance across the surface: temporary, fleeting, ephemeral, at once utopian and heterotopian.



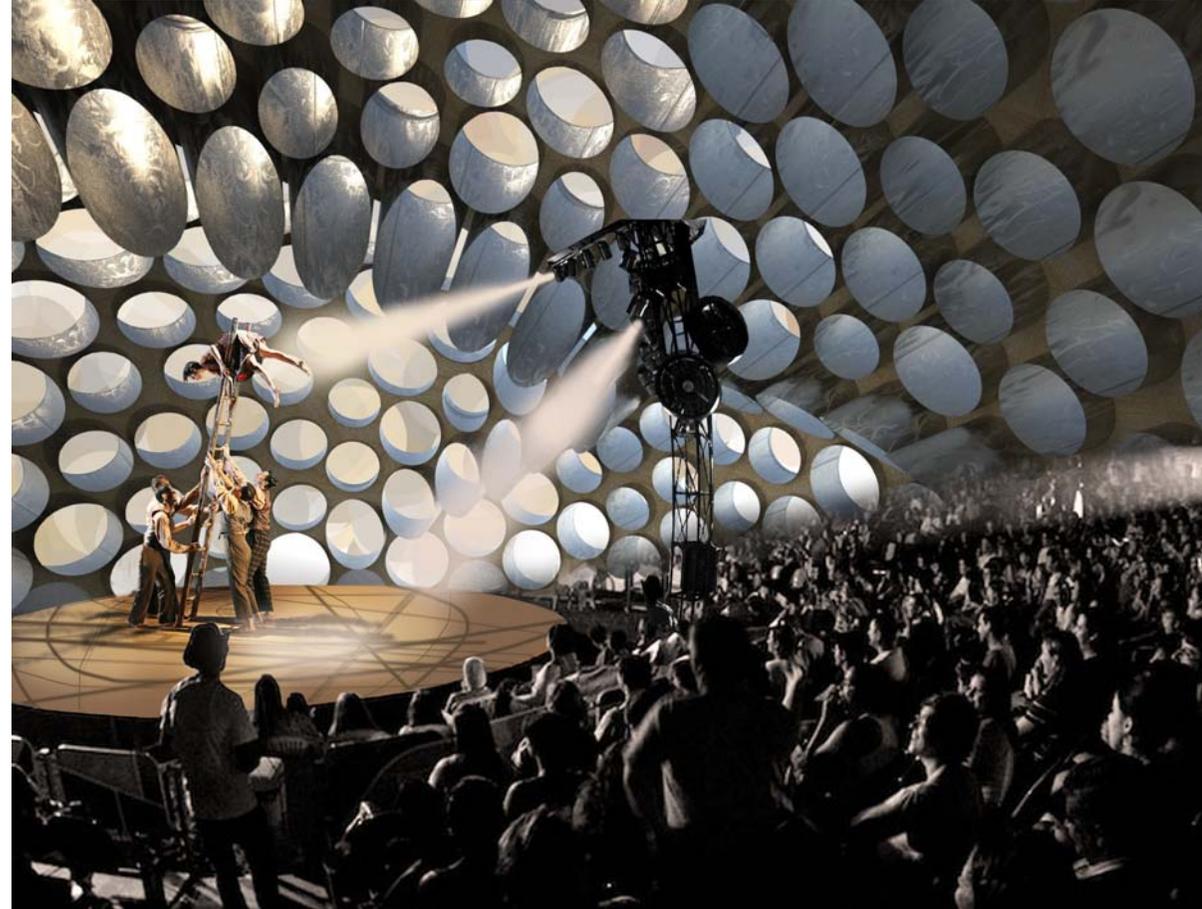
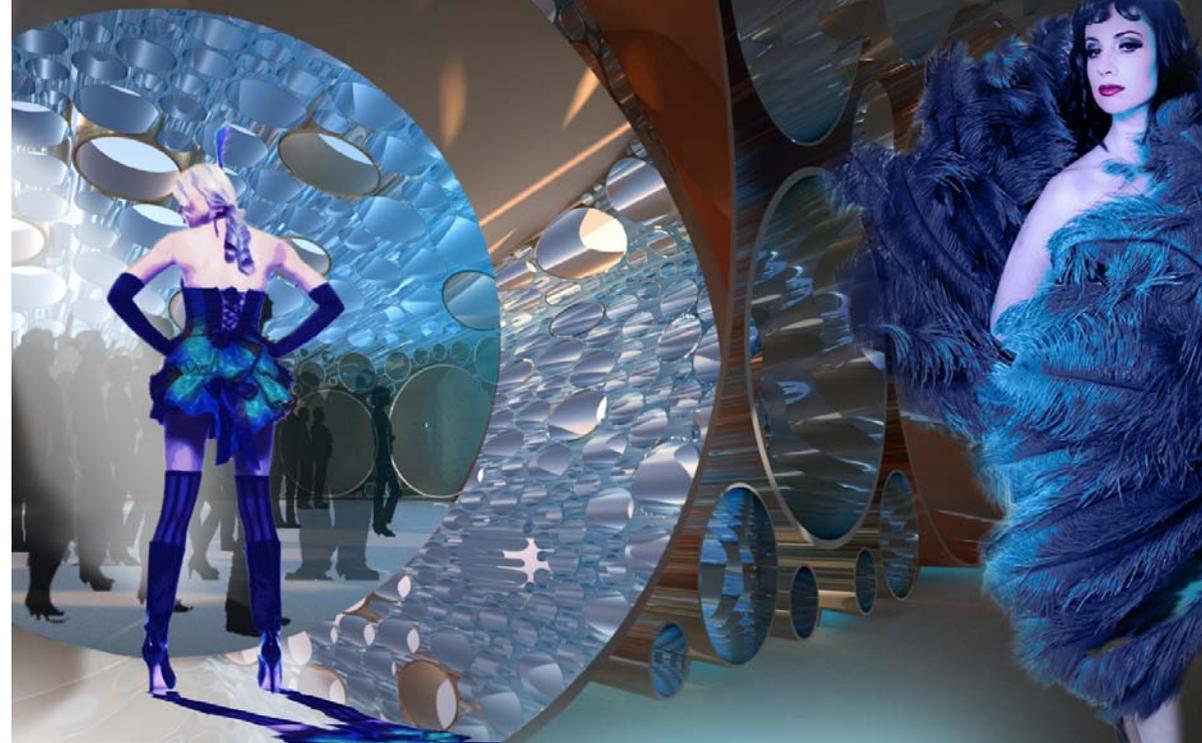
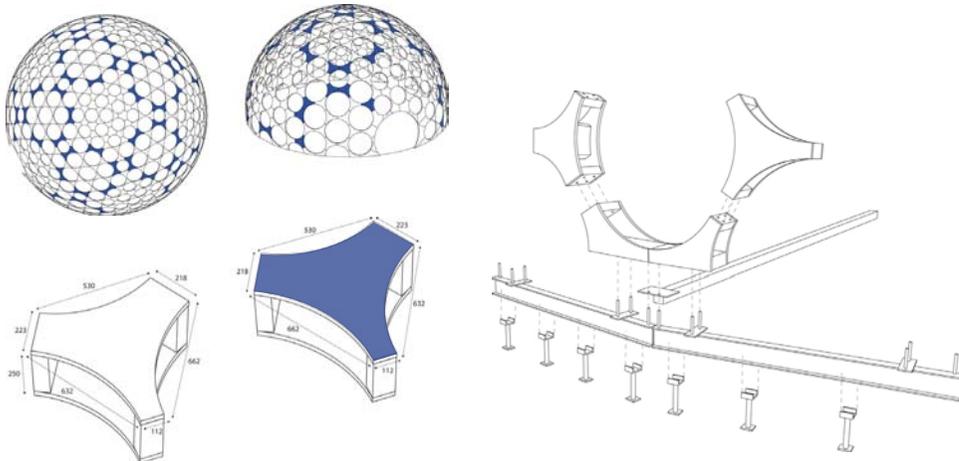
The Spritz is a modular structure, designed for quick construction, dismantling and transportation. The dome can be installed with or without the cones and caters for many different types of performances or uses.

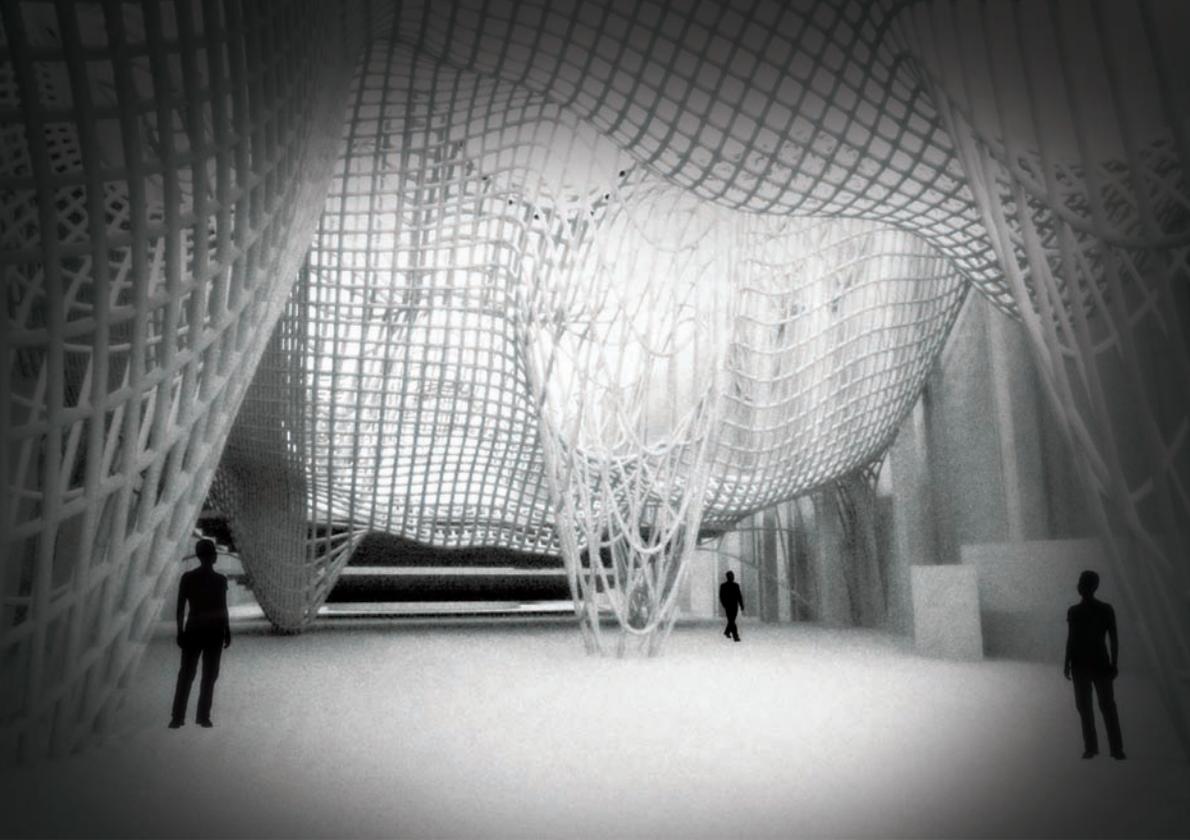


The diagrams above illustrate the way in which the geometry of *The Spritz* was derived from the icosahedron. The open plan of the dome, shown below, allows for a variety of seating arrangements to cater for different performance types.



The faceted dome of *The Spritz* is comprised of 11 flat modules plus door pieces. The joining edges of each module are slightly angled to create the double curve of the dome structure.





Generic Landscape

Ellen (Siyue) Sun

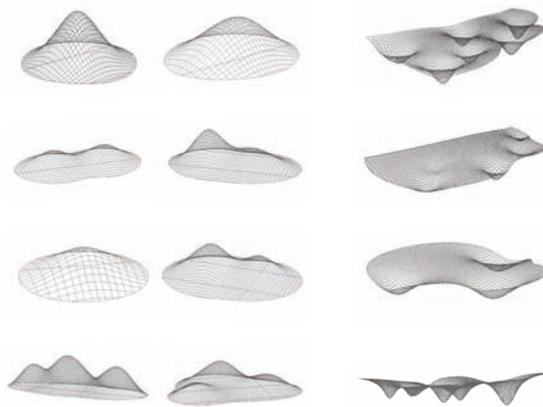
Chris (Se Ming) Ho

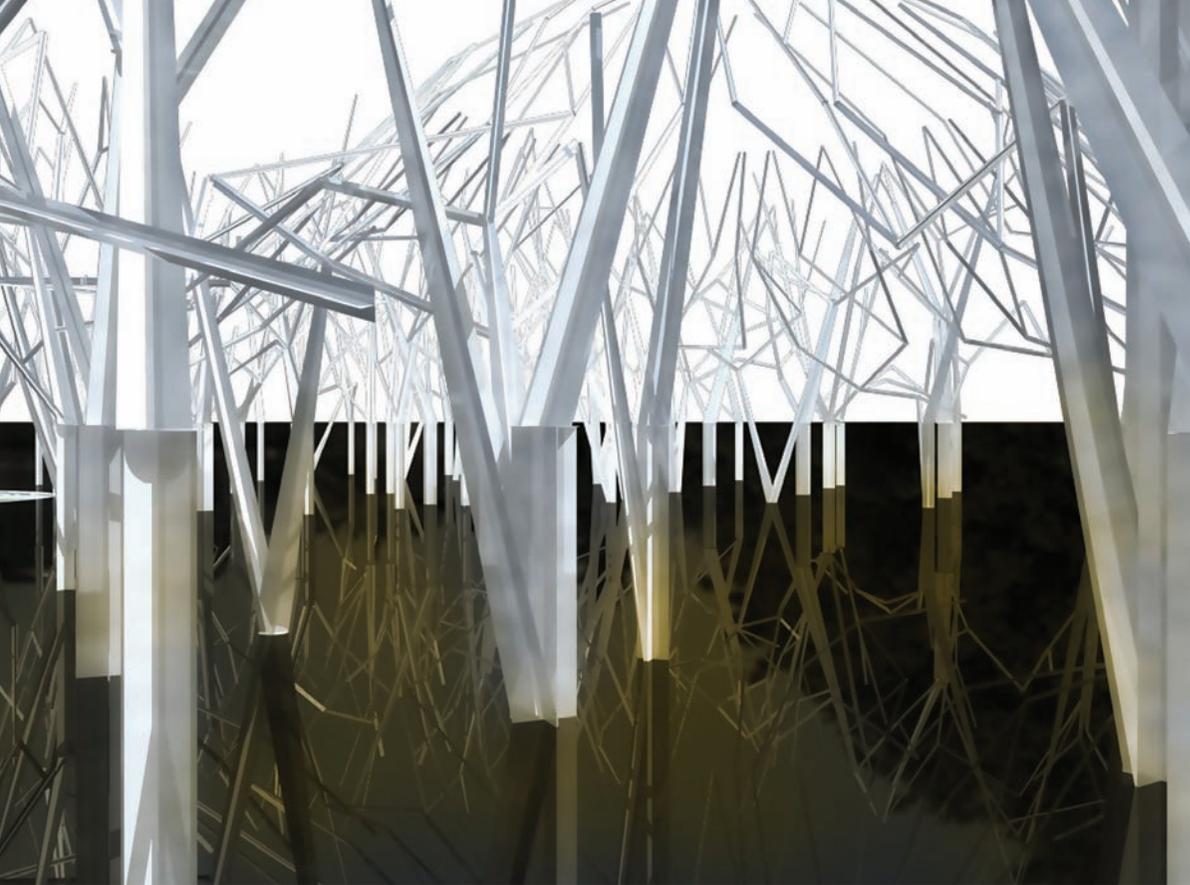
The concept for 'Generic Landscape' explores the transfer between the performer and the audience, represented in a landscape of clouds and mountains answering each other. While theatre is traditionally a space with defined zones and roles for both audience and performers, this project understands the performance as an interactive process. The Turbine Hall provides a blank canvas for an installation that transforms the vacant space into a vibrant performance environment by suggesting the concept of artificial nature. The design situates the audience in a twofold landscape topography that provides a stage able to address diverse forms of performance. The interaction between these landscapes, and the existent fabric of Turbine Hall, creates a specific spatial sensation for each area, transported by the energy of the audience perceptions and emotions in the theatre.

The project is realized by the deformation of a grid system on a surface; a huge mesh that covers the whole performance area and which supports sound and ambient intensification. The surface is generated through variations of control points on the surface, applied to both the ephemeral cloud and the more solid ground topography. The arrangement of the landscape is varied so as to create different settings for the foyer area according to the theatre program. The ground system is treated as a landscape system, which divides space into different program and usage. The ceiling system acts as a responsive surface to compress and amplify the spatial atmosphere corresponding to the landscape formation.



Through the variation of control points, surfaces are deformed to open typologies of inhabitable landscapes, or cloud formations. Different types of landscape are generated in related to different scales and programmatic requirements. In the foyer, the landscape is adopted for seating, at moments formulating an installation character, at other instances being explored and connected to the performance.





The Clearing

Phoebe Goodwin
Evan Gilchrist

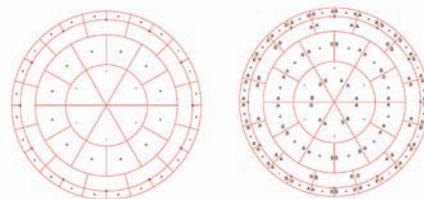
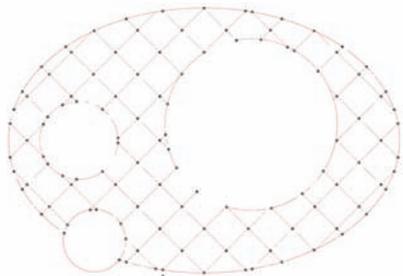
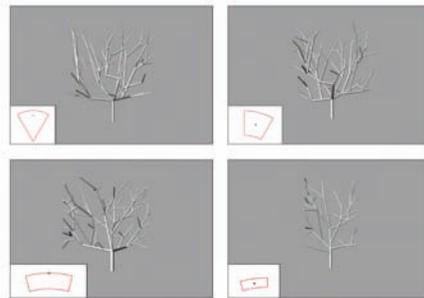
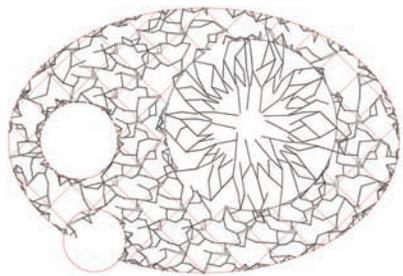
'The Clearing' seeks to create a building that draws on the immediate geographical context of the Festival Garden to derive a design aesthetic. It deploys a structural system of common modules modelled after Hyde Park's abundant growth of native Moreton Bay Fig trees, which create an intimate atmospheric volume of canopies formed by branches.

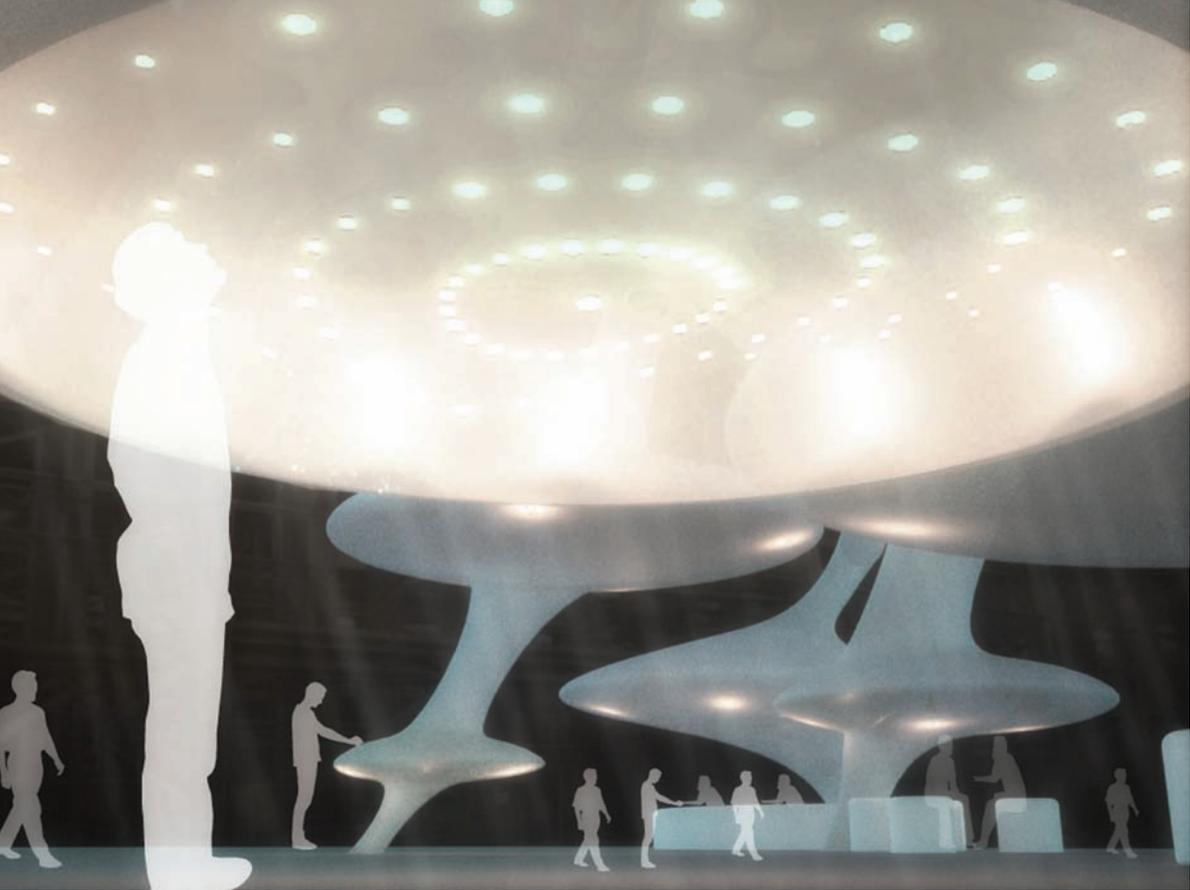
The design dismisses any stage or seating delineation. Instead, the architecture directly engages performances within, acting as scenery, thus blurring the boundaries to enable performances to overlap and occur amid the audience. To achieve this, the project uses a configuration of branching components. These lean structural members create layers of silhouettes that build up the appearance of a forest, and filter light. The modules are built up of steel segments, easily assembled off or on site. All architectural elements follow the form of these branching modules, forming a full forest enclosure, in which individual trees can no longer be visually separated by the spectators.

The central performance space is defined with an ETFE membrane dome roof supported by beams above the skin. This versatile space can also be used without the roof, exposing performances to the night sky. A secondary roofing system comprises stretching membranes supported by tensioned cables that are strung between certain anchor points on module members. This forms a faceted, non-waterproofed roof that allows for partial solar access and dripping rainwater below, simulating the forest canopy. 'The Clearing' uses a structure that is the primary aesthetic expression of its design process.



Different variations of branching systems were tested in the design process, modelled after generic L-systems. The final version deploys interconnected modules that create a deep space frame supported on a grid of columns, which provides a high levels of rigidity to the design. Only specific paths in the module formation are load bearing and form the base structure.





Seascape

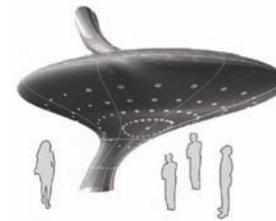
Connie (Cuiting) Zhang

Betty (Na) Jiang

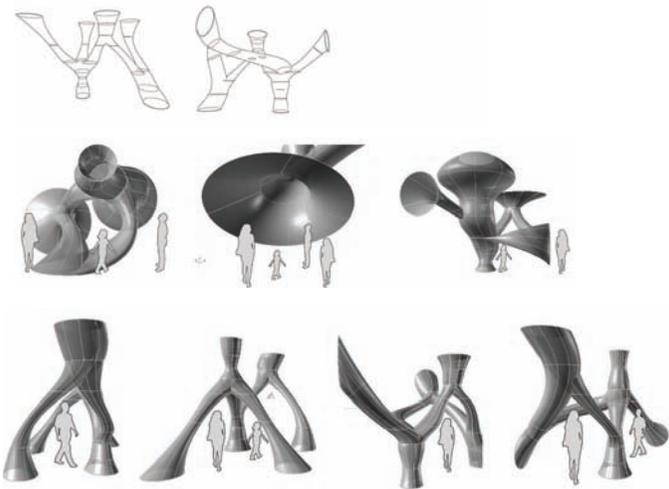
The eighteenth century theatre stage afforded lavish costumes, in an extraordinary and sustained elegance that both influenced and inspired European culture. Theatrical tastes at that time tended towards the spectacle and opulence, designed to please the masses. Repertory companies received loans for lavish costumes. Gorgeous costumes started to appear in ballet, opera, and dramatic offerings, with tight bodices and flared basque shirts, a variety of ingenious trimmings- embroideries, fringes, puffs and paddings, inlaid ornamental motifs, pastes, and semi-precious stones to punctuate every small part.

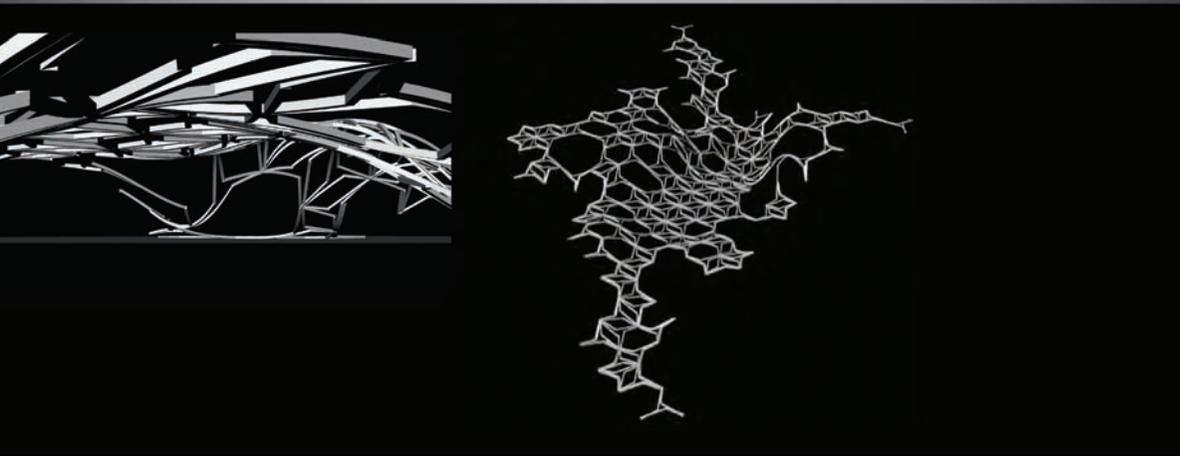
The project deploys a singular element of this fashion, the gesture of the female body transformed by a petticoat or underskirt. These items expanded the contour lines by a series of circular hoops that increase in diameter from the waist down, often to such an extent that moving became difficult. Soft textiles and the rigid framework of underlying steel structures form a body that exceeds traditional clothing garment, and becomes a spatial device.

'SeaScape' traces both the fashioning of bodies, and the way in which women in society present - or have been presented as - an imposing and ultra feminine spectacle. It transfers these techniques of forming the body towards forming a series of theatrical bodies that inhabit the Turbine Hall, creating an otherworldly, underwater sea in which such non-gravitational, luminescent bodies seem to float.



Soft textile bodies are inserted into the Turbine Hall, echoing its industriousness and co-acting with the existing structure. Their white fabric provides a blank canvas for projecting, thus providing different moods by varying intensities of light.

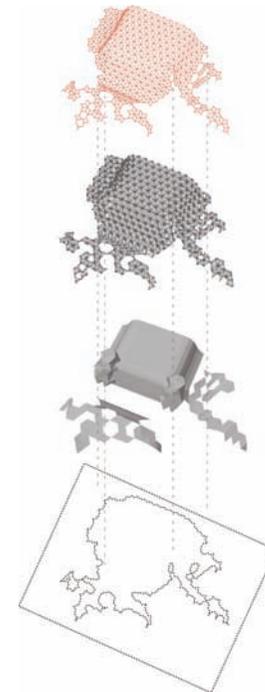




TriStar Autopoeisis

Tiffany Allan

Alice Chirculescu



'TriStar Theatre' explores the concept of Autopoeisis, a term that relates to the self-creation process by which a system generates and specifies its own organization and operation, by creating and maintaining, in a network of processes, the production of its own components. The project uses this system to investigate the influence of performance on architecture through a fluid movement occurring within a static environment.

Based on a pattern tessellation of a triangle (tristar) module, a tetrahedral pyramid without a base is organized forming a structurally efficient figure, commonly deployed in structural space grids and trusses. This three-dimensional module is then applied to a grid surface, in which it interlocks with other triangular modules. Essentially, the space grid allows for modules to be subtracted during construction, in order to vary the system behaviour and to achieve different performance spaces, hereby allowing a diversity of spatial organizations for theatre and performances. The resulting structural space grid frame transforms into a surface with different densities in structure.

Different densities could be derived from organizing the module in a dense hexagonal grid, or as an open, disjoint configuration, responsive to points of contact with the ground. Positioned as a structure within the landscape of the Festival Garden, the project offers an open, emergent formation in conjunction with existing vegetation, developing in and through different occupational zones and densities, and thus options of programming for the theatre.

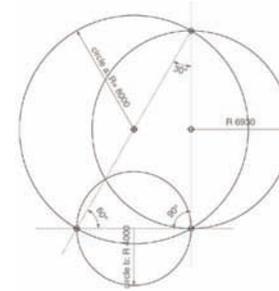
Three tripods form the structurally efficient volume of a triangle (1). The triangular module is then distributed over the surface field and forms the structural network of a hypergrid (2). Volumes for theatre and services are embedded, and several contact points within the module network are identified that anchor the structure to the garden context.



Through The Looking Glass

Natalie Miles
Ji Young Choi

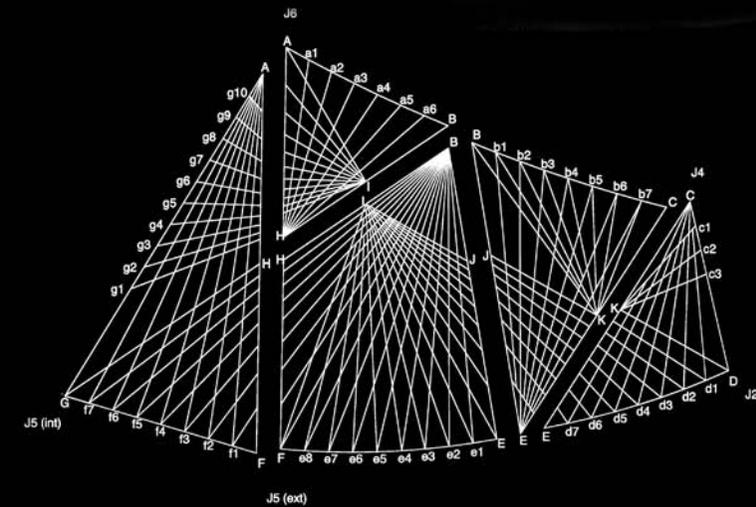
Within the site of the Festival Garden, 'Trough the Looking Glass' expresses a desire for an active, animated, and modern festival environment. Its mirrored interior façade is an instrument to enliven the area, and the city. The project complements its precedent, 'The Famous Spiegelent', by inverting the phenomenon of the mirrored façade. It evokes notions such as Carrolls 'Behind the Looking Glass' and Crystal Palaces of the 19th century. The design proposes a curtain made of multiple faceted mirrors that extends reflections from the interior towards the exterior garden, and so allows people to interact with the project. The fragmentation and distortion of the mirror plays with blurring the boundaries of reality and fiction, where spectators find themselves merged in the mirrored reflections of an ongoing performance.

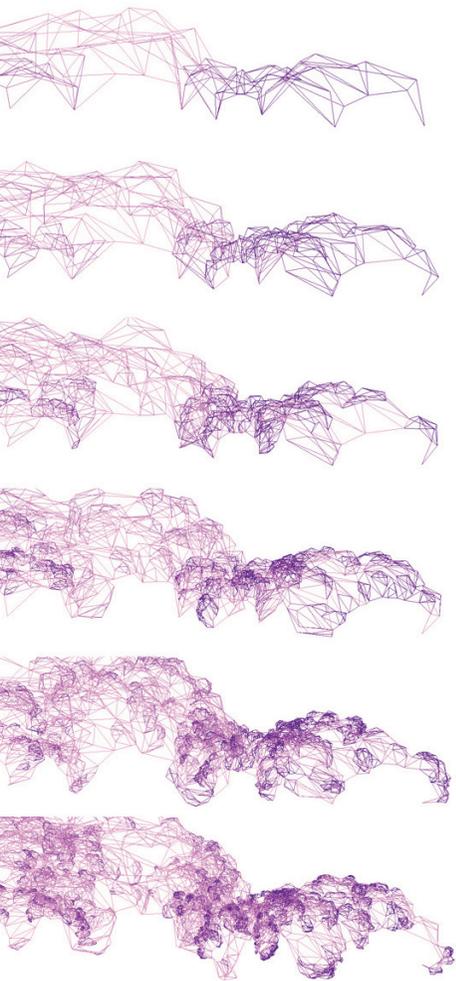


Three circular rings provide the main structural elements of the project, and are separated by slender vertical columns. The internal space adopts a flexible plan with movable elements, where various seating and utility arrangements can be made, similar to the programming of the Spiegelent. This flexibility also extends to the mirrored curtain, which can be moved to create an outdoor stage facing the Garden. The entire structure breaks up into single steel elements to be easily transported in one standard shipping container.



The mirror surface reflects the city back towards the public and the audience, creating a connection to place. The fragmentation and distortion within the mirror plays with blurring the boundaries reality and fiction - connecting and including the city with the ideals of theatre.





Recursive Mesh, UFO (Aus), 2009

Design by Code

Eduardo de Oliveira Barata, Dirk Anderson of Urban Future Organization (UFO)

In recent years there has been a distinct transformation within the teaching and practice of architecture that is the result of a new breed of digital tool sets, both of software and of hardware. The computer as seen within the design community is no longer used purely as a device for representation and delivery, but rather now implemented as a medium to conduct investigations of computation. This exploration has led to a new and unbiased understanding of architectural space and geometry, which permits a dynamic and adaptive interchange between concept, organization, structure, materiality and its resulting poetic space.

Scripting is a new frontier for the description of architecture. This narrative of space is not bound by the composition of subjective criteria; rather it is a product of qualified feedback through genetic, parametric multicriteria controls.

This text discusses a research of the history of digital exploration in relation to practice investigations that the office of Urban Future Organization (UFO) has undertaken: investigating the use of code and the act of scripting, from the idea of analogue scripting and rule based design logic to the implementation of code in built form.

A Context of Descriptive Geometries

Architecture emerges as a trace of algorithmic operations. Surprisingly enough, algorithms - deterministic in their form and abstract in their operations - challenge both design conventions and, perhaps even more surprisingly, some of our basic intuitions.¹

Practitioners and academics are revisiting rules from which the exploration of early computing began. Initially executed through command line sequences, operating systems and software rapidly moved towards a graphical user interface (GUI) with the intent of capturing the imagination of the general public. As early as the first GUI Sketchpad CAD program written in 1963, the graphical interface, although providing a simple abstracted method of drawing, pushed the computing tool away from the opportunity of generative, iterative and rule based design frameworks, thus reverting a traditional approach to composition and refinement.

Through a series of software adaptations over the last 10 years, the transference of commercial 'bloatware' to bespoke software culture has renewed interest in computational design. Contemporary architectural practices and educational institutions have rediscovered programming, providing a seismic shift from the use of computer-aided design (CAD) to computational design (CD).

Boundaries of analogue systematic study models (material systems) and deep simulation within code have now blurred as designers engage more freely with new sets of digital tools, bridging scripting, associative design frameworks and open-source community based resources.

In conceptual art the idea or concept is the most important aspect of the work. When an artist uses a conceptual form of art, it means that all of the planning and decisions are made beforehand and the execution is a perfunctory affair. The idea becomes a machine that makes the art.²

Computers have no intelligence but enormous calculating power. Humans ...have enormous intelligence but limited calculating power.³

CAD facilitated a generation of architects to optimise their workflow practice, resulting in efficient drawing production whilst enabling changes in design and documentation to become procedures of relative ease. Digital formats permitted a cross pollination of ideas between disciplines, by integrating design, fabrication and management software programs, thus elevating the awareness of each members focus within the industry.

Alias Maya and Autodesk's 3DStudioMax emerged in the 1990s as the animation industry's flagship packages introducing architects to an array of new, complex and hybrid forms. Approximations of autoplasmic forming, exploration of double curved and faceted geometry coupled with novel techniques of process and organization led to the beginning of a resurgence of calculus and mathematical based formations such as the generative surfaces of Karl Chu's 'X Phylum'.⁴

Documented in 'Non-Standard Architectures' (2003, exhibition and catalogue) were the industry's recurring interests in non-Cartesian geometry and parameter space.⁵ From Frederick Kiesler's prototypes of the 'Endless House', Frei Otto's experiments with material systems and the then leading works of Greg Lynn, deCOi and Lars Spuybroek, the exhibition teased out the repeating patterns of appeal and demise of such complex geometry over the

last 100 years. The descending waves of disinterest were seen due to particular bottlenecks in the process of articulation and realization of full-scale architectural proposals.

In 2003, the restraints were a combination of computing power paired with the nascent but confined digital fabrication methods. Although digital fabrication at the time was well beyond post-Fordism and already in mature development within the industrial design industry, it had not yet been tempered for the large-scale construction industry.

Currently, a new generation of digital practitioners, through the advent of hightech toolsets, have departed from the constraints of descriptive geometry and compositional representation to direct design methodologies dictated by relational and dynamic inputs. Software tools and increased computer processing power have also led to deeper investigations of natural systems and phenomena through simulation and algorithmic studies.

Such searches have produced new forms and smart materials whilst providing a greater understanding of complex organizations such as cities, network structures, agent behaviour, environmental feedback and simulated evolution. Bound with an ever improving integration of digital fabrication, this generation is at a cross roads whereby the use of such tools and techniques set out a different departure point in design. For a large proportion of contemporary hybrid practitioners, the sketch begins on the screen, in code.



Lace Bloom, UFO (Aus), 2009

An Introduction to Code

Ultimately what interests us about the parametric project is exactly what it excludes, the socio-political dimension of architecture. Parametrics' potential is to produce a hyper inclusive network of parameters and relationships - the more multivalent the object the more meaningful and complex it is. The more multivalent the object the more engaged it is in culture market and the more elusive it is to being absorbed by it.⁶

Design through an exploration of scripting has clarified the persistence to identify objectives that are not infused with a refinement of a singular formal composition but are primarily concerned with the search within process, organization, fabrication and assembly. Code allows for a development of rule sets to emerge during the schematic stage of design, which may be adjusted and repositioned as the intrinsic part of an evolutionary design process. Focus on such an analytical methodology seeks not only to document pre-existing

design nodal types or ancestral trees, but also provides an opportunity to investigate diffuse typologies of hybrid process and multi-material performance through a recombination of scripts and algorithms.

The potential of code goes beyond that of purely resolving solutions within geometry, structure and fabrication, but presents an opportunity of investigation which encompasses emotional and physical involvement of human and environmental interface that considers past, current and future strategies. Scenarios within code allow for the removal of preoccupation and uncertainty of intuition during the design phase, perhaps uncovering the subversive patterns of condition and underlying opportunities of concepts whilst integrating an immediate feedback device for the design process.

Qualified feedback can be used to assess a proposed design's fitness via environmental or programmatic testing through unbiased multi-criteria methodologies such as fluid dynamic simulations and energy analysis tools. An iterative search within the design process continues to promote the objective over the subjective qualification. This does not mean that the computer autonomously designs; rather it produces the designer's iterative concepts that can be evaluated against specified fitness criteria.

An introduction to design through scripting may seem like an overwhelming concept with thousands of different coding languages available to the programmer, from low-level machine code, which is comprised of registers, memory addresses and processor call stacks to the high-level languages which have abstracted details of the computer process in order to provide a large degree of flexibility and readability for the human programmer. Within the realm of the designer concerned with the generation of geometry, graphics and interface, languages quite frequently used consist of Net(C#/Visual Basic), Java and the currently popular Python whose design philosophy 'emphasizes code readability' aims to make it easier for the non-programmer to immerse themselves in the process of object oriented design. Languages vary between low to high-level, yet all are executed using the same procedure for different levels of flexibility, legibility and relaxation of syntax.

Machine Code (Binary)

```
01000100 01101001 01101101 00100000 01100001 01110010
01110010 01010011 01110100 01100001 01110010 01110100
00101100 00100000 01100001 01110010 01110010
01000101 01101110 01100100 00001010 01100001 01110010
```

Rhinoscript Python

```
import rhinoscriptsyntax as rs
start = rs.GetPoint("Start of line")
if start:
end = rs.GetPoint("End of line")
if end: rs.AddLine(start,end)
```

Rhinoscript VB

```
Dim arrStart, arrEnd
arrStart = Rhino.GetPoint("Start of line")
If IsArray(arrStart) Then
arrEnd = Rhino.GetPoint("End of line")
If IsArray(arrEnd) Then
Rhino.AddLine arrStart, arrEnd
End If
End If
```

Teaching students thinking by code as a new design methodology may be challenging, yet there are a number of conducive steps that may guide students through practical analogue tasks and references that accelerate the understanding of rule based design. A lead-in to design by code may come from familiarisation with every-day processes of scripting, from

interpreting a film or theatre screenplay, the breaking down of an instruction manual or the mapping of a simple board-game rule set. In the following, a number of codes are described that relate to new avenues of design thinking:

- Analogue Code

As a more immediate reading of rule based design, the analysis of structural organizations within material systems uncovers logical patterns that can be mapped and translated to a set of diagrams that deal with vectors, force and relationships. For example, the blowing of soap bubbles produces varying degrees of formal topology, scale or boundary conditions due to initial parameters of air pressure, viscosity of liquid, aperture layout and other influencing factors. Such an examination of rule based systems within analogue models forms a precursor to understanding parametric models, leading to the understanding of relationships between geometry and affecting agents which drive much of the object oriented scripts that contemporary architects develop. Other analogue codes may be exercised as folding, stacking, variations of contouring, moulding, lattice and component assembly, and follow simple rule sets by which a clear understanding of the overall system can be attained.

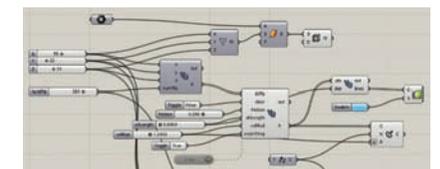
- Visual Scripting

Scripting within the CAD environment was propelled with the development of Bentley's Generative Components (GC) and Dassault Systems Digital Project (DP), both of which developed primitive graphical interfaces. Though obscure in operating process, and with a lack of community support or documentation of any manuals, the software was only digestible by those familiar with some sort of coding experience, therefore

excluding the larger design community from really grasping the potential of the techniques. With a more intuitive visual scripting style of operation, Robert McNeel and Associates Grasshopper3D allowed any level of user to pick up the program and immediately understand the power in the relationships between data, geometry and transformations. The ability to drop components and parameters on a digital canvas and connect each element in order to produce a combination of both volatile and persistent data results in designers gaining a basic yet quick understanding of parametric logic - the visual style of scripting.

- Serial Macros

A first step in digital coding would be to apply a sequential script that executes one line after another. This organisation of script is called a *Macro* and usually is called to execute repetitive automated tasks such as adding new primitive geometry into a modelling environment.



Auto Organization - Grasshopper Definition, UFO (Aus), 2010

- Script Flow

Once the process of text based instruction is understood, the next step is to familiarise oneself with ways to control the flow of scripts, primarily through the inclusion of loops and conditionals. Loops repeat the same steps but usually change one value of a variable each time the sequence of code is looped. For example - if one was to create a chair object into the scene, a loop of 10 repeats could be used to iterate rotations, scales and move transformations on each new chair populated, e.g. copy chair in x direction by i when the value of i is incremented by 1 per loop move (0,1,2,3,4,5...) until the count stops after 10 cycles.

Conditionals are a method of checking on the value of a variable. We may use a conditional to see whether the count value of the variable i is an odd or even number. If $i \text{ Mod } 2$ (when i is divided by 2, will there be a remainder?) - in this case, the conditional would either carry out additional code if the condition is true, otherwise do something else or nothing at all. Script flow becomes powerful when responding to site specific or programmatic information. An example may be the scale or thickness of tube elements that make up a ceiling structure. If the tubes locations are closer to zones in a theatre that require more or less sunlight, locations for light rigging or prop positioning, they can respond accordingly and vary the aperture size of packed elements.

- Adding Features

Starting with primitive operations of with one dimensional points, comprehending the characteristics of its particular class unravels all the operations that can be performed on or with this particular geometry. Moving through each geometry

subsequently reveals the relationships that each has with one another (point > curve > surface > solid) when building or extracting from each class. Writing the first function or subroutine provides an insight into an economy of scripting through succinctly packaging loops of code that can be called or reused during any part of the script. These reside outside of the main body of code and do not perform any operation until they have been called to execute their specific lines.

- Classification, Organization, Reuse, Recombination

Both Subs and Functions work towards developing a system of classification through the breaking down of script into simpler more specific chunks of code. This sets up a practice of categorising of performance based scripts that can be packaged and catalogued within a library of code. Organised code promotes the effective reuse and recombination of code. Within this level of practising code, emerges the opportunity to produce indeterminate outcomes of design. This is achieved through the concatenation and mashing up of functions, subroutines and conditionals - generative design.

- Open Source Code

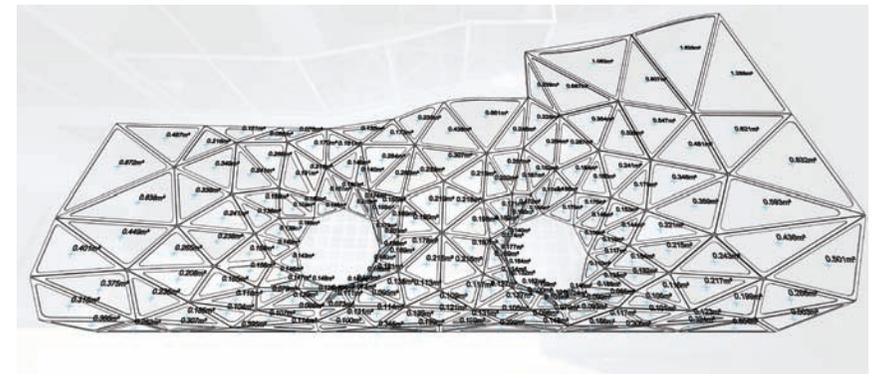
The concept of open source has been around since the beginning of civilization; take the sharing of a cooking recipe for example, something that has had multiple revisions for millennia. However, open source coding differs due to the multi-layered interoperation, accessibility, expedient recombination and qualified revision of ideas and rule sets. The acceleration of coding culture, primarily due to online forums, workshops, repositories

and symposiums has produced a digital society of collaborating open source-material, blueprints and libraries of code and functions. The manner in which the programming design community operates is not one of secrecy or exclusivity, of sole design or authorship. Forums clustered around specific software and plug-ins has become the international destination for designers sharing code whilst helping others with the development of code is of high priority. The 'Grasshopper3d.com' forum is an example of one of the predominant online resources which has not only allowed for the development of the graphical algorithmic editor plug-in for the Rhino 3D software tool but, has indeed changed the computational design landscape forever, with the abundance of published code, resultant forms or solutions

to specific problems - accelerating the culture of cutting-edge design within the industry. The digital realm has become more accessible, open, sophisticated, highly integrated, and generally ubiquitous within diverse practices, changing design procedures from the bottom up.

Designers learn not just through experience but also largely via the implicit knowledge of others. The interpretation, dissection and re-development of pre-existing code provide a dynamic gene pool of ideas that are readily digested, recombined and re-presented to the larger community.

Code, its language and formatted structure, make the perfect framework for the social interaction of ideas through a standardization of syntax.



Minimal Tension Canopy, UFO (Aus), 2010

Practice of Code

The onset of computation has, however, offered us the chance not only to reconnect architecture with geometry and pursue the possibilities of non-Euclidean geometries, but also to realise the opportunities that other branches of mathematics, such as calculus and algorithms, afford. This places an important emphasis on looking beneath the surface, providing architects with a fuller understanding of the processes and software that they use and solving problems from the baseline.⁷

The architectural practice of Urban Future (UFO) undertakes research on code and scripting by exploring practice-oriented design and teaching design via scripting techniques that seek to identify a universal language of code assembly. Beyond the aforementioned serial progression of macrocode that executes one line after another, the practice researches a scripting language that introduces loops, conditional statements and other forms of controlling the flow of construction in the development process. UFO is specifically interested in Descriptive Code, a scripting language that has the ability to become a basis for classifying spatial forms and structural typologies, so as to enhance the discussion of specific project limitations and economical procedures. In the following, different phases of scripting applications are discussed.

As part of generative geometries, UFO uses self-organised particle systems bound by network principles, which have the ability to determine the constraint of site conditions (such as boundary locations) and lighting requirements. This can be informed by, for example, a compression structure based on Hooke's Law of Elasticity that states the extension of a spring is in direct proportion with the load applied to it. When combined with the two-dimensional topological network that the particle system acts under, a simulation can result in a series of self-forming three-dimensional catenary arches.

Equally, lightweight, self-supporting and adaptive deployable structures can be used to investigate core principles of minimal surfaces, such as tensegrities and geodesics. Structural logic of gravity and force distribution within these formal organizations can be embedded within a parametric model whilst employing the formal aesthetic of isostatic surfaces.

Initial parametric sketch models allow for the unfolding of multiple spaces from a structural matrix whilst other parameters such as member density and node force can provide feedback on material lengths and structural performance.

Following the phase of generative geometries, scripting is deployed for design optimizations. Here, performance based algorithms can be written to optimise structural and patterning systems. Structural revision can gradually reduce the thickness of members towards the periphery, which can produce effects of light to shade as apertures vary from edge to edge of a network.

Maximum structural lengths, membrane offsets, membrane stretch and clash detection can be implemented as coded subroutines optimised for the organization and construction of structures. Clash detection and permutation scripts can be written in order to optimise entire structures demonstrating the power in scripting and parametrics and exhibiting the level importance that these techniques carry when faced with complex problem solving.

In a phase of fabrication, scripts are written to score part numbers, locations and angle values can be automatically generated and tagged to each element. Data can be read as simple instructions for fabricators and installers to understand how elements are associated and assembles with respect to neighbouring parts.

Unfolding scripts, orientation functions and nested part arrangements allow for minimising material wastage and reduce workflow. These functions are not only useful to reduce errors during the process but most importantly update the entire process if at some stage the design is altered either in form, part complexity or materiality.

Conclusion

The new breed of digital scripting tools which have been introduced into both the teaching and practice of architecture has allowed for the reintroduction of design through computational and mathematical based form rather than through devices that act as a refined extension to the pen and an optimized delivery system.

Implementation of code as a design basis has allowed for greater control and understanding of the space and geometry that is required resulting in robust interchanges between concept, organization, structure and materiality. The resulting quality of space can therefore be manipulated artificially and dynamically and furthermore through an iterative design process that can evolve a better-suited organization of space over a number of virtual generations.

We are entering a new age of consistency through digital frameworks that are enabling an enlightened exploration of new typologies of parameter space. Design through relational values rather than compositional aesthetics is leading the practice of spacemaking into an exciting and new territory devoid of past preconceptions, and into unknown frontiers of generative architecture.

Notes

- [1] Ingeborg Rocker, *AD Programming Culture* (Chichester, UK: Wiley Academy, 2006).
- [2] Sol LeWitt, *Paragraphs on Conceptual Art* (1967), http://ddooss.org/articulos/jdiomas/Sol_Lewitt.htm, access date 04.12.2011.
- [3] Chris Williams, "Digital Tectonics", in: Neil Leach, *Design By Algorithm* (Chichester, UK: Wiley Academy 2004).
- [4] Karl S Chu, *X Phylum* (Domus no.822 January 2000), 42-45.
- [5] *Non Standard Architectures* (Paris:Centre Pompidou, 2003).
- [6] Michael Meredith (ed.), *From Control to Design: Parametric/Algorithmic Architecture* (New York: Actar 2008).
- [7] Helen Castle (ed.), *The Mathematics of Space* (Chichester, UK: Wiley Academy, 2011), editorial.

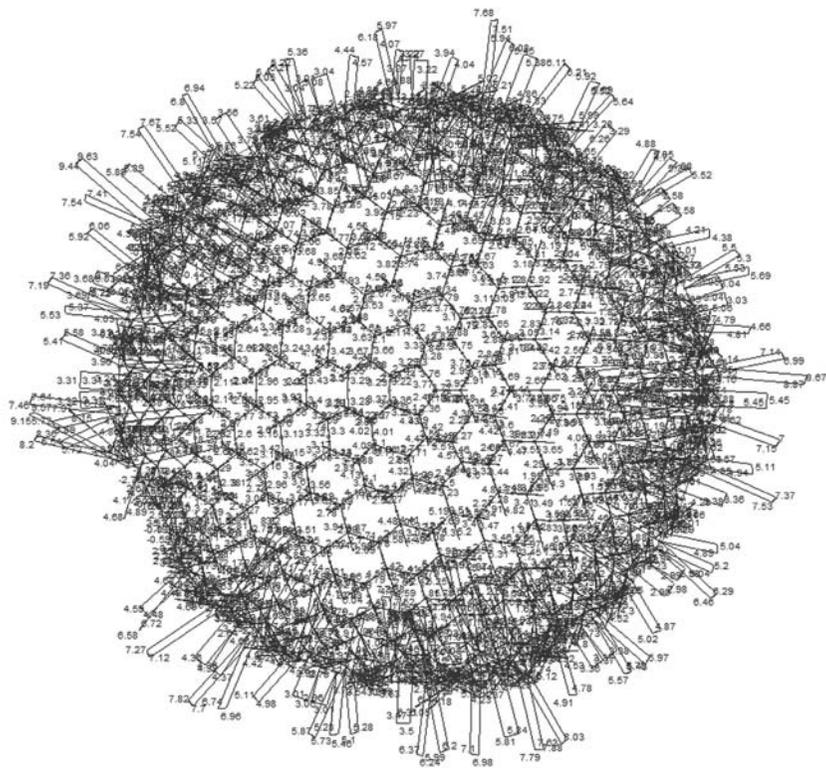
SAAC Hub, *Design Iterations, UFO (Aus), 2011*



Towards a Unified Approach

Design and Analysis between Architects and Structural Engineers

Harry Partridge and Dagmar Reinhardt



Engineering and theatre share the performance of structures, or the structure of performances. Both develop within a framework that allows interpretations as much as variations. The following essay reflects on generic principles of self-forming organisations, the new tools in engineering, and software as a platform of design and analysis.

It investigates the position of engineers and architects, their designing together, and traces a way in which architectural design can be enhanced through case studies that inform the digital design process, and allow for shared design conversations at an early stage in project development.

Structural design and analysis are typically regarded as a domain specific to a particular type of individual, a cross between an academic and a builder; a logical thinker who is good with formulae and calculations, in short: a professional engineer. But this is not always the case. The best engineers may be those engineers who do not resort to calculations, who do not need the support of mathematics, but who can see into the heart of a structure; who can see the forces of nature at work: and who also can reflect on the behaviour and performance of the materials (in all their varying shapes) in resisting these forces.

Yet most importantly, the special ability of 'seeing' is not confined to engineers trained specifically for that knowledge. Most people, in fact, possess a natural ability to both see and 'feel' a structure and its applied forces. All of us resist the force of gravity from the moment we get out of bed each morning until we lie down again at night. Our bodies are constantly aware of this force, answering a need that keeps us balanced and upright by the continuous exercising of dozens of fine muscular motors. If we can be attentive, this will teach us all we need to know about gravity. We have been learning this since the day of our birth (and probably before). We know what it's like to fall out of a tree; we have seen how far we can throw a ball; we have measured our strength to that of gravity countless times. So we inherently know much more than think; we are all engineers, in the sense that deep within us we understand the force of gravity. The question is then, how can we connect our bodily knowledge to the design work we are undertaking?

Self-forming Processes: Structural Design

Self-forming processes or formations that respond to forces have been a shared interest between engineering and architecture. Design models that investigate complex rules of structure or self-formation have a history of invention (Antonio Gaudi, Frei Otto, Frederick Kiesler) and continuation (Lars Spuybroek, Greg Lynn, UN Studio).¹ In *Experiments: Form, Force, Mass* (1960), Otto describes a series of structural tests that are modelled according to natural phenomena, which explore the effects of forces on form.² These early design models were defined by boundary conditions specified in the process of design. They delivered visual evidence of force flows within, or prompted towards, the structures, providing analytical descriptions. These tangible, explorative experiments contribute to a design that anticipates a projected reality. In a sense, these models forecast computational analysis and design techniques: in contemporary parametric and algorithmic design methods, rules, parameters, fitness criteria become the design drivers of object formations.

There is a fundamental interrelation between the form of a structure, the forces which act during its creation, or which it transmits, and the mass required to fulfil this structural task, without primarily aiming to find a direct application in the field of architecture. This comprehensive involvement with self-forming processes, result in greater knowledge of forms, structures and the processes, which lead to their development. In addition to providing an analytical description of the structures found in all fields of nature and technology, this can mainly be used in the synthesizing activity of designing.³

The key concern here is a shift from architectural language or typology towards the immediacy of materiality reacting to contextual impact, within controlled boundary conditions. Deformations are organised according to rule sets that differentiate relationships between form, mass and force in degrees. Stressed systems generally tend to optimise themselves, so through the materiality of these systems, and depending on strength, grid or pattern densities, a number of different behaviours and responses (in terms of stability and expansion) can be observed, and calibrated.

More importantly though, Otto's investigations build on universal principles where structure is constituted in a 'self-forming process' that follows general (universal) principles, rules, and parameter sets. Form is thus addressed as structural object that follows the internal rules and external forces that shape its generation.

These principles in a sense illustrate transformative design systems such as algorithmic and parametric design, because form develops in response to a generative process. An analogue (physical) modelling allows the intuitive control of the project through the designer, which can then be rationalised by translating the principles into a 3D modelling environment. Structural forms exemplify the physical result of forces and alterations, and reveal a 'behaviour' of the model in process, acting on boundary conditions and threshold criteria. Between principle analogue modelling of self-forming objects and the transfer to parametric design resides thus a generative design process: a process of design (boundaries), and process of self-generation (object), in which architecture and engineering seamlessly interact.

Digital Tools: Structural Engineering in Teaching Architecture

Teaching architectural students approaches to structural engineering might therefore entail encouraging them to work with generative rules that form the base condition for structures from the start of the design. Firstly, through modelling intuitively in structural experiments, and secondly, by learning to listen to their own bodies, to trust the memories stored in their own muscular frames and to pursue this in their design approach of sizing building elements. In research and studio, transformative processes can thus become interactions between designer, material structure, technology and user: through gestural traces, the impact of hands and tools, or as a deformation of geometrically generated objects. This approach also explores different planning methods: from the architect as inventor, to the architect as a participant developing rules in an experimental process. The design process is then interactive and emergent, a continuous development between the designer, and a number of instruments, software tools, or other design machines.

An initial component of the Sydney Festival project 2012 required students to engage with design concepts in an analogue modelling exercise that reviewed typologies of formative processes and temporary, performative, adaptive or reflexive behaviour of a structural system. As an introduction to self-forming structures, Otto's research was introduced, in order to start the project with structural requirements, behaviour and a set of principles or rules.

These specific structural approaches for surfaces and objects under gravitational forces included rigid frames, space frames, geodesic domes, lattices, self-supporting shells, tensile structures (membranes), modules, and composite systems (Fig 1). The formations responded to forces by torsion (twisting), by compression (buckling), or overall sway (stability). The interaction with such a dynamic, hands-on model was a revelation to many students. To be given permission to 'man-handle' their models (rather than regard them as semi-precious objects) enabled students to comprehend the behaviour of their variously shaped and joined members.

These initial work sessions thus allowed architectural students to understand – perhaps for the first time – the concepts of bracing, torsion, slenderness and P-delta effects. More importantly, this knowledge was generated through actual experience, within their bodies rather than by using traditional engineering terminology. For the second stage, the translation of these analogue systems into the three-dimensional environment of digital modelling and scripting proved a challenge: to equally simulate rules of behaviour required both understanding and application of the procedural logic that informs the structure and construction of forms.

Rules and generative principles become here the shared language between architects and engineers, and start to bridge a previous gap between the professions. 3D modelling and parametric design packages are tools shared between engineering and architecture, and achieve their optimum efficiency and results when they are used simultaneously by both disciplines. They form a solid bridge that overcomes a development of a historical division between engineers and architects.

At the height of the industrial revolution, architecture and engineering were essentially the same profession of the ‘Master Builder’. However, the introduction of building materials such as steel and concrete required specialisation due to their more complex characteristics and behaviours in the late 19th century. Consequently, the application of steel enabled the construction of skyscrapers, but also required a greater degree of mathematical calculation and certification for public safety. Thus were born structural engineers. This situation has remained relatively constant for a century, and has been reinforced due to generations of graduates in both professions following a specialised curriculum.

Yet with advanced computational software, the gap between professions starts to close in a digital environment that establishes a joint platform between the 3D modelling of structures, and their calculation. These include various design, calculation and form-generating programs, such as parametric design (generative components), automotive design (Maya); form-fitting programs (McNeelRhino); scripting programs (Grasshopper3D) and evolutionary programs (Galapagos), all of which can be linked to structural analysis software, such as SpaceGass, or R-Stab, or StrandZ.

In a contemporary engineering practice, these different computational tools are connected together so as to allow addressing an architectural design from different angles of expertise, changing fitness criteria from aesthetic design to structural analysis to manufacturing processes. That is to say, design is the result of an interactive analysis loop, guided by both the parametric rules of the architect and the stress-strain limitations of the engineer, working together to produce numerous solutions.⁴ Each solution is then again measured against more specified ‘fit-for-purpose’ criteria and either rejected or allowed to pass into further self-improvement looping. In this way, evolutions begin to emerge after numerous generations of analysis, where generations breed with generations, mutant solutions are proposed and either accepted as a leap forward to a newer and better type (solution), or are discarded as being unfit.

This methodology establishes a major advancement in the field of design, specifically in the interaction between architects and engineers who are no longer bound to rectilinear geometry, neither in creative thinking nor in the desire for simplistic, upper-bound solutions. Free-form, three-dimensional analytic solutions can now be passed directly to the fabrication process for manufacture and assembly. New CNC milling machinery and laser cutters receive their instructions directly from the virtual solution, and deliver the real solution.

Case Studies: Structural Analysis for Theatre Projects

While structural explorations have in recent years increasingly become part of a design curriculum (see the Design Labs of AADRL, or Achim Menges, Michael Weinstock),⁵ an interlinkage between analogue modelling of structure, the consecutive paraphrasing through parametric design, and the transfer to engineering software have not yet been widely explored. The Digital Architectural Research Studio of the University of Sydney, following the structural investigations, thus asked students to translate their generative forms into 3D (McNeel Rhinoceros), and to develop variations by parametric modelling (Grasshopper). The initial structures students suggested were very varied, and adopted mainly one simple structural principle – tension cables, compression domes, simple beam bending, complex beam bending and a combination of these. While an initial difficulty lay in identifying which principles were predominant and how to best utilise these within an architectural form and context, students were quick to recognise structural principles and force paths, and addressed how they might use, express or bypass principles of structural systems.

Based on the self-forming exercise and the parallel or consecutive 3D modelling, structural advice was given on the principle structural approaches. Students submitted their 3D modelling data (Rhino) to the engineering office of Partridge and Partners, which were then transferred to SpaceGass and R-Stab.⁶ While no full evolutionary design process by Galapagos was undertaken, these Rhino models were directly imported to the structural packages, which allowed simple and immediate information to enable structural sizing and rationalisation of the member junctions and arrangements.

The design protocol applied here developed in phases:

- self-forming processes developed between architecture and engineering
- inserted into an academic environment as structural analogue modelling exercises
- introduced as parametric design logic to digital architecture design
- continued as transfers to structural engineering
- explored and analysed as load paths.

A number of projects will be discussed in the following that are case studies of generic structural principles:

- Series of Catenary Arches
- Dome Structure by Circle Packaging
- Minimal Tension Surface
- Hypergrid formed by Triangular Packaging

A Series of Catenary Arches

(Project: *Dolve and Heude*)

The project builds up structurally by a decreasing series of arches built from different member parts and materials combined: each individual in dimensioning, and consisting of a curved portal frame supported on four steel legs that partially interlock; interweaving between the archways; and a fabric membrane that connects the field of arches into a singular roof (Fig 1).

The basic structure follows the logic of arches (a structural exploration that resembles Otto's analysis of Catenary arches). In the structural analysis, bending moments are shown for a deformation by wind load (Fig 2). The two dual rafter members split into their individual circular members to form the four supporting legs.

The curved members are designed as dual circular hollow aluminium sections separated by a vertical plate of varying depth, with a maximum of 6m to the roof. This allows a simple way to achieve increased bending moment capacity in the centre of the span. Because of the weight distribution that occurs from the main beams to the eight legs, the punching stress at each foot is divided by four. As a consequence, no footage is needed. This fact complies with the requirements of the Heritage restrictions where no footing is permitted.

The inter-weaving between the arch members is based on the structural tube being drilled to enable the threads to go through the structure. Drilling points are 8mm in diameter, the minimum drilling section that still permits the galvanisation of the tubes without blocking the drill holes. To minimise the assembly process on site,

parts of the structure can be woven before installing them. The pair of tubes with the weaving weighs about 44 kilograms and can therefore be lifted by two people. For transportation concerns, the extruded tubes are split into 5 parts, which do not exceed 8 meters each. The rods are galvanised and have a diameter of 120mm. At the junction between the arches and the beginning of the roof, a node is placed for 2 purposes: firstly, it strengthens the structure as a whole, and secondly it provides a support for a light at every node. The tensile fabric fixation system takes its technology from sailing gear: the textile fabric slides in between the main structure using a full batten system, on a rail.

The structural analysis calculated the response to climatic influences (wind load) in a sheltered environment; the enclosure of the Main Quadrangle at the University of Sydney. The calculation of the bending moment informed both aesthetic design choices (the degree of curvature for arches) and selection of material (hollow tubes) to be driven by stress requirements rather than to remain oblique to real-time affordances.

A Dome Structure by Circle Packaging

(Project: Couper and Kuzmanovska)

The Spritz project is a 'porous' dome structure with sheet metal cones. The project contains four levels of member parts: a steel sub-floor with beams and joints (adjusted to existing topography); the timber panel system with parquet flooring; the timber modular structure unit; and galvanised steel cones (rolled sheet) and Perspex weatherproofing caps.

The form of the design is based on a half-sphere - a four frequency truncated icosahedron - and manipulations to its

surface (Fig 3). Its span is approximately 15m in diameter, with a height of 7.5m, and consists of a series of wooden parts (eleven frame elements). Each of the structure's components is CNC cut from standard sized panels (such as composite panels or plywood panels), with each piece approximately 1 sqm. Structural units consist of two wooden sheet components (top and bottom) in order to generate a conically deformed body. The structural units and their weight are conformable with standard assembly requirements.

The secondary structure is defined by sheet metal cones that can be inserted into the main structure. The geometry of these cones responds to a centre point of the dome, and they are cut to different lengths. These cones are also based on one angle in order to allow easy assembly, and can be stacked into each other. As a third layer, the cones can be closed with lids of different translucencies and colour, also used for weatherproofing. Using the latest digital design and manufacturing techniques, the project explores architecture at the boundaries. The project is designed to be efficiently manufactured by nesting individual pieces within one another, thus saving on production time, material use, and shipping volume.

While concept and geometric rule-set were advanced, the structural analysis investigated buildability, cost effectiveness and construction issues. When these had been largely resolved, the Rhino model was imported into SpaceGass (Fig 4) in order to analyse the behaviour of the structure's main members: two layers of plywood separated by timber blocking pieces that form shape and structure of the dome. The analysis focused on the gravity and wind

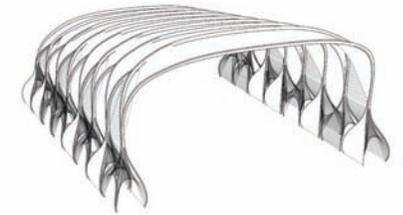


Fig 1: Catenary Arches, Decreasing Series

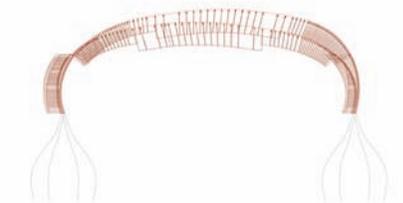


Fig 2: Catenary Arches, Bending Moments/ Wind Load

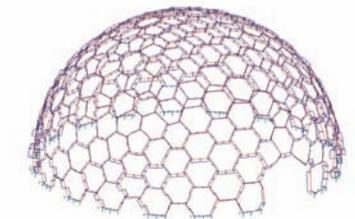


Fig 3: Dome, Structural Unit

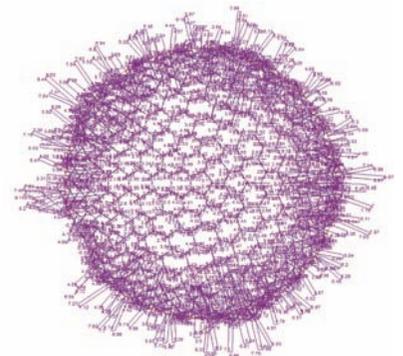


Fig 4: Dome, Force Analysis

forces within these repetitive elements, especially around the large doorway where there was a stress build-up and towards the lower half. Modelling the plywood properties initially indicated local buckling failure in lower sections of the dome. Additional timber blocking pieces were added and the ply strength was upgraded and thinned (in order to reduce weight).

A Minimal Tension Surface

(Project: Miles and Choi)

This mirror tent is based on a minimal circular geometry that holds up the roof. The design consists of three full interlocking circles and a half-circle, arranged in three dimensions, and connected by tubular columns that intersect and form a minimal surface area between the rings (a structural system similar to Otto's minimal surface structures developed by envisioning soap film taking the shortest path between lines). There are six main pre-welded joints, which locate the three rings. The rings are connected using sleeve joints for strength and stiffness (Fig 5). The vertical members are bolt fixed to steel lugs located along the main structural rings.

This structure was analysed in SpaceGass, and AISC Steel Institute tables were used to choose member sizes suitable for this structure under ultimate combined gravity and wind load cases. Gravity load and wind loads were used to perform an initial design of sections that could be used (Fig 6). This was based on hollow sections. A combined load case was then applied to the structure, and revised loads were checked against the designed members under the wind load case. The priority here is to provide maximum usability of space as well as ease of construction and transport.

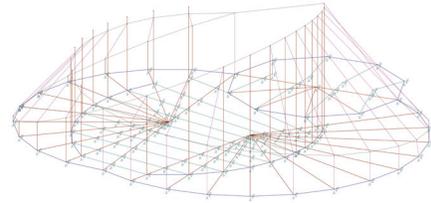


Fig 5: Minimal Tension Surface, Structure

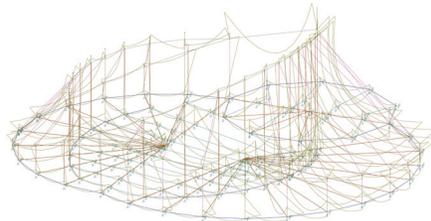


Fig 6: Minimal Tension Surface, Wind Load

A Lattice formed by Hypergrid

(Project: Allan and Chirculescu)

The design focus for the Tri-Star Theatre uses a series of triangular modules that form a dense hexagonal grid, a hypergrid with structural frame. Its system consists of three structural layers: the primary structure of the theatre consists of the tetrahedral steel modules, the secondary structure is an interior waterproofing and acoustic membrane. The third structural layer is composed of the tetrahedral base tri-star member, which acts as a top chord member to the space grid system (Fig 7).

Explorations in pattern tessellation were undertaken where replicating module members enabled different densities; creating open and closed spaces through interlocking with other triangular modules. The project moved from a 2D pattern tessellation of the triangle to a module in a 3D environment, by joining one triangle with two others, thus forming a tetrahedral pyramid without a base.

Structural analysis from Partridge and Partners delivered more specific behaviour of individual member parts in the hyper grid, reinforcing elements at critical points. The resulting tetrahedral module is constructed out of prefabricated steel sheet metal tri-stars that are welded onto the steel modules for structure depth. To assemble the tetrahedral module, the tabs on the triangular modules are folded over and pop-riveted onto the base tri-star member. This method of construction allows the structure to be adaptable to various degrees of density, size, shape and function. The resulting theatre design interweaves between fluid and static through degrees of adaptability (Fig 8).

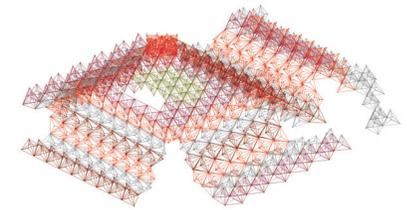


Fig 7: Hypergrid, Tristar Theatre, Structural Analysis



Fig 8: Hypergrid, Tristar Theatre, Members

Conclusion

Engineering and architecture are increasingly bridging a development that has distanced both professions. By deploying generic principles of self-forming organisations, architecture and engineering share a mathematical logic for space and structure. This logic, as has been discussed, can be embedded in a design curriculum in a phasing manner; by researching form behaviour through analogue modelling according to preselected principles; and by transferring the results towards a computational modelling environment. The benefits of this procedure are twofold: students experienced the underlying logic of models responding to force (a realtime behaviour), thus accessing a knowledge of structures by calling upon their own sense of force and balance. Once the rules were understood, students were then further able to transfer and vary this logic in the scripting process. More importantly, the design interaction between architects and engineers enabled students to proceed further; receiving feedback on their 3D data on structural behaviour, thus allowing for further revisions of constructability and performance.

The performance of structures within the design process thus increasingly becomes a design criterion that opens communications beyond purely aesthetic driven formal gestures in digital architecture. The exchange with engineers in that sense is vital, because the design develops as continuous loop according to real-time affordances, constantly addressing cost-effectiveness, optimization, fabrication and construction criteria. Through an intelligent and consistent use of digital software, architects and engineers can thus join forces to derive new species in the evolution of architectural formations, and architectural performance.

Notes

[1] Antonio Gaudi's Hanging Chain/Catenary systems for the Sagrada Familia have been discussed in: Mark Burry, *City Icons* (London: Phaidon, 1999). Frei Otto published numerous structural experiments in his series IL - Information of the Institute for Lightweight Structures, University of Stuttgart, Germany. Lars Spuybroek has continued several of Otto's experiments in: Lars Spuybroek, *Nox: Machining Architecture* (London: Thames and Hudson, 2004). For animated forms, see: Greg Lynn, *Bodies, Blobs and Folds - Collected Essays* (Brussels: Books-by-architects, La lettre volée, 1998). Design model strategies are described by Ben van Berkel and Caroline Bos, *UN Studio: Design Models, Architecture, Urbanism Infrastructure* (Amsterdam: UN Studio, 1999). For a general overview on design model strategies, see also Dagmar Reinhardt and Alexander Jung: 'Representation as Research: Design Model and Media Rotation', *RIBA Journal of Architecture*, ed. Hilde Heynen, Vol.13, April 2008, 188-201.

[2] Frei Otto published his research at University of Stuttgart in collaboration with the Institute for Lightweight Structures

extensively. Frei Otto (ed.), *IL 25: Experiments - Form, Force, Mass* (Stuttgart: University of Stuttgart, Information of the Institute for Lightweight Structures IL, 1990).

[3] Frei Otto, *Experiments*, 7.2.

[4] A discussion on collaborations between architects and engineers has been discussed by Oliver Tessmann, *Collaborative Design Procedures for Architects and Engineers* (Books on Demand, 2011, www.bod.com).

[5] Michael Weinstock and Achim Menges, *Emergence and Design Group*, Architectural Association, London. Michael Hensel, Achim Menges, Michael Weinstock (eds.), *Emergence: Morphogenetic Design Strategies* (Chichester: AD Wiley-Academy, 2004).

[6] Within the framework of the Digital Master of Architecture Research Studio (Faculty of Architecture, Design and Planning, The University of Sydney), structural analysis has been provided by the office of Partridge and Partners, www.partridge.com.au.



Touch Skin

Benedict Torrefranca
Cameron Halls

If theatre is an escape, is there a way to approach transitions as a process with key stages? Can architecture use tools similar to those used by performers to invite continuous shifts between the real to the unreal?

Theatre is the most experientially immersive of all performance art. A live performance has the ability to engage the audience on a very personal level because there is a direct relationship with the human senses. The success of a performance depends on how much it allows an audience to imagine, forget, or escape the real or everyday. Throughout the performance, the audience should be blissfully unaware of the real and replace it with the unreal world that the performance creates.

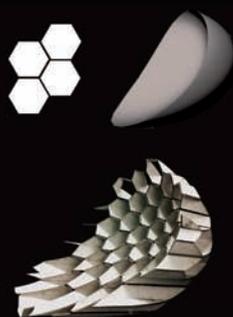
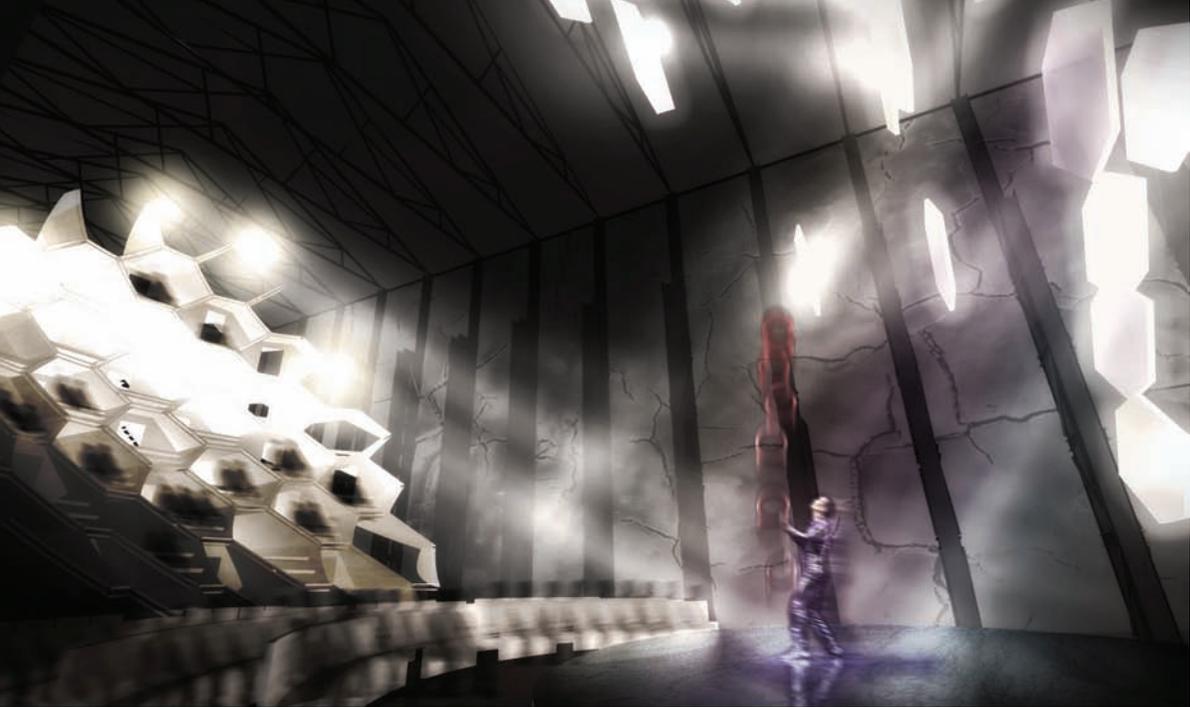
The concept of sensory transition began with designing a component that would be simple for fabrication but dynamic enough to perform visually and acoustically according to the desired sensory stimuli. Stretchable fabric panels were selected as the most suitable for the design proposal. Before deciding on the design parameters that would ultimately produce the final form, a grid was set up as a base form to be subjected to deformations. The grid was based on the structure of the warehouse, specifically, the 3.5 metre spacing between the internal columns. The uniform spacing was applied to all the other elements in the design. The parameters for deformations were applied to the base form through a magnetic point in Grasshopper3D. The intent was to specify a few simple deformation rules that generated a great variety of outcomes.

The resulting transition process followed four phases that translate into four zones or areas in the design proposal: Zone 1 introduces the audience to the unreal world of theatre; Zone 2 encloses the audience with visual stimuli from the performance; Zone 3 prepares the audience for immersion, and Zone 4 sets the theatre space, where the actual performance takes place. In doing so, it aims to prepare the audience psychologically, priming them for the complete immersion in the theatre.



Visual, audio, and tactile sensory stimuli are the main tools that performers use to transport their audience. Through subtle manipulation of these various stimuli, the proposed theatre design will gradually replace stimuli relating to the real with those of the performance.





AtmoSphere

Keiko Hosoda

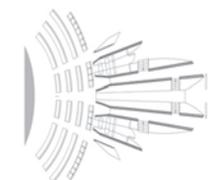
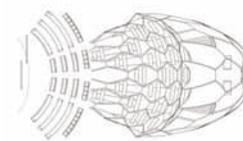
Sang Gao

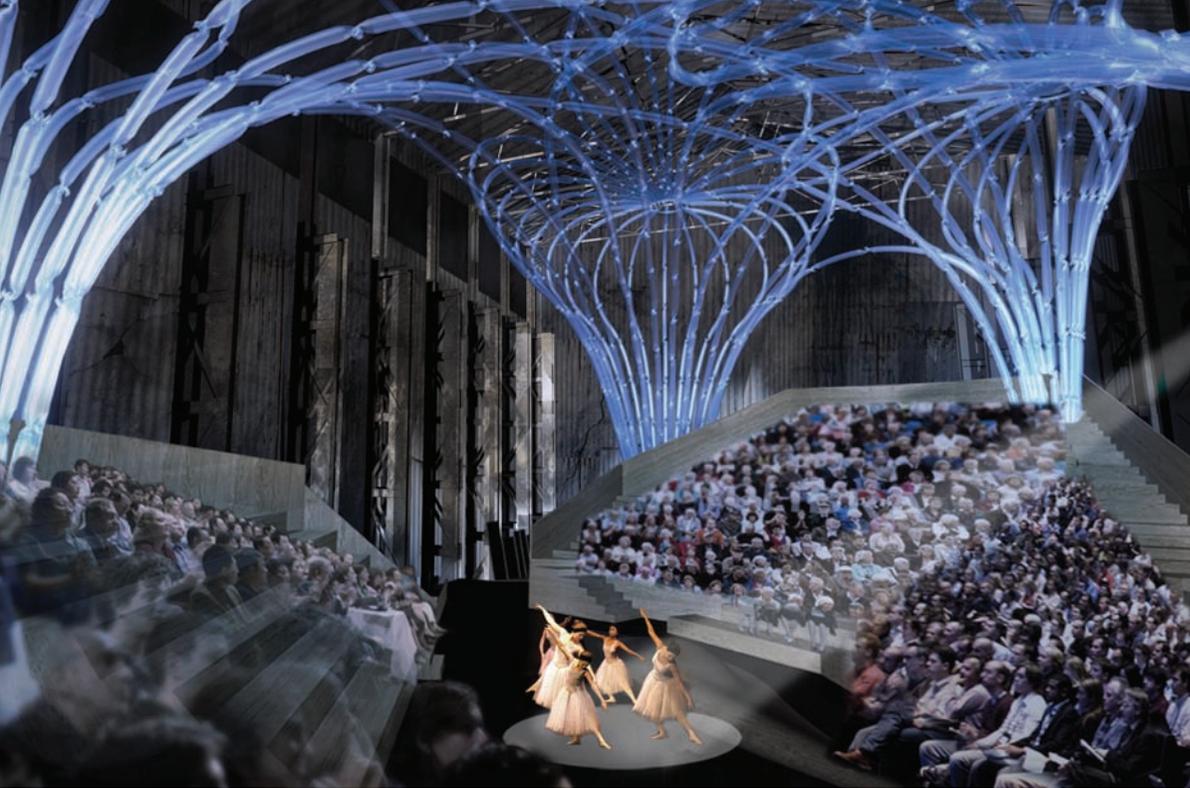
If a flower is a performer, the bouquet is a theatre. Theatre performances in general develop through a wide array of aesthetic elements. Yet when individuals within an audience perceive the same event, their experience may vary due to their personal attitudes, knowledge and life. Furthermore, a spectator's mind will not only perceive a flower (the actual play) but also envision absent flowers in the bouquet (other plays that could have been). Theatre lures partakers into both a shared, and at the same time very private imaginative world.

'AtmoSphere' pursues the privacy of a theatre experience by the individual positioning of spectators. There is an element in theatre known as the 'Side Box', sometimes referred to as 'My Lord's Room', where seats are exclusively offered to people with a certain social status. The project aims to recreate these seats in order to emphasise a power relationship within the audience, creating privileged viewing lines that play an equally important role as the performance itself. The base geometry of the project explores a regular hexagonal grid or honeycomb, and so derives a surface partitioning into regions of equal vision within the smallest total perimeter. Accumulated hexagonal cells arranged in a radial manner enhances the individual visual perception of the performance.

'I say: a flower! And, beyond the oblivion to which my voice banishes no contour, as something other than the familiar calyces, arises musically the fragrant idea itself, the absent flower of all bouquets.'

Stéphane Mallarmé





Theatre, as one might argue, exceeds the sum of its parts, for the duality generated by the audience and the performers undergoes a metamorphosis in which both become a single infinite entity. Theatre “generates and manipulates pleasure in relation to bodies”.¹ Within theatre, atmospheres or a netherworld factor are brought into being by a coming together, an aligning. Deleuze suggests that “the Other, as a structure, is the expression of a possible world; it is the expressed, grasped as not yet existing outside of that which expresses it”.² It is this ethereal quality, which establishes scenery so imagination can be unlocked, emotion is augmented and the immersion of the audience in the performance is complete.

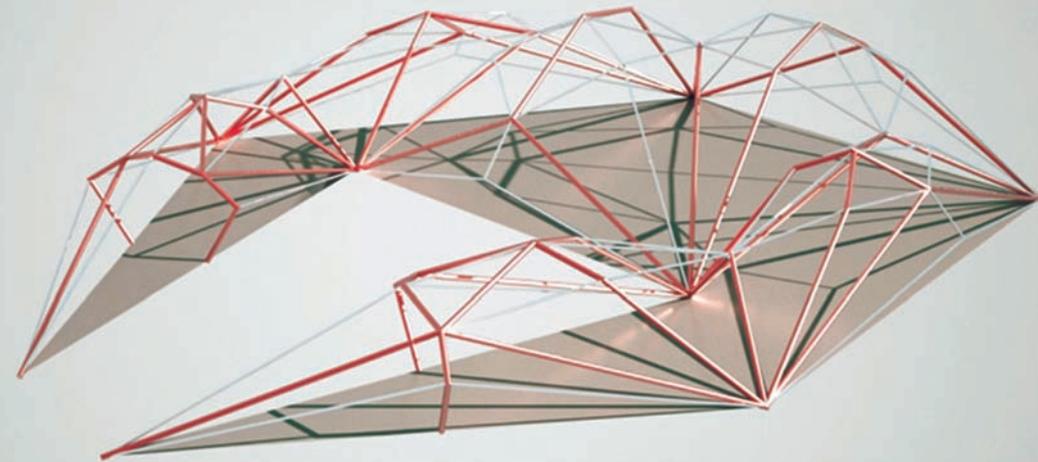
The theatre allows for the existence and creation of the ‘Other’, a concept that is explored through the constant metamorphoses of the elements (balloons) which make up the floating theatre enclosures.

Flow

Carly Martin

[1] Simon Shepherd, ‘Theatrically Imagined Bodies’, in: *Theatre, Body and Pleasure*, (London: Taylor and Francis, 2006), 1.

[2] Gilles Deleuze, *The Logic of Sensation* (London: Continuum, 2005).

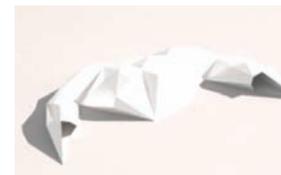


Transformers

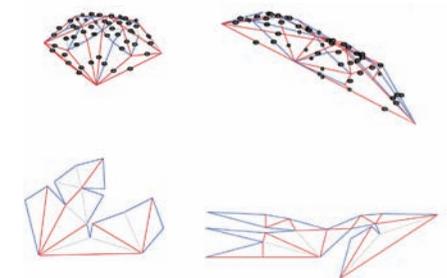
Mi Ran Kim

Sun Mingze

The concept for ‘Transformers’ explores the possibilities of a temporary tent through origami triangles. The result is a structure that consists of six inter-locking components, sharing four varied designs that result from a process of continuous deformation and manipulation of one triangular surface. ‘Transformer’ can be assembled into many possible combinations. The flexibility of the design allows it to perform as an environmentally sound, lightweight and low cost temporary building, which could be suitable for different sites and different purposes in future. In a theatrical sense, the project moves from one pose to another, being easily deconstructed for transportation or storage.



The performance tent is created from a steel structure covered with an elastic waterproof material with translucent properties, easily re-installed and re-used in the future, within new forms.





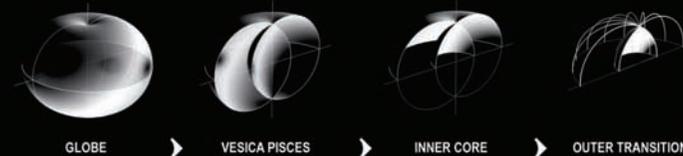
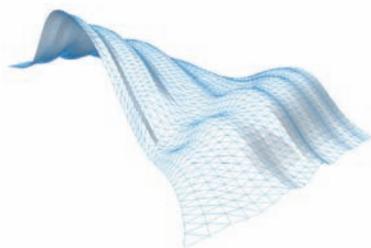
Performances start with the rising of the curtain. The project departs from an interpretation of this generic element of theatre, and develops an elegant insertion into the historic space of The Quadrangle. The curtain theatre project is formed as an inflatable continuous canopy, folding down and calmly blending in with the natural surfaces, reinforcing a sense of tranquility. Softness and lightness are physically transmitted by the transparent material that stands in contrast to the surrounding stonewalls. The triangular pattern tessellated along the undulating surface of the roof translates the rigid structure into a soft form composed of membrane layers infilled. Ripples on the inflatable roof remind the audience of the image of the curtain and its role in theatre.

During the performance at night, the structure will act like a lamp in the Quadrangle, illuminating the dark side façades, which balance the darkness and lightness in the space. Lighting will be projected from both inside and outside of the theatre according to the theme of the performance. In this manner, the project explores the relationship between renewal and preservation, innovation and tradition, the physical and sensational: a performance space as a play on balance.

Curtain

Danny Sit

Katherine Chen



Diegesis

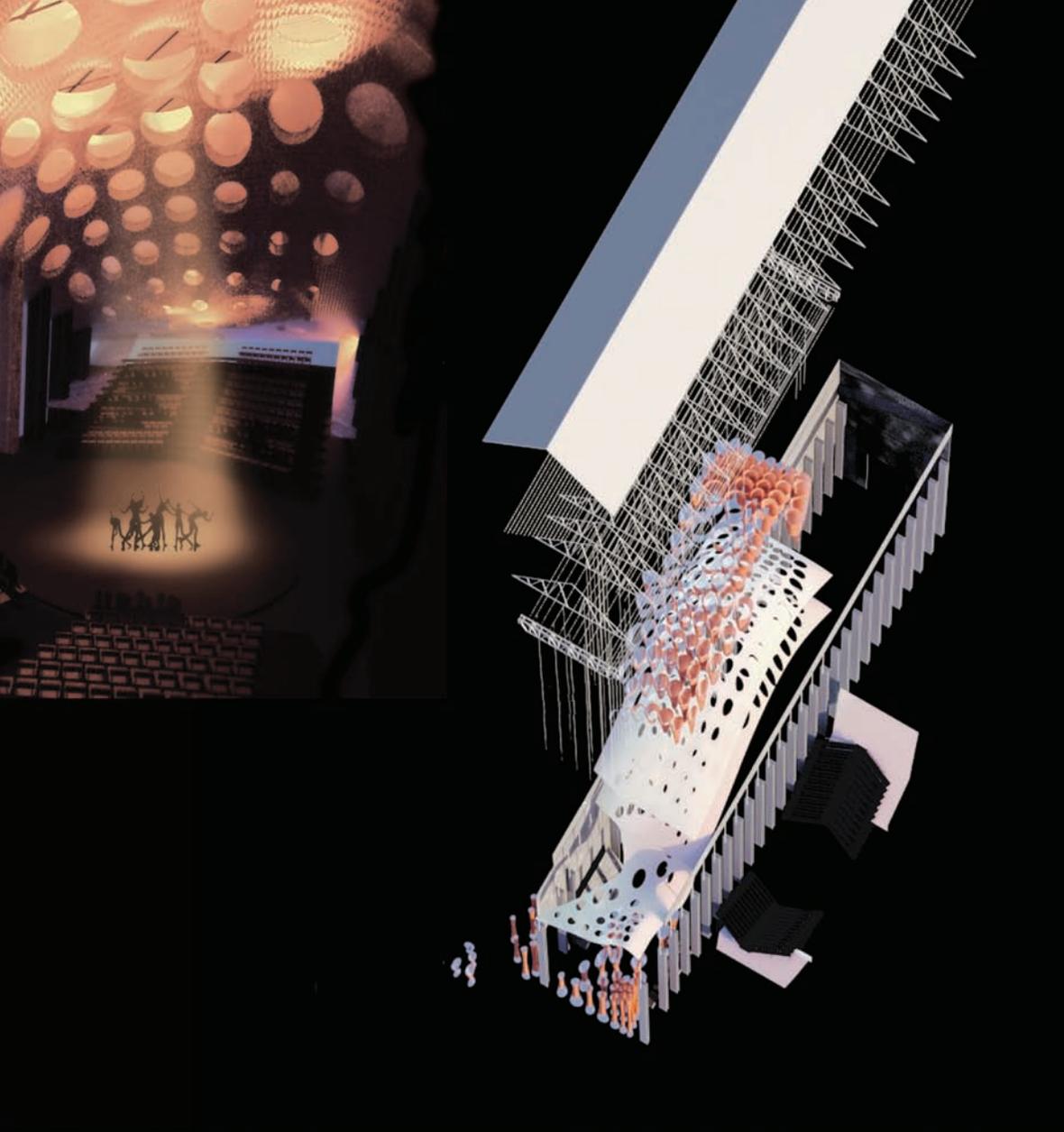
Joseph Byrne

Robert Elcome



Circles intersect in such a way that the centre of each circle lies on the circumference of the other. When the resulting geometry is rotated 360 degrees, single circles become a homogenous form, with an inner and outer core thus providing the basic spaces intended for the program of a theatre.

The term 'Diegesis' typically refers to an internal world created by the story that characters in theatre experience and encounter themselves. It is a parallel reality imagined by the viewer, an immersion of all the senses and the suspension of disbelief for the duration of the experience. This project seeks an architectural expression for the transition between two worlds or realities. It is based on the shape of the *vesica piscis*; the intersection of two circles with the same radius that are translated into a structural diagram. Here, a series of steel arcs are rotated in a double-circular form, so as to define an inner core, the theatre space, and a peripheral zone that radiates into the Festival Garden.



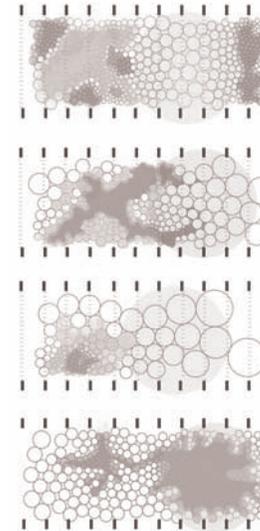
Forest of Lights

Jonathan Combley

Alexandra Haage

The project reviews Architecture and Dance, two practices interested in the movement of bodies through space, and concerned with the way these bodies interact with space. Every summer, the Sydney Festival transforms the city through theatre and dance. With different pockets of performances and displays spread around city, the Festival begins to unpack and celebrate the culturally diverse population. The project thus explores the relationship between the movements of a body, the tracing of movement, and the connection between music and architecture.

Derived from a strategy of packing circles that vary in their dimension and tracing lines through these circles, the project creates a mystical forest of geometries and lights, which can guide and lead the visitor through the space of Turbine Hall. The circles translate into voids within a translucent Lycra fabric that spans between ground and ceiling, and embedded cones of the same material, which absorb ambient noise. The project retraces a human scale by playing with the size and geometry of the cones, and in doing so creating certain moods through different colours and lighting. It directs the visitors' movements and inhabits the wide and open space of the Turbine Hall in an inviting manner, without interfering with its grandeur of size and sounds.



During daytime, white daylight discreetly shines through narrow slots in the roof of Turbine Hall, and passes through the cones, creating a mystical atmosphere.

Left side:

Turbine Hall: Structure and Surface Insertion. Assembly of components: Lycra, Acoustic Foam, Reinforced Fibreglass Circles. Interior Spaces of 'Forest of Lights' with light transmission, section with cones.





Fireflies

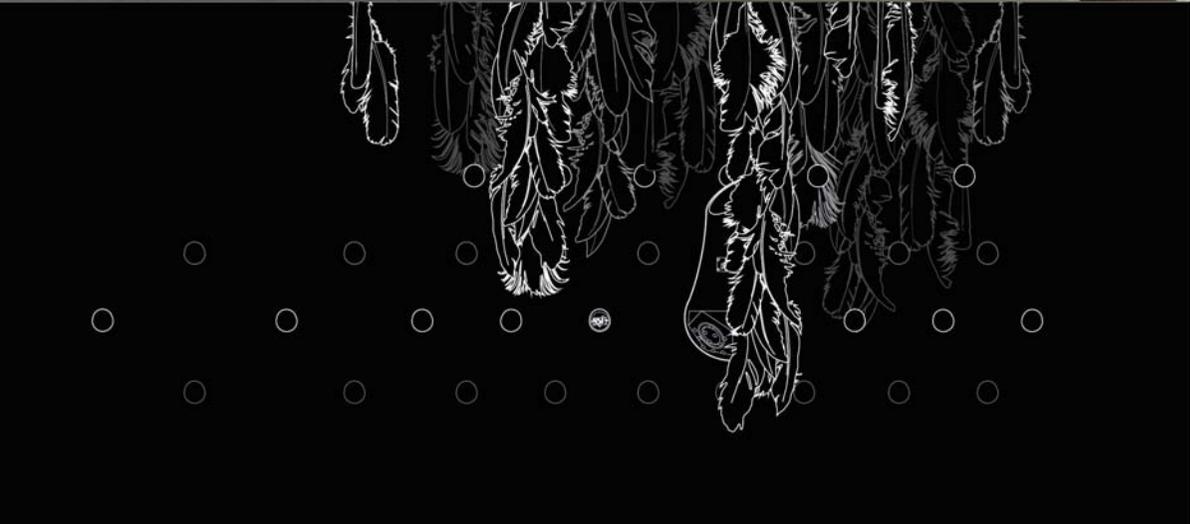
Sean Bryen

The project is a twofold proposal for Sydney Festival: for a dispersed interactive installation with an 'ushering' (sign-posting/way-finding) and performative function; and a small theatre venue in the Turbine Hall on Cockatoo Island.

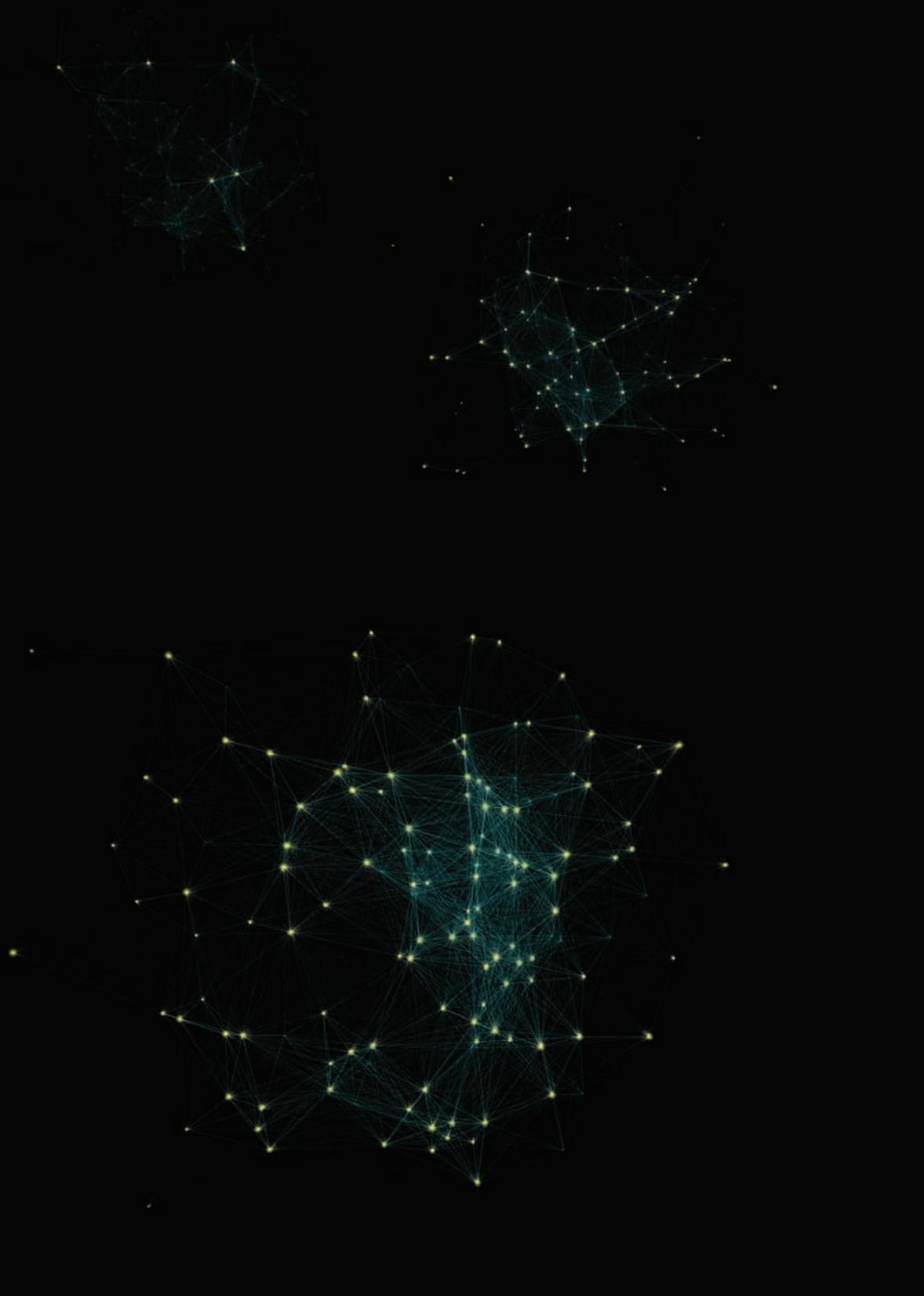
The first is an abstract simulation of the emergent synchronizing behaviour of fireflies, using LED nodes (an LED, sensor, and micro-controller in a diffuser/container) which independently senses and responds to the flashing of other firefly nodes. Ephemeral, captivating, and a fixture of summer like the Sydney Festival, 'Fireflies' would subtly indicate festival activity at night — just as yellow balloons can be found wherever the festival holds events in the day. They can replace much of the conventional signage which otherwise chips away at one's suspension of disbelief. For example, fireflies might entice passers-by into a hidden laneway installation, or lead alighting visitors to a venue on Cockatoo Island by gradually migrating from the wharf to other trees, awnings, and tunnels. Once inside the Turbine Hall, the synchronous blinking of 'Fireflies', rather than the ring of a bell, might indicate a performance is about to start. They might even be integrated with the performance, building to synchrony in a climax only to erratically disperse at the downfall of a tragic protagonist — realizing their potential as low resolution voxels.

The theatre consists of hanging columns of dyed black feathers of different lengths. The feathers are suspended from a net affixed to the ceiling trusswork, and define a small negative space within the Turbine Hall in which an intimate performance may take place. The permeable envelope of feathers masks the hall's visual noise, dampens reverberation, conceals stage equipment, and acts as a screen or threshold through which actors may emerge — without completely separating the audience from the post-industrial romance of the Turbine Hall.

The focus of the studio was on the application of digital processes to architecture. In this project, scripting was used as a generator of form (to define the negative space under the mass of feathers, using Processing output translated into a 3D form using Rhino and Grasshopper), and to demonstrate the ushering behaviour of the fireflies. Using programming as a design medium allowed for close control of the resulting design while harnessing the potential of emergent patterns, and was partly a reaction against the



On facing page, from top to bottom: concept model demonstrating the definition of space using a field of vertical elements of varied length; photomontage of the proposed bar to accompany the theatre venue in the Turbine Hall; detail of independent firefly nodes and a larger 'attractor' node which allows the stage director to influence the behaviour of the fireflies.



On facing page: Output from a Processing simulation of the emergent synchronizing behaviour of fireflies.

Each firefly begins with a random phase value between 0 and 1, increasing at a regular increment. When a firefly's phase value reaches 1, the firefly pulses, its phase value returns to 0, and that of nearby fireflies is increased according to a piecewise linear function (the phase response curve) — reducing the time between the firefly's pulse and that of its neighbour, eventually establishing synchrony. The phase adjustment is visualized using a blue line, the opacity of which is proportional to the magnitude of the adjustment.

The Processing sketch was informed by a paper by Gunther Auer, Christian Bettstetter, and Alexander Tyrrell on the application of the firefly's phase response curve to the development of self-organized wireless networks,¹ and was implemented with the indispensable assistance of Rob Saunders, lecturer in Design Computing at the University of Sydney.

dangers of surrendering design agency to the new digital tools becoming available to architects.

Fireflies are a family of natural pulse-coupled oscillators. The phase response curves of various firefly species have been studied for decades, but are receiving renewed interest from physicists, mathematicians, and technologists who recognize it as one of a number of emergent phenomena which promise to yield great improvements in computing and communication. Fireflies are useful at multiple levels of abstraction — ad hoc wireless networks might imitate their phase response curve,¹ but a more generalized model of their behaviour is the basis of a metaheuristic optimization algorithm which, according to one study,² has been shown to outperform similar Genetic Algorithms and Particle Swarm Algorithms in solving NP-hard class problems (of which the travelling salesman problem is the most famous example). In both cases, the swarm of simulated coupled agents outperform a more centralized approach.

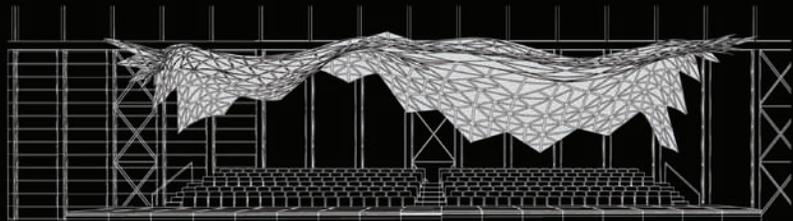
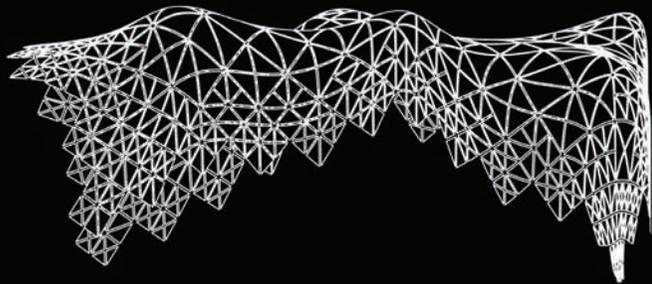
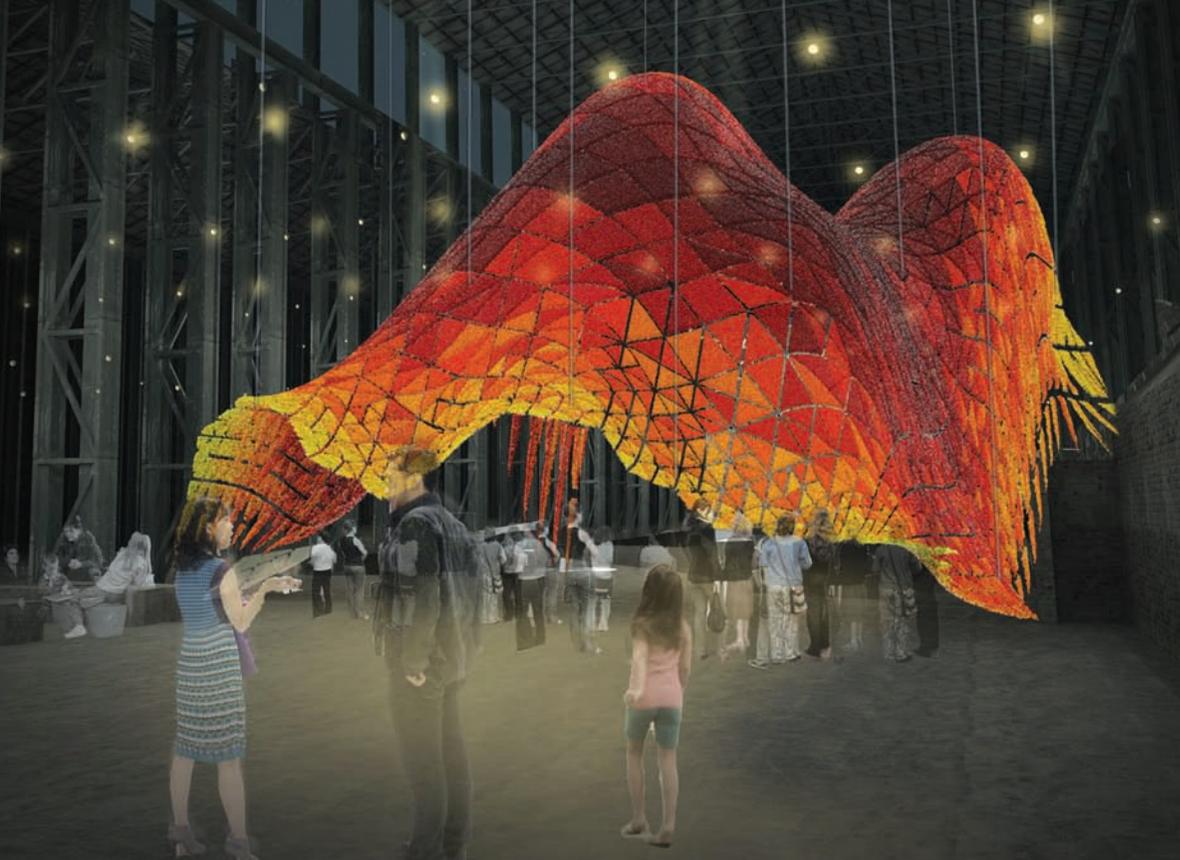
So long as design agency is not surrendered to generative algorithms, insights gained from the study of emergent natural phenomena will also profit architects — if in no other way, by providing the tools to optimize circulation or any other aspect of a model using objective parameters defined by the architect. As the experience of designing and documenting this project demonstrated, this mode of design puts more emphasis on posing the right questions rather than providing answers, as the work of iteratively testing candidate solutions is partly given to the computer. The project also underlined the importance of considering the appropriate level of detail in a biomimetic model when putting it in the service of design, as different levels of abstraction suit it to different purposes.

Notes

1. Auer G, Bettstetter C, Tyrrell A. "On the Accuracy of Firefly Synchronization with Delays," in: Proc. Intern. Symp. on Applied Sciences in Biomedical and Communication Technologies (ISABEL), Aalborg, Denmark, October 25-28 2008. (Available online at <http://www.bettstetter.com/publications/tyrrell-2006-bionetics-firefly2.pdf>. Based on an earlier paper, "Firefly Synchronization in Ad Hoc Networks," available at: <http://www.bettstetter.com/publications/tyrrell-2006-minema-firefly.pdf>)

2. Yang XS, "Firefly algorithms for multimodal optimization," in: *Stochastic Algorithms: Foundations and Applications*, SAGA 2009, Lecture Notes in Computer Sciences, Vol. 5792, pp. 169-178, 2009. (Available at: <http://arxiv.org/abs/1003.1466>)

Videos and source code for the Processing output shown is available at <http://hisean.com/march/digital>



Puppet Pavilion

Raffaello Rosselli

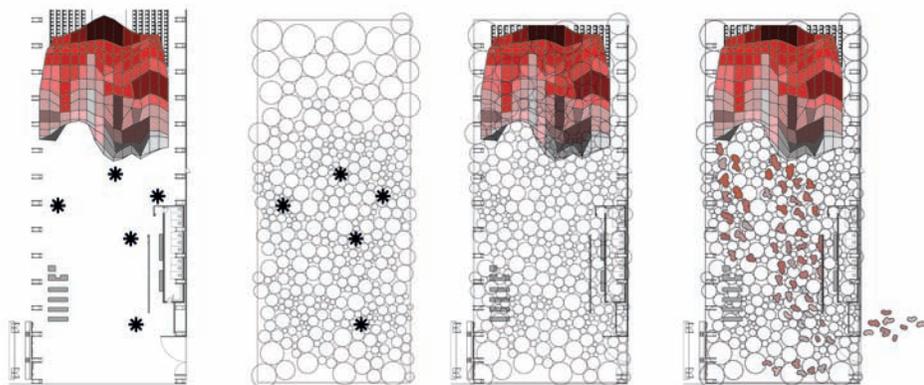
The 'Puppet Pavilion' is a soft amorphous hanging theatre space that inhabits the cavernous but intricate Turbine Hall. It envelops the audience and performers intimately like a child's fabric cubby. The structure removes the static formality of familiar structures and appeals to our yearning of simpler times, of soft, tactile spaces, to cuddle and to be lost in. The form of the pavilion is produced through the interaction of gravity on the tessellated grid surface hung in tension from an array of winches. These winches can be controlled to contort the surface, like a marionette or puppet, to provide spaces suited specifically to the mood of the audience.

The form of the space can dictate the mood of an event, which can be small and intimate, large and expansive, tall and dramatic, low and claustrophobic. Colourful on the outside and muted on the inside, it wraps around the performers and audience while leaving the floor clear for the director's and set designer's program.

The surface is composed of triangle modules made from thick shag hair carpet tiles. At the centre of the surface, large triangles dominate. The triangles recursively reduce in size, as a fractal, towards the outer edges. The smaller triangles, now at a human scale, allow the audience to disrupt and interact with the surface as they pass to and from the space. As the surface is changed and comes to rest, the geometry creates a form much like the drapery studies of Albrecht Dürer or Leonardo da Vinci, but faceted and abstracted.

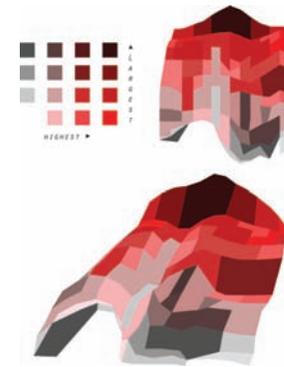
Detail of Carpet Tile Structure and Lighting System





Puffscape

Jessica Ngan
Andrew Short

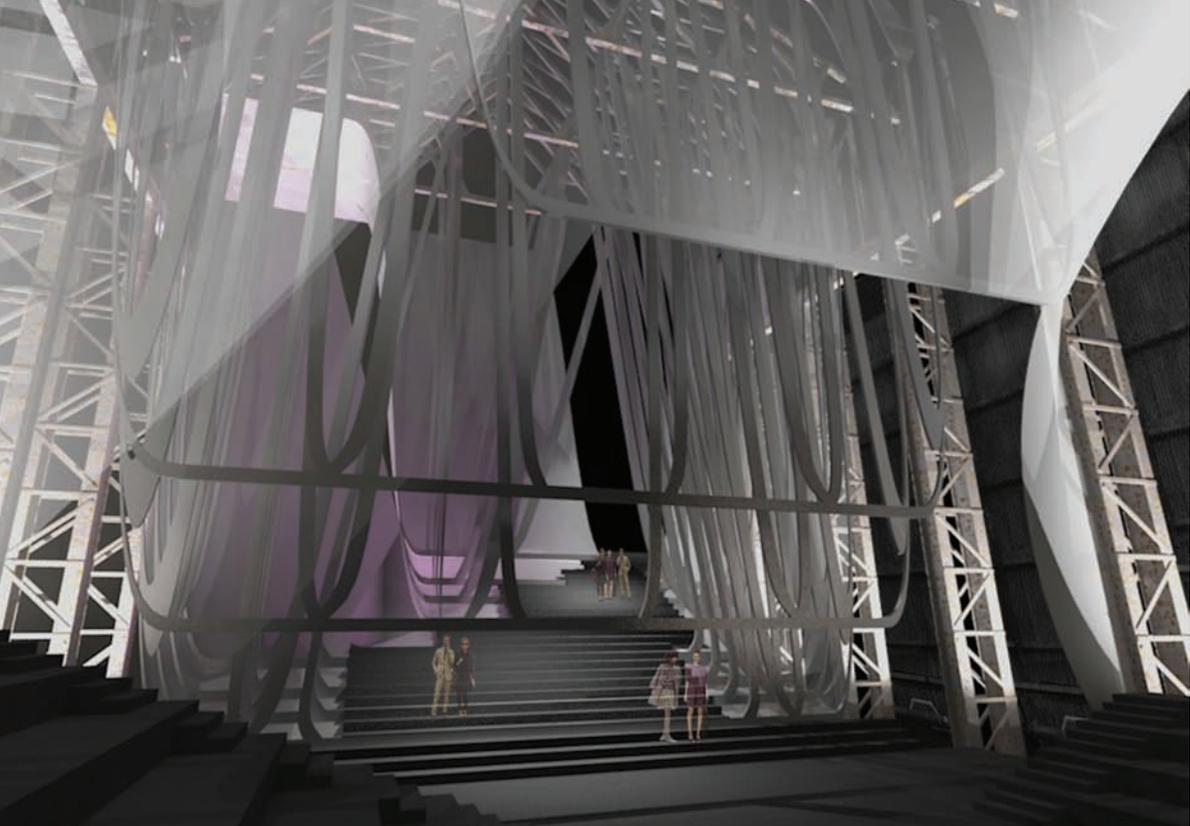


Following a Deleuzian dichotomy of smooth and striated space, the project explores the insertion of a large surface (the Puffscape) to a volume (the Turbine Hall), by which the volume is conceptually split into two. Both spatial entities are used to create different theatre settings for Festival use, an anti-space of foyer, and a performance space.

In this construct, smooth space is argued to be haptic and amorphous, relating to a person in a nomadic state. Smooth space acts to steer thoughts away from the rational towards the sensual, as is the foyer space that clears the minds of prospective audience members, priming them for a cathartic experience. It is intended that the whimsical nature of the foyer space combined with the ferry ride to the island will create an atmosphere of wonder and intrigue. In contrast, striated space is regimented and concentrated, much in the same way that theatre seats have a rigid order focusing on a central point, such as how an audience settles in direction towards a stage setting.

The project emphasizes the tactile elements of theatre to engage audience members with their surrounds. 'Puffscape' is a quilt-like formation, constructed from multiple interlinked panels that combine two layers of 'fabric' with a soft fill. The installation's soft form is set as a theatre enclosure/partition, and further brought to ground level where it functions as seating. This form then fractures off and spills throughout the space creating more seating, and as it spills out of the door, an indication is given of what can be expected inside. Further articulation is achieved with extra lines being drawn from key points on the partition and trusses towards the surface. The result is a structure that explores a sensuous approach to digital design and fabrication, in that it pursues a distinctly non-digital experience and feel. Patrons enter the performance space by leaning on the quilted landscape, or passing through a narrow opening, brushing against the panels, thus coming into direct contact with the haptic smooth space generated by the partition.

Panels are supported on a network of wires, which are suspended between the roof, wall trusses and the ground. The shapes of these various panels are derived from splitting an original surface form into many smaller shapes which when reassembled recreate the original form in an, albeit similar, but recognisably different way. The outer layer is made from an elastic material, and coloured in relation to adjacent areas and elevation. The stuffing consists of crumbed foam for elevated panels, and a combination of crumbed foam and sandbags for panels, which act as both seating and anchor points. The internal layer is made from thin non-elastic foam.



Performance of Play

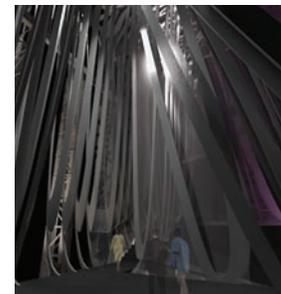
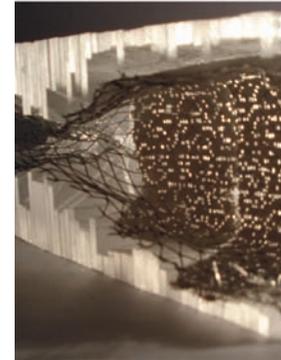
Scott Jackson

In the music video *Another World* (Chemical Brothers), dots and points form into the lines of a human face that again dissolves before transforming into oscillating sound waves. In a similar manner, other images are constructed, suggesting that music and body could be formed by equivalent codes.

In 'Performance of Play', the code that continuously transforms is that of the existing truss of Turbine Hall. It is rebuilt according to point criteria set in accordance with a number of rules derived from height, width and proportion. These transformed, recoded structural trusses are slotted in with the existing structure. A cotton-Lycra material is wrapped around to provide acoustic insulation, and to lead through space, impacting on visibility and connection.

The transition through the Turbine Hall performance space begins when an audience member steps off the ground-plane when entering the new structural field, and ascending a staircase wrapped in a translucent texture. The spatial trusses and their transformed series of structural kin submerge into an undulating spatial sequence in which structural reality, and the integrated gestures produce a dreamlike quality of spatial sequence.

Analogue modelling researches here spatial qualities, in transition from passage to void. The Perspex material enables different levels of light diffusion. Individual trusses are morphed, and inserted back into the system.

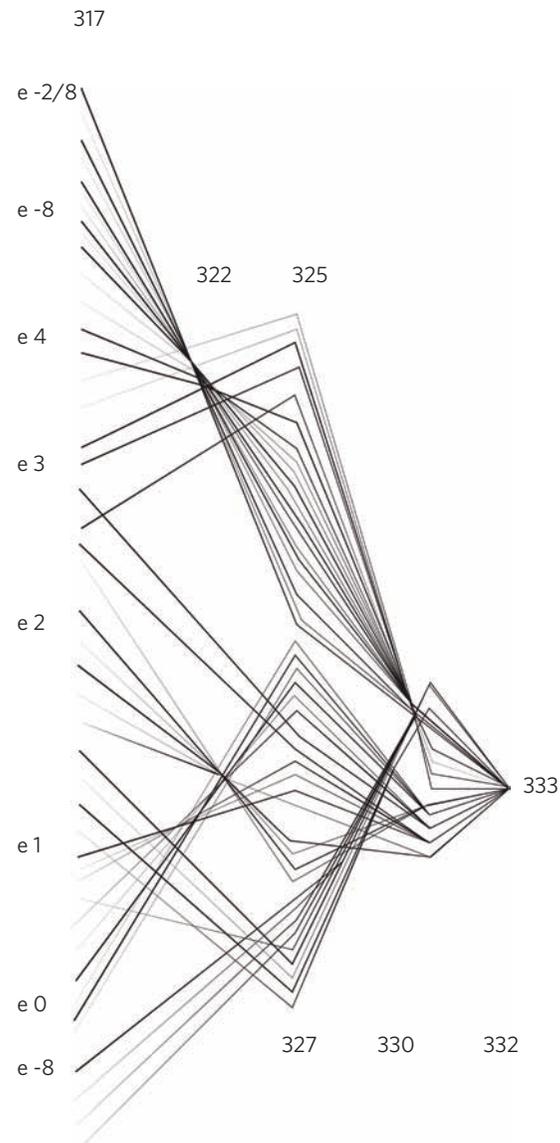


Practical Wisdom:

About the Tactical Behavior Between two Points

Über das taktische Verhalten zwischen zwei Punkten

Alexander Jung



In music and architecture, there exist parallels between parametric and generative design, and the notations, conductions and variations of sound and music. This text analyses the creative thinking and actions during a systematic process in music, in order to derive a shared approach to thinking, conducting and design methodologies. It explores mathematical regularities in music that encourage the development of flexible structures and parameters, which in turn determine, and potentially increase, a creative factor within the controlled, rule-based environment of contemporary architectural practice.

In the first part, the text describes a basic mathematical derivation of the tempered tone system, and outlines the relevance of embedded intervals as mathematical derivations between two given threshold conditions in music.

The second part concerns itself with system, structure and parameters in general, and aims to situate these in the context of music and architecture. It focuses on a mathematical organization shared by contemporary digital architecture, and its performative and integral development of musical ratios.

The third part reviews music as an emergent system, tracing diverse styles such as jazz, blues, hard bop, their methods of notation, and their development of variations. Specifically in Jazz, music develops as a dynamic process and communicative teamwork, in which the position of a single musician or solo instrument is set in relation to the musical formation, the band, in its entirety. The essay engages with the way in which creative relationships are determined within controlled environments, and the emergence of new solutions.

Note: The following text is in kept as original manuscript. For a transcription, please see the website that parallels book and exhibition, www.youtopiaexhibition.com.

Left: *Between Two Points*

Zwischenparametrischen und generativen Entwurfsansätzen, und dem physikalisch und akustischen Gerüst von Klang und Musik besteht ein Zusammenhang, der sich auf das methodische Arbeiten innerhalb bestimmter Regeln bezieht. Dieser Text versucht, das kreative Denken und Handeln während eines systematischen Prozesses zu analysieren, und untersucht mathematische Gesetzmäßigkeiten in der Musik; Entwicklungen von flexibleren Strukturen und Parametern, die den verbleibenden Kreativfaktor innerhalb eines Regelwerks bestimmen.

Im ersten Teil dieses Essays wird eine grundlegende mathematische Ableitung des heutigen wohltemperierten Tonsystems beschrieben. Dieser Teil beschreibt die Relevanz von Intervallen, die als physikalische Grundprinzipien der Tonstruktur in der Musik, ebenso wie Rhythmen und Proportionen in der Architektur, zugrunde liegen. Der zweite Teil befasst sich mit den Begriffen *System*, *Struktur* und *Parameter* im Allgemeinen, und versucht den Zusammenhang von Musik und Architektur herzustellen. Hier liegt der Schwerpunkt in der mathematischen Organisation und reicht von dem Proportionsverhältnis der Pythagoreer bis hin zur zeitgenössischen digitalen Architektur und deren performativer und integraler Entwicklung.

Der dritte Teil des Textes untersucht Musik als emergentes System, und zeigt, wie beispielsweise die offene Struktur von Jazz ermöglicht, dass sich dieser immer wieder neu definiert. Im Besonderen als gruppenspezifischer Prozess und als kommunikative Teamarbeit wird die Position des einzelnen Musikers oder des Soloinstruments in Bezug auf das Gesamte hinterfragt: Wie ist der kreative Umgang mit Regelwerken, und wie entsteht etwas Neues?

Entwicklung des Tonsystems in der Musik

Das übergeordnete System, mit dem wir unsere Musik notieren, basiert auf der allgemeinen Notenschrift. Diese ist bestimmt durch die 5 Notenlinien, deren 4 Zwischenräume, und der dem System angrenzende Raum darunter und darüber. Auf den Notenlinien und in ihren Zwischenräumen liegen die einzelnen Notenköpfe, welche den jeweiligen Ton, bestimmt durch seine Tonfrequenzzahl, und seine Notenlänge darstellen (Fig 1).

Ein Ton ist physikalisch gesehen eine reine Sinusschwingung, aber im musikalischen Sinne eine Kombination aus Teiltönen wie Obertönen, Partialtönen, Nebentönen und Aliquotttönen, deren Zusammenklingen dem menschlichen Ohr den Eindruck vermittelt, als sei es ein einziger plastischer Ton. Der Charakter eines Tones in Bezug zu benachbarten Tönen in gespielter Abfolge, dem Intervall, wird als Tonsystem bezeichnet. Dieses Tonsystem umfasst Ordnungszahlen, Tonleitern, Stimmungen, die Funktion einzelner Töne, und deren individuellen Ausdruck. Basierend auf dieser Notenschrift kann fast jede Art von Musik aufgeschrieben oder ‚notiert‘ werden. Die Notation in der Musik ist das grafische Festhalten aller relevanten Parameter innerhalb eines Systems, die nötig sind, diese Aufzeichnungen wieder zu vertonen. Komplexere oder modernere Richtungen haben diese Notierung verändert, erweitert oder in andere Schriftzeichen oder Aufzeichnungsarten modifiziert (Fig 2). Diese graphischen Notierungen sollten es möglich machen, Klangeräusche und deren Charaktere improvisatorisch wiederzugeben.

Das Tonsystem ist eine Auswahl bestimmter Töne und deren Intervalle zueinander. Jede Schwingungszahl ergibt eine andere Tonhöhe. Das menschliche Ohr kann zwischen 16 bis 15000 Schwingungen wahrnehmen, demnach müssten wir theoretisch nahezu 15 000 verschiedene Tonhöhen erfassen können.¹



Fig 1: Notensystem

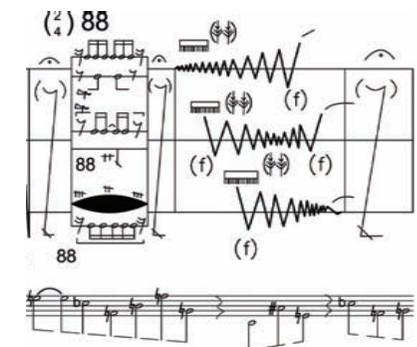


Fig 2: nach Ladislav Kupkovic, 'Das Fleisch des Kreuzes'

In der Geschichte der Musik entwickelten sich verschiedene Tonsysteme, die auf unterschiedliche Art und Weise diese Tonvielfalt vereinfachten, indem sie die hörbaren Frequenzen herausfilterten und in ein Verhältnis zueinander setzten. Diese Töne wurden als Bausteine oder Elemente in wechselseitige Beziehungen zueinander gesetzt, und bildeten in ihrer Gesamtheit ein Tonsystem. Den Pythagoreern zufolge ist die Musik eine Erscheinung der Zahlenharmonie, auf Grundlage mathematischer Verhältnisse und dem proportionalen Verhalten von Intervallen. Darüber hinausgehend spielen in diesem Kontext aber auch rein subjektive Emotionen eine Rolle, die von bestimmten Tonleitern - basierend auf spezifischen Intervallabfolgen - ausgehen, und die im rhythmischen Zusammenspiel entsprechend einen psychischen Effekt beim Mensch auslösen, so wie beispielsweise das Hören von Melodien in Hypophrygischer Tonleiter (Halbverminderte - klagender Toncharakter) beruhigt, und im Gegensatz dazu eine Phrygische Melodie (nach spanischem Flamenco klingend) den Gemütszustand belebt.²

Das Pythagoreische Tonsystem ist das erste uns bekannte System der Musik, das bis zum Anfang des 16. Jahrhunderts in der abendländischen Musik verwendet wurde.³ Andere, aufwendigere musikalische Systeme wie das Indische System unterteilt die Oktave in 22 gleiche Töne, während das afrikanische System die Oktave in 7 gleiche Teile dividiert (Equiheptatonic). Diese Tonfolgen klingen für Westeuropäische Ohren atonal, da wir die Intervallsprünge aus den Kirchentonleitern gewohnt sind, welche die Vorläufer unserer heutigen Skalen darstellen.

Das uns geläufige, temperierte Tonsystem teilt den Ton-Oktavraum in 12 gleiche Halbtöne. Das bedeutet, dass der Abstand eines Tones zu seiner achten Tonstufenwiederholung Oktave genannt wird. Dieser Ton ist, vereinfacht gesagt, ‚tongleich‘ zu dem Grundton, der seinen Ausgangspunkt bildet. Das temperierte Tonsystem verläuft in Intervallen. Ein Intervall (lat. intervallum: Zwischenraum) bezeichnet den Abstand zweier Töne zueinander und die Töne selbst. Diese Aufteilung in 8 Schritte bezieht sich auf die auftretenden Frequenzen der Obertonreihe (Fig 3 und 4, Tafel 1). Weiterhin werden die Ganztonschritte in Halbtönen aufgeteilt, dessen mathematische Formel $1:12\sqrt{2}$ beträgt. Unterschieden werden diese Intervalle weiterhin in reine, kleine und große Intervalle, die das Oktavsystem in seine 12 Halbtöne unterteilt (Tafel 2).

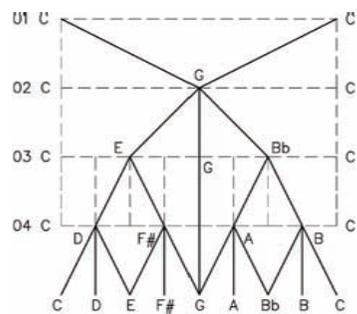


Fig 3: Oberton Zellgruppenteilung

Prim(e)	1
Sekunde	2
Terz	3
Quarte	4
Quinte	5
Sexte	6
Septime	7
Oktave	8

Tafel 1: Intervallbezeichnungen

1	Kleine Sekunde	7	Reine Quinte
2	Grosse Sekunde	8	Kleine Sexte
3	Kleine Terz	9	Grosse Sexte
4	Grosse Terz	10	Kleine Septime
5	Reine Quarte	11	Grosse Septime
6	Tritonus	12	Oktave

Tafel 2: Oktave (Temperiertes System)

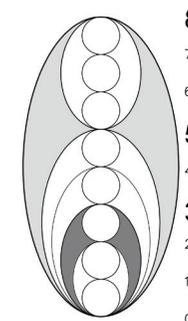


Fig 4: Oktave - Intervallabfolge

Durch diese Annäherung und Vereinfachung entsteht ein mathematisch ‚aufgehendes‘ System, das sich nach jedem Oktavsprung wiederholt und darüber hinaus enharmonische Verwechslungen (cis = des) zulässt. Jedes der Intervalle hat seinen eigenen Klangcharakter, und die Kombinationen dieser Intervalle ergeben Skalen. Die Musiktheorie unterscheidet in Konsonanz, also zusammenklingende und Dissonanz, das bedeutet, auseinander klingende Intervalle. Die Klangschönheit von Skalen oder Eingängigkeit von Melodien ist auf das Zusammenspiel von beiden zurückzuführen. Eine Symbiose dieser unterschiedlichen Tonreize prägt unser musikalisches Verständnis und versetzt uns in die unterschiedlichsten Stimmungen.

System, Struktur und Parameter

Ein System (altgriech. *συστημα*: das Gebilde, Zusammengestellte, Verbundene) wird gebildet durch die Gesamtheit seiner Elemente, die sich aufeinander beziehen. Ebenso wie Töne in der Musik werden die Elemente in wechselseitige Beziehungen zueinander gesetzt, reagieren aufeinander und bilden damit eine Einheit. Da diese Komponenten ausschließlich auf einen bestimmten Zweck gerichtet sind, kann ein solches System autark von seinem Kontext bestehen (siehe auch Tonsystem). Diese Elemente wiederum sind über Strukturen (lat. *structura*: ordentliche Zusammenfügung, Bau, Zusammenhang) organisiert, und als Muster oder Formen ablesbar. Diese Systemelemente befinden sich in spezifischen Relationen zueinander, sind also gewissermaßen miteinander verbunden, so dass ein System oder Organismus entsteht und ‚sich erhält‘. Diese Funktion ist oftmals als geometrisches Gerüst, wie beispielsweise eine Baumstruktur, geordnet und definiert den logischen Aufbau (siehe auch Intervalle, Fig 3). Die Formvariable innerhalb einer Struktur wird als Parameter (altgriech. *παρα*: gegen, neben, bei/ *μετρον*: Maß) bezeichnet. In der Mathematik tritt diese Variable neben anderen Variablen auf, ist aber von anderer Ordnung, da ein Parameter nur für einen spezifischen Fall konstant ist und danach wieder variieren kann. Dadurch unterscheidet er sich hauptsächlich von einer Konstanten, die eine fest definierte Zahl darstellt. Für die Musik beschreibt der Begriff Parameter elementare Größen wie Tondauer, Tonhöhe und Tonstärke bzw. Lautstärke.

„Der Ausdruck [Parameter] selbst entstammt der Mathematik; er musste sich wie mancher naturwissenschaftlicher Terminus, den die neuere Musiktheorie adaptierte, einen Bedeutungswandel gefallen lassen. Jetzt, in der Musik, nennt man Parameter alle Dimensionen des musikalischen Verlaufs, die sich isoliert verändern lassen. [...] Nachdem man sich einmal entschlossen hatte, alles dem Begriff Parameter zu unterstellen, was irgend sich in Reihen anordnen, also serialisieren ließe, ging man dazu über, weitere Parameter zu bilden. [...] Was den Parameter definiert: Er gibt einen Bereich an, der sich kompositionstechnisch verwalten, also vorbehaltlos jedem noch so abstrakten Regelungsschema anpassen lässt.“⁴

Der ukrainisch-amerikanische Musiktheoretiker und Komponist Joseph Schillinger (1895–1943) legte seiner Kompositionslehre bereits algorithmische Kompositionstechniken zugrunde; erste Parameter, die eine mathematische Organisation seiner Musik definierten, und die er als Gründer des ersten sowjetischen Jazzorchesters und später als Mitglied der ‚New York Musicological Society‘ an bekannte Komponisten wie George Gershwin, Benny Goodman, Tommy Dorsey und Glenn Miller weitergab. Zusammen mit einem russischen Physiker entwickelte Schillinger einen der ersten Musikapparate, das ‚Rhythmicon‘, um Soundtracks zu bewegten Bildern zu spielen.⁵

Ebenso wie in der Architektur ermöglicht auch in der Musik der regelbasierte Ansatz die Erweiterung einer traditionell festgelegten Formsprache. Formen, die nicht mehr den traditionellen Regeln von Form, Funktion oder Konstruktion folgen, oder gedanklich der Proportionslehre verhaftet sind, können Spielraum für

intuitives oder regelbasiertes Entwerfen lassen; das heißt, dass sich zwischen bestimmten Punkten Variablen oder Modifikationen entwickeln oder frei entfalten können.

Eine mathematische Logik liegt dabei, in Architektur wie in Musik, nicht nur der Kommunikation oder Ausführung zugrunde. Die Entwicklung einer Objektgestalt oder musikalischen Figur wird anhand von Formeln und Zahlen mathematisch präzise beschrieben. Damit ist ein organisatorischer Kontrollmechanismus entstanden, der direkten Zugriff auf das Objekt und seine Machbarkeit ermöglicht.

Für solche generativen Prozesse werden anhand von Programmen oder ‚Scripts‘ algorithmische Entwurfsstrategien als eindeutige Handlungsvorschriften aufgestellt, die in ihrer Vielfalt die sich daraus ergebenden Variationen bestimmen, und die die Notation eines Prozesses darstellen. Zeitgenössische Architektur ist nicht mehr ausschließlich an Form, sondern am formbildenden Prozess und dessen generativen Gesetzmäßigkeiten interessiert. Vergleichsweise spielt der Orchestermusiker in erster Linie auf eine perfekte Technik hin, die eine vorgegebene Notation möglichst präzise wiedergibt, wobei der Interpretationsspielraum annähernd Null ist. Im Gegensatz dazu ist der Jazzmusiker nicht darauf bedacht, ein spezielles Solo originalgetreu wiederzugeben, sondern hinterfragt vielmehr, wie es zu solchen Tonabfolgen, Artikulationen und Stimmungen kommt, und welche Theorie einer Spielweise zu Grunde liegt.

Es geht in der Improvisationsmusik um eine Reaktion auf das Umfeld, um einen Entwicklungsprozess, im Gegensatz zur

angewandten Typologie, die als formale festgeschriebene Lösung agiert. Der Faktor Zeit und der Moment spielen in diesem Zusammenhang eine große Rolle, da ein bestimmter Zeitpunkt den Ausgang definiert. Deleuze beschreibt diese Situation mit den Schnitten durch einen Kegel, der, je nach Lage und Position des Schnittes, eine Linie, einen Kreis, eine Ellipse, eine Parabel oder eine Hyperbel ergeben kann.⁶ Je nach Einfluss des Prozesses verändert sich also das physische Resultat. Das Objekt wird demnach in stetigem Wandel, ist also immer im Prozess sich zu verändern, und generiert Variationen. In Musik wird die Transformation der Notation zu einem emergenten performativen Stil.⁷

Transformation von Musiksystemen und deren Notationen

Die Entwicklung der Musik stellt ein sich selbst organisierendes System dar, das von Generation zu Generation mutiert. Unerwartete Momente im sozialen und politischen Umfeld haben dabei Einfluss auf dieses System, und begünstigen ein plötzliches Aufbrechen, um etwas Neues zu generieren. Dabei kann es sich um Teilstücke innerhalb des Systems handeln, oder auch das Ganze betreffen. Meistens jedoch vollziehen sich diese Veränderungen auf der Makroebene.



Fig 5: Blue Notes

Solche Veränderungen sind beispielsweise ‚Blue Notes‘, die man im temperierten System nicht notieren, aber spielen kann, da sich diese zwischen zwei Halbtönen befinden (Fig 5). Sie sind die Adaption ursprünglich afrikanischer Melodien (basierend auf der Pentatonik, die eine Oktave in 7 Intervalle unterteilt) in ein abgewandeltes 12-Ton System, aus der sich der Blues ableitet. Die ersten Bluesänger sangen ursprünglich Töne, die zwischen der kleinen und der großen Terz oder der kleinen und großen Septime lagen. Blues und Jazz Musiker entwickelten eine vereinfachte Schreibweise der Blue Notes, manipulieren diese aber nach unten oder oben (eine physikalische Veränderung insbesondere bei Blas- und Saiteninstrumenten), um authentischer zu klingen.

Die Struktur von Blues ist durch ein System von 12 Takten organisiert, die eine Basis unserer populären Musikgeschichte darstellt. Aus diesem 12-taktigen System entwickelten sich Jazz, Rock’n’Roll, Fusion, Funk, und Punk. Generell wird in der Musik auf standardisierte, dem Ohr vertraute Akkordfolgen zurückgegriffen, um von dort aus das System zu verlassen, und zu verändern.

Eine solche Modifikation des 12-taktigen Blues Schemas (auch bekannt geworden als ‚Bird Changes‘ oder ‚Bird Blues‘) ist beispielsweise ‚Blues For Alice‘ (von Charlie Parker), bei dem die ursprüngliche Bluesstruktur aufgebrochen, und Akkorde hinzugefügt werden (Substitutions). In ‚Ornithology‘ wird das Akkordgerüst von ‚How High The Moon‘, ursprünglich als Broadway-Show uraufgeführt, von Parker mit Dissonanzen und rhythmischen Verschiebungen modifiziert. Parker benutzt dazu eine Technik namens ‚Diminution‘, bei der vorhersehbare Swingmelodien

in einzelne Teilstücke zerlegt und als rasend schnelle Tonkaskaden gespielt werden. Diese Abfolgen sind geprägt von chromatischen Überleitungen, die den bekannten Tonleitern hinzugefügt werden, um einen rhythmischen Fluss zu gewährleisten. Typisch für Parker's Stil war der dissonante Intervall-Sprung der großen Quarte. Diese neue Stilrichtung war sein Markenzeichen, und initiierte den Bebop. Virtuosität und unvorhersehbare Wechsel wurden dazu benutzt, den Zuhörer zu begeistern und in einen trance-ähnlichen Zustand zu versetzen.

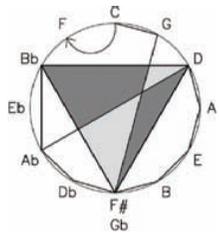


Fig 6: Major Third Circle

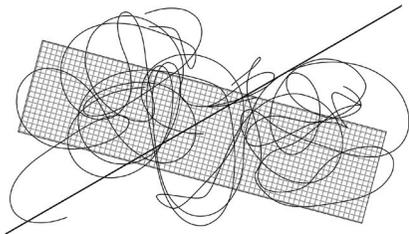


Fig 7: nach John Cage's Fontana Mix

Eine weitere Mutation ist John Coltrane's Hard Bop, in der Adaption der Akkordfolge der Bridge aus dem Lied ‚Have You Met Miss Jones‘ (1937 von Rodgers and Hart). Coltrane benutzt dabei die ‚Major-Third Progression‘, die als legendäres ‚Giant Steps‘ (1959) aufgenommen wurde und eine kompositorische und solistische Meisterleistung darstellt (Fig 6). Coltrane kombinierte in seinem Spiel verschiedene Tonleitern und inszenierte seine Stücke über sich ständig wechselnde Klangfarben, die durch ineinander klingende Töne und experimentelle Intervalle geprägt waren. Sein Spiel in den verschiedenen Skalen variierte so stark, dass die begleitenden Bandmitglieder lediglich ein C anstatt einem C-Dur oder C-Moll Akkord spielten, um dem Solisten mehr Flexibilität zu bieten.

Blues, Hard Bop und Jazz sind geprägt von spontanen Variationen. In ‚Kind Of Blue‘ entwickelte Miles Davis aus dem ‚Cool Jazz‘ den so genannten ‚Modalen Jazz‘. Hier orientiert sich die Improvisation der Solisten über weite Strecken anhand von Skalen (also einer Aneinanderreihung von Intervallen), anstatt sich über Akkordfolgen/ Kadenzen zu definieren. Modaler Jazz ist vielmehr charakterisiert durch ostinate Bassfiguren, mit sich stetig wiederholenden, eingängigen Themen (‚Vampings‘) von hypnotischer Wirkung. Ziel war hierbei, dem Solisten mehr Freiheit in seiner Improvisation zu lassen, und ihm die Möglichkeit zu geben, während seines Spiels eigene Melodien zu entwickeln. Die Minimierung oder Vereinfachung des Systems erweitert ebenfalls das Spiel durch eine Vielschichtigkeit im Gebrauch mit den verschiedensten Tonleitern. Die Wechselwirkung der einzelnen Musiker hat daher großen Einfluss auf die Homogenität eines Stückes, da alle Musiker aufeinander

reagieren und als Einheit auftreten. Diese Symbiose ist nur möglich, indem man miteinander spielt; indem man sein Spiel der Stimmung des Stückes und Spielweise der Mitmusiker anpasst.

Über die Variation in der Spielweise existiert aber auch noch die Variation durch Notation, durch entstehende oder systemoffene Schreibweisen, wie beispielsweise von John Cage als ein Vertreter der Modernen Musik. Cage ist kein Komponist im konventionellen Sinne, sondern an einem offenen und direkten Entstehungsprozess interessiert: er zeichnete Konzepte und Strukturen auf, und liess diese aufführen, um erst dann zu erfahren, wie sie klingen (Fig 7).

Diese am Prozess orientierte Arbeitsweise setzt jedoch voraus, dass alle Eckpfeiler, die den Verlauf oder den Höhepunkt eines Stückes beschreiben, strukturell oder konzeptionell so festgelegt sind, dass dem Künstler genug Spielraum bleibt, ein offenes Resultat zu erzielen, und das dennoch die Kapazität hat, sich fortwährend zu ändern. Cage benutzte dafür so genannte Zeitklammern (‚time brackets‘), die dem Solisten einen Einsatz vorgaben, jedoch keine weiteren notierten Vorgaben machten. Er generierte so eine zeitliche und stilistische Freiheit innerhalb seines Notationssystems.

In Kompositionen von Earl Brown wurde die Notation von Musik vorher schon vollständig aufgelöst, so dass diese dann richtungslos, ohne Anfang und ohne Ende und von jedem Punkt aus begonnen werden konnte (Fig 8). Die Dauer war ebenso beliebig wie die Abfolge (Spielrichtung). Diese Notierung diente als graphische Anregung zur Improvisation, von der man sich nach Brown ‚zu Deutungen anregen‘ lassen konnte.

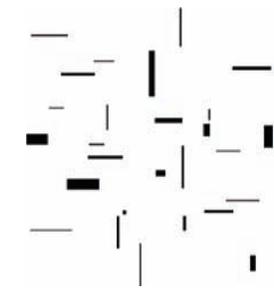


Fig 8: nach Earl Brown's December 1952

Nam June Paik drehte die Abstraktion einer Notierung um, und machte die Notation selbst zum interaktiven Instrument. Diese beschrieb eine Art des performativen Lesens von Musik, bei der mittels Tonkopfes eines Plattenspielers Strukturen an der Wand abgefahren, und akustisch wiedergegeben werden konnten.

Iannis Xenakis, ein Musiker, Mathematiker und Architekt, arbeitete insbesondere mit visuellen Verknüpfungen von Musik und Form. Er entwickelte die Stochastische Musik, bei der er Phänomene von Massenbewegung (Menschenmengen, Bienenschwärme) für seinen kompositorischen Prozess verwendete. Dieser Vorgang begann meist mit einer Visualisierung in Form einer Graphik, aus der er Formeln für seine moderne Musik ableitete, die darauf hin von Rechenmaschinen notiert wurden.

Für eines seiner wichtigsten Werke in Zusammenarbeit mit Le Corbusier drehte er diesen Notationsprozess um, und liess sich von dem Schriftbild seiner Komposition ‚Metastaseis‘ (Transformationen) inspirieren. Das Fundament für ‚Metastaseis‘ war die mathematische Reihe von Le Corbusier's ‚Modulor‘, ebenso wie die Vernetzung von sechs temperierten

Intervallen und der Tondauer, die ein Muster ergaben. Diese geometrische Folge führte zu einer graphischen Notation in Form eines Diagramms, wobei eine Achse die Tönhöhen, und eine weitere die Zeit beschrieb.

Da Musik nur aus einer Perspektive (einer akustischen) wahrgenommen werden kann, Architektur jedoch aus mehreren Perspektiven, übersetzte Xenakis diese Partitur in gebauten Raum. Bekannt als ‚Phillips Pavilion‘ (1959), entstand in Zusammenarbeit mit Le Corbusier eine ‚gebaute‘ Partitur aus hyperbolischen Paraboloiden, die einer dreidimensionalen Materialisierung der Notation entsprach.

Zwischen zwei Punkten: Eine Zusammenfassung

Ebenso wie die Musik unterliegt auch die Architektur einem System mit gewissen Regeln und systematischer Vorgehensweise, bei der zu jedem Zeitpunkt innerhalb des Prozesses Entscheidungen gefällt werden müssen, die den Ausgang bestimmen. Wie im Vorangegangenen besprochen wurde, erlauben bestimmte Mechanismen in der Musik, Veränderungen oder Modifikationen des Notationssystems, also des Handlungsablaufes, vorzunehmen.

Musik und Architektur sind jedoch nur bedingt vergleichbar. Musik ist eine Performance Art, bei der Musiker schnell und intuitiv reagieren, innerhalb eines Rahmens von wenigen Sekunden. Architektur hingegen ist ein sehr langsamer Prozess, der viele unterschiedliche Komponenten und Handlungen beinhaltet, und der ständig und fortwährend hinterfragt, analysiert und modifiziert wird – innerhalb eines mehrjährigen Prozesses.

Darüber hinaus ist auch die Materialität dieser Prozesse nicht wesensverwandt. Im Gegensatz zur Musik bleibt in der Architektur das Gegenständliche, das Objekt. In der Musik bleibt die Erinnerung einer Atmosphäre, an Klangfarben, skizzenhaften Bildern in unsrem Unterbewusstsein und ist damit viel mehr einem Moment verschrieben. Das Ergebnis dieses Essays zielt daher auf einen methodischen Vergleich beider Herangehensweisen, um einen performativen Ansatz und Motor für Kreativität innerhalb eines Regelgerüsts und seiner Ausweitung zu entwickeln.

Charlie Parker spielte in seinen Anfängen so miserabel, dass er sich aus lauter Verzweiflung in der Harmonielehre unterrichten lies. Erst danach war er in der Lage, seine Ausdruckskraft im Spiel zu erweitern, und den Reichtum seiner Interpretationen voll auszuschöpfen. Trotzdem und genau deshalb propagierte er immer wieder: „Learn the damned changes, to forget them“.⁸

Auch Architektur greift auf bekannte Regeln zurück, da diese auf Wissen, Ausbildung und Erfahrung beruhen. Ein Regelwerk als Grundlage muss erlernt und verinnerlicht werden, um dann individualisiert und weiterentwickelt zu werden. Das Wissen um die Grundlage der Entwicklung von Prozessen beinhaltet damit auch die Möglichkeit, sich von vorgegebenen Lösungsansätzen zu entfernen und sich neue Variationen, neue Kombinationen, neue Stilrichtungen anzueignen – in Musik wie Architektur.

Eine entscheidende Rolle spielt dabei Kreativität; die als Ausdruck unseres Seins abhängig ist von einer assoziativen Vielfalt; die wir entwickeln und die uns befähigt, Strukturen zu erkennen, zu

verstehen, zu adaptieren und letzten Endes zu modifizieren. Phantasie erweitert die Grenzen unserer Vorstellungskraft, wird zum kreativen Motor und bestärkt die Fähigkeit, sich auf Unbekanntes einzulassen, und mit bestehenden Systemen zu brechen. Diese Fähigkeit erlangen wir vor allem durch eine intuitive, spür- oder fühlbare Erkenntnis im direkten Umgang mit den Dingen selbst, nachdem wir ein dafür notwendiges Grundwissen verinnerlicht haben.

„Kreativität bedeutet, dass auf einmal erscheint, was es vorher noch nicht gegeben hat“.⁹

Als Architekten kommunizieren wir durch Aufzeichnungen oder Dokumentationen von Projekten, genauso wie der Musiker in einer Notation Stücke festhält, um diese aufzuführen oder aufführen zu lassen. In Architektur wie in der Musik geht es jedoch grundsätzlich um das Erschaffen, und um die zwangsläufig folgende Umsetzung des Erschaffenen. Musik muss gespielt werden, um sie zu hören, Architektur muss gebaut werden, um sie räumlich zu erfahren. Für die Entwicklung von räumlichen Systemen stehen uns über computerunterstützte Entwurfs- und Produktionstechniken Handlungsparameter zur Verfügung, die wir gerade erst anfangen, in vollem Umfang zu bespielen. Das bedeutet auch in zunehmendem Maße, sich von bekannten Notationen zu lösen und zu improvisieren – die Architektur sich entwickeln zu lassen, damit neue Melodien, neue Räume geschaffen werden können.

„Knowing how to play instruments is fine, but knowing how to make music only belongs to the truly great“.¹⁰

Notes

[1] Erich Wolf, *Die Musikausbildung Band 1 Allgemeine Musikausbildung* (Wiesbaden: Breitkopf & Härtel, 1967), 37.

[2] Umberto Eco, *On Beauty – A History of a Western Idea* (London: Secker & Warburg, 2004), 63.

[3] Die Aneinanderreihung von reinen Quinten brachte jedoch einen Fehler (Pythagoreisches Komma) im System mit sich. Arnold Schlick (um 1455 bis um 1525) versuchte mit seinem mitteltönig temperierten Tonsystem anhand von reinen (natürlich) grossen Terzen dieses Problem zu beheben. Aber auch dort gab es einen Systemfehler, denn auch hier bleibt ein Intervall übrig das „nicht stimmt“, die so genannte Wolfsquinte. Erst das wohltemperierte Tonsystem, von Andreas Werckmeister (1681 eingeführt), behebt diesen Fehler, da es nicht mit reinen, sondern annähernd reinen Intervallen arbeitet und somit das System als mathematische Folge aufhebt. Abgesehen von der Oktave sind nämlich alle anderen Töne ein wenig „verstimmt“.

[4] Dibelius schrieb bereits 1929 das erste Stück für ein elektronisches Instrument namens ‚1st Airphonic Suite‘. Ulrich Dibelius, *Moderne Musik I*. (München 1966, 4te Auflage 1988), 337f.

[5] Joseph Schilling, in Wikipedia, 04.11.2011.

[6] Gilles Deleuze, *Bergsonism* (New York: Zone Books, 1988).

[7] Emergenz ist die spontane Herausbildung von Phänomenen oder Strukturen auf der Makroebene eines Systems auf der Grundlage des Zusammenspiels seiner Elemente.

[8] Zitat von Charlie Parker (<http://www.jazz-fun.de/parker-charlie.html>)

[9] Prof. Dr. Hans-Peter Dürr, Metronom und Pendel, Youtube: <http://www.youtube.com/watch?v=Si3phMKnEQU>, datum.

[10] John Cage, Moderation in der Video-Dokumentation, *The Eyes Scream – A History Of The Residents* (TORSO VID7001, 1991).

Index

A

acoustics 100ff,106
 acoustic reflection 98ff
 actor 100
 actualisation 66ff
 algorithmic 137ff,171
 Allen, Woody 40
 Alice 65ff, 135
 amplification 99ff
 analysis, structural 146ff
 analogue 149
 anechoic room 103
 appearance 45
 apparatus,
 of destruction 37
 architecture 46
 artist 30
 artistic director 60
 atmosphere 127
 audience 32, 38, 58, 101, 123
 auditorium 61

B

Banquet 42
 Being 68
 body, the 40, 85, 131, 149
 branching 129
 Brecht, Berthold 51

C

Cage, John
 Catenary 152
 Celebration 29
 chocolate 41
 circle 135, 167
 city, the 30
 cloud 127
 code 64ff, 137ff
 Colosseum 50
 Coltrane, John 188
 communication 106
 community 29, 32, 58
 costume 59, 131
 counteractualisation 94
 crane 79

D

Deleuze, Gilles 90ff, 162, 175
 digital, the 14ff, 32, 66ff, 72
 Dionysian 39

E

edibility 34ff
 emergence 63, 137
 engineering 147
 enstrangement 50
 entertainment 33
 erosion 2, 75
 event 92ff
 experience 31, 38, 46, 55, 119

F

festival 29ff
 fireflies 168
 flow 162
 fold 85
 forest 129, 168
 formation, self- 148ff
 Foucault, Michel 115, 123
 Fried, Michael 26

G

gesture 119, 149
 Grimm Brothers 41
 Gropius, Walter 51

H

heterotopia 123
 humanity, shared 29
 human 45, 113
 hypergrid 133

I

illusion 5, 42, 46, 61
 immersive 16, 173
 interaction 63ff
 interval behaviour 71, 183ff
 intimacy 101
 intuitive 46

K

kinetic machine 117
 Kwinter, Sanford 72

L

Lacan, Jaque 90
 language 89
 lattice 81
 light 61, 167
 logistics, context 71

M

Martin, Steve 38
 matrix 29, 55
 microphone 100
 mirror 123, 135
 Mise en Abyme 83
 movement 43, 67
 music 177, 179, 182ff
 musical ratios 179, 181

N

narrative 46, 65ff, 119
 nature 147ff
 network 66

O

open source code 71, 142ff
 Other, the 163, 123
 Otto, Frei 148ff

P

Paik, Nam Jun 189
 parametric 141ff
 Parker, Charlie 187
 perceptual 64, 68
 performance 36, 49, 103, 121, 123
 play, theatre 46
 Price, Cedric 54
 Proscenium 44
 puppet 173

Q

Quilt 175

R

recombination 138
 resonance 61, 100, 107,
 response 46, 57ff, 62, 64ff, 171
 resistance 89
 reverberation time 107ff, 115

S

script 137ff, 141
 Seinfeld, Jerry 38
 sensation 67ff
 sensual apparatus 27
 Shakespeare 37, 50
 shell configuration 107ff, 148
 singer 102
 social capital 30
 Sophocles 37
 Southern, Richard 54
 Sound experience 61, 104
 space 46, 72, 102, 144
 spectacle 44
 speech 89ff, 99ff
 stage 107
 stage design 44, 59
 story 66
 structure 124, 147ff
 swarm 71, 119
 system 104, 183

T

tesselation 133,
 theatre 51, 61, 64, 123
 theatre design 44ff
 theatricality 26
 theatrical combat 38
 time 65ff
 touch 159
 transformations 92

U

urban space 32, 58ff
 underscore 46

V

venue 31, 39, 44
 vesica pisces 165
 video installation 60
 voxel 7, 169

Z

Zeitgeist 29

Dirk Anderson and Eduardo de Oliveira Barata are co-directors of Urban Future Organization (UFO) Sydney. UFO was founded in London during 1996 as a collective of self-organised architectural practices who share common design strategies in practice, professionalism, and architectural discourse. UFO has an international agenda, yet maintains the specific qualities of local diversity. Its members are multi-national design professionals, who conduct their work through collaboration with experienced consultants. UFO has professional experience ranging from the execution of a single residential house to a national concert hall. Anderson and Barata have lectured and led workshops at schools of architecture including the Architecture Association, Brighton University, London Metropolitan University, and Greenwich University and The University of Sydney respectively.

John Bayley is the Head of Technical Production of Sydney Festival. John has held technical administration positions for most of his career. He commenced his career on the road with 5 years of touring with everything from puppets and theatre to rock and roll. Once he settled in Sydney John moved back to his first love, the theatre, as a Production Manager. Since that time John has held 3 positions spanning 25 years: five years with Marion Street Theatre as production Manager; ten years with Sydney Theatre Company as Technical Director and 10 years with Sydney Festival as Head of Production where he currently works. John's primary professional commitment has been to not-for-profit organisations whose goal is providing an environment in which artists can do their best work. Career Highlights include: working closely on the construction of the Sydney Theatre Walsh Bay; being part of the creation of Festival First Night; establishing new precincts as performance spaces. This has included a complete refurbishment of the Domain, AR Rahman at Parramatta Park and Cockatoo Island.

Rob Beson recently co-founded AR-MA with partner Gabriele Ulacco, a design and communications firm focused on conceptual design, fabrication and assembly.

Joseph Buch is an archive of knowledge on the subject of theatre and performance, and has been in practice in this context and in teaching architecture at various institutions for the last 25 years.

Dr. Densil Cabrera is an acoustic scientist working mainly in room acoustics and psychological acoustics. In part due to his background in music, his research in acoustics has an emphasis on understanding the human experience of sound in spaces. Recent research, in collaboration with others, has included the development of real-time interactive auralization systems, modelling the loudness of music, developing a theory of reverberance, and developing new techniques for room acoustics measurement and analysis. He has numerous scientific publications, and is co-editor of the book "Principles and Applications of Spatial Hearing" (World Scientific, 2011). Densil is a senior lecturer at the University of Sydney, where he coordinates the postgraduate program in audio and acoustics. He is involved in significant international research collaborations, currently with colleagues in Korea (Hanyang University) and Japan (Tohoku University, where he is a visiting associate professor at the Research Institute of Electrical Communication).

Bill Harris is the Head of Programming at Sydney Festival, a position he has held for the past 6 Festivals. A graduate of the University of Melbourne (Commerce) and the National Institute of Dramatic Art (Technical Production), Bill toured nationally and internationally with many shows and Festivals, before undertaking the role of Production Manager for the Sydney 2000 Olympic Arts Festival. As Production Director for the 2002 Adelaide Festival of Arts, Bill's role incorporated the creation and development of new work, together with the engagement, inclusion and management of several community based projects. In mid 2002, Bill returned to NIDA as Head of the Production course, fulfilling a desire and commitment to the training of young people in the arts. He joined the Sydney Festival in late 2006.

Lindy Hume is the current Festival Director of Sydney Festival. One of Australia's leading directors and artistic directors, Hume is acknowledged internationally for a wide variety of repertoire and for progressive artistic leadership of a number of Australian arts organisations including West Australian Opera Victoria State Opera, OzOpera and the 2004-2007 Perth International Arts Festival. Lindy has a distinguished Australian and international career as a stage director, including The Barber of Seville and Rigoletto (Houston Grand Opera), Norma, A Streetcar Named Desire (Theater St

Gallen); La bohème (Deutsche Staatsoper Berlin); Phaedra, Albert Herring, (Aldeburgh Festival); Tolomeo (Muzicktheater Transparant, Belgium) and Radamisto (Handel Festspiele Halle), as well creating more than fifty major opera and theatre productions in Australasia for companies including Opera Australia, West Australian Opera and State Opera of South Australia, Pinchgut Opera and New Zealand Opera. Lindy is the recipient of an Australia Council Theatre Board Fellowship to develop a contemporary performance language in baroque repertoire with the State Opera of South Australia. In 2007 the University of Western Australia awarded Lindy the Honorary Degree of Doctor of Letters in recognition of her contribution to the cultural life of Western Australia. She serves on a number of panels and boards including the Major Performing Arts Board of the Australia Council, Regional Arts NSW and South East Arts Region. Following her 3-year term as Festival Director at Sydney Festival in 2012, she will take up a new appointment as the Artistic Director of Opera Queensland.

Alexander Jung is a co-principal of reinhardtjung architects, a registered architectural office based in Frankfurt and Sydney. Jung was trained as a draftsman, and worked internationally in Italy, Netherlands and Germany for large architecture companies. He received a postgraduate degree of Conceptual Design from Städelschule Frankfurt (Ben van Berkel, Mark Wigley, Peter Cook). Jung received the Taut-Preis, the famous distinction of the BDA Germany, in 2002. He was a project architect for UN Studio (van Berkel und Bos) between 1998-2004, and collaborated on IFCCA Manhattan, Almere Expo 2001, Venice Architecture University, Mercedes Benz Museum Stuttgart, before founding the office reinhardt_jung. reinhardt_jung lately received the „max40“ prize from the German Institute of Architects for the Jones House, and are runner-up for the DEUBAU Prize 2012. Jung has taught and lectured internationally, including at Städelschule, FH Wiesbaden, FH Frankfurt, UTS and The University of Sydney.

Dr. Sandra Kaji-O'Grady is Professor of Architecture at the University of Sydney where she teaches design, history and theory. She has held academic positions at the University of Melbourne and Deakin University, and was Head of School at the University of Technology, Sydney for five years prior to her current appointment. Sandra's research is in the transfer of

techniques and knowledge from other disciplines, such as art, music and medicine, to architecture. Her particular focus is on the 1960s and 1970s. Sandra writes regularly for professional journals. Additionally, Sandra has investigated seriality, colour and coding through her own work, exhibited in Sydney and Singapore. Sandra's partner, John de Manincor, is a director of DRAW architects and they juggle their mutual architectural obsessions with two children, Marita and Xavier.

Dr. William L. Martens is a perceptual psychologist who has been active in spatial hearing research since the early 1980s, and has been awarded several patents for novel spatial sound processing technologies. In more recent research he has focused on the design and evaluation of multimedia display technology to augment human interaction in virtual environments, and on the effects of room acoustics on sound recording and reproduction systems. Working primarily with musical sound and speech stimuli, his he has been attempting to relate physical measurements made on multimodal stimuli to subjective responses of human subjects, especially targeting multimodal interactions influencing aesthetic or hedonic preferences and the perceptual attributes related to such expressed sentiments (working since 2007 with colleagues at Yamaha Corporation's Center for Advanced Sound Technologies in Hamamatsu, Japan). He is an Associate Professor in Architectural Science and Associate Dean (Graduate Research Studies) for the Faculty of Architecture, Design and Planning at the University of Sydney.

Luis Alejandro Miranda Jofre is currently a PhD candidate at the University of Sydney in the Faculty of Architecture Design and Planning, in the Audio and Acoustics area. He graduated from the University of Sydney with a Master of Design Science (Audio and Acoustics) with Honours in 2008. Upon completion of his degree he has continuously worked as a professional audio and acoustics consultant. His current research interests include spatial audio capture and reproduction and spatial psychoacoustics.

Marjo Niemelä is currently leading the Digital Fabrication Lab within The University of Sydney. The Lab researches innovative digital fabrication techniques and facilitates the manifestation of 3D digital modelling to tangible products utilising CNC milling and routing, laser cutting and rapid prototyping in powder and resin.

Patrick Nolan is the artistic director of Legs On The Wall. He has been working as an artistic director for over twenty years. In that time he has created numerous new Australian works, that have been performed in festivals, opera houses, theatres, showgrounds, city streets and car parks. He's had the privilege to work with highly skilled performers, horses, opera singers from across the globe, pipers, Lord Mayors, and a hundred school children dressed as the animals on Noah's ark. As a theatre maker he is driven by a process in which a performer explores the extreme of their capacity to find a way of expressing an idea, a feeling, a sound, that takes the audience to a place of enquiry and perhaps, understanding.

Harry Partridge graduated from Sydney University with a BE in 1969. After much travel, and working in consulting practices in the UK, the USA, and Saudi Arabia, he returned to Australia and founded Partridge Partners in 1982. He graduated from UNSW in 1984 with a Masters in Engineering and has particular interest in devising structural solutions that complement the architecture. He has written several papers on sustainability issues and has built his own straw-bale house in Sydney. He co-founded Event Engineering in 2009, which is a consultancy dedicated to providing artists with comprehensive engineering and project management for their works. He is currently a director of both companies and is enrolled at COFA studying for a Fine Arts degree.

Dr. Dagmar Reinhardt is the Lecturer of Digital Architecture at The University of Sydney, where she currently leads the Master of Digital Architecture Research, and coordinates Architectural Communications. She is a co-principal of reinhardt_jung architects, a registered architectural office based in Frankfurt and Sydney. reinhardt_jung is a research-led practice that develops architecture through buildings, installations and curatorial work, publications, academic education and research, which has been widely published and received a number of awards. Reinhardt's research engages the technological and affective potentials of a latent, performative, phenomenal architectural design. Such unfolding performance is addressed as a latent potential embedded in design, through an organisational, structural, material expression of 'unfigured', non-finite form(ation), able to develop as change in operation, stimulating sensation and experience.

Michael Scott-Mitchell is Head of Design / Director, Undergraduate Studies at NIDA, and previously lectured in Theatre Design at UTS. Through his work and engagements, Michael bridges between the fields of architecture and theatre design. He studied architecture at Sydney University before receiving a Bachelor of Dramatic Art - Design from NIDA. Michael was a founding director of the architectural firm D4DESIGN, whose projects have included the award-winning Rockpool Restaurant in Sydney, and the Regents Court Hotel. As a theatre designer, Michael has designed more than 150 productions in Australia and internationally. His opera designs include the set design for Adelaide's 'Der Ring Des Nibelungen', which won the 2005 Helpmann award for Best Scenic Design, Andrea Chénier and La Fanciulla del West for Opera Conference, which was mounted by the State Opera of South Australia and West Australian Opera (APDG Award for Best Theatre Set Design) era Australia's L'Elisir d'Amore (Green Room Award for best Opera Design), Rinaldo and Tannhäuser.

Dr. Chris L. Smith is an Associate Dean (Education) and Associate Professor in Architectural Design and Techné at The University of Sydney. Chris's research is concerned with the interdisciplinary nexus of philosophy, biology and architectural theory. He has published on the political philosophy of Gilles Deleuze and Félix Guattari; technologies of the body; and the influence of 'the eclipse of Darwinism' phase on contemporary architectural theory. Presently Chris is concentrating upon the changing relation the discourses of philosophy, biology and architecture maintain in respect to notions of matter and materiality and the medicalisation of architecture.

Dr. Simon Weir, lecturer in Architecture at Sydney University, is a painter, designer and scholar, investigating the application of surrealist theories to contemporary architectural practice and discourse. Seen as a classicising process, as a synthesis of the Dionysian and Apollonian, surrealist methods employ the creation of interpretations in the concretisation and revelation of contemporary cultural mythology.

Sydney Festival enlivens and transforms Sydney with a bold cultural celebration based on the highest quality art and big ideas every January. The Festival opens each year with the unique Festival First Night - a feast of music, dance and visual spectacle on the streets and in the parks of central Sydney, attracting over 200,000 people. This free event is the curtain raiser to a three week ticketed and free program that reaches an audience of around 1 million people. The program is kaleidoscopic in its diversity, from burlesque circus to New York rap to Russian theatre; from contemporary dance to family programs to traditional Indigenous arts practice. In all, the program comprises around 300 performances and 80 events performed by over 1000 artists in at least 20 venues each year. Inclusive programming, a broad range of free events and accessible pricing policies for the ticketed shows means that Sydney Festival is open to all, welcoming Sydneysiders and visitors from wherever they live.

The Faculty of Architecture, Design and Planning at the University of Sydney has a proud history of over 90 years of innovative thinking in architectural research, teaching and practice, and continues to attract the brightest young minds, both locally and internationally, with the highest entry standards of any undergraduate architecture program in Australia. Our students excel in Australian and international design and architecture competitions. In 2011 our students received world-wide recognition with Royal Institute of British Architects commendations and first prize in the Barcelona 2011 international architecture competition, beating 500 other entries. In addition to this exhibition as part of the Festival of Sydney, our students have participated in a number of major festivals including Vivid Sydney, Smart Lighting Singapore and Sculpture by the Sea. <http://sydney.edu.au/architecture/index.shtml>.

Freerange Press is an online and print co-operative based in Melbourne, Australia and Wellington, New Zealand. Freerange's focus is on global issues of design, politics, art and life for an urbanized humanity.

Tin Sheds Gallery is located within the Faculty of Architecture, Design and Planning at the University of Sydney. The gallery provides a forum for nurturing excellence in contemporary art from both emerging and established artists within NSW, nationally and internationally. The gallery encourages a multi-disciplinary and dialogic approach to art, being a venue for exhibitions, performances, discussions, events and artist publications. Tin Sheds Gallery supports the development of artistic practice by providing opportunities for artists to create and exhibit new works offering situations for creative research and experimentation.



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Architecture at the Intersection
of Digital Processes and Theatrical Performance

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Youtopia. A Passion for the Dark celebrates architecture at the intersection of Digital Processes and Theatrical Performance. 'Youtopia' pursues dreams: of other spaces and times; of outrageous and fascinating experiences; of the glamour and lights of Sydney Festival. The book reviews design conversations between architectural practice, architectural theory, audio and acoustics, digital fabrication, interaction and mediation, structural engineering, theatre and performance studies, and cultural research. It parallels an exhibition that showcases ephemeral and captivating interactive landscapes, theatre installations, iconographic architectural objects, heterotopias and performative spaces. These speculative projects are developed by advanced design processes in 3D modelling and scripting environments, and by the production of prototypes through structural analysis and digital fabrication.

Edited by Dagmar Reinhardt, with interviews and essays by Dirk Anderson, Eduardo Barata, Joseph Buch, Densil Cabrera, Bill Harris, Lindy Hume, Alexander Jung, Sandra Kaji-O'Grady, William L. Martens, Luis Miranda, Patrick Nolan, Harry Partridge, Dagmar Reinhardt, Michael Scott-Mitchell, and Simon Weir.

Featuring projects by Tiffany Allan, Iain Blampied, Renee Blythe, Sean Bryen, Joseph Byrne, Kayla Browne, Katherine Chen, Alice Chirulescu, Jiyoung Choi, Jonathan Combley, Rachel Couper, Elizabeth Dalton, Robert Elcome, Benjamin Elphinstone, Andrew Fong, Sang Gao, Evan Gilchrist, Phoebe Goodwin, Lucian Gormley, Joanne Gray, Alexandra Haage, Cameron Halls, Nina Heude, Oliver Hessian, Keiko Hosado, Adam Higginbotham, Mark Hill, See Ming Ho, Georgia Jarrett, Na Jijang, Aya Kaneko, Mi Ran Kim, Ivana Kuzmanovska, Belinda Lee, Roger Lee, Carly Ann Martin, Xina Meng, Natalie Miles, William Miller, Sun Mingze, Wipawee Nitivoranant, Jessica Ngan, Monica Dolve, Ellen Rosengren-Fowler, Raffaello Rosselli, Yon Safmat, Kim Saggars, Andrew Short, Danny Sit, Chun Sukh, Siyue Sun, Benedict Torre Franca, Andrew Whiteman, Xu Kai Wu, Cuiting Zhang, and Yilun Zhang.

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