PORTFOLIO
Paul Poinet

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B.Arch.
(ENSAPM - Digital Knowledge Dpt.)

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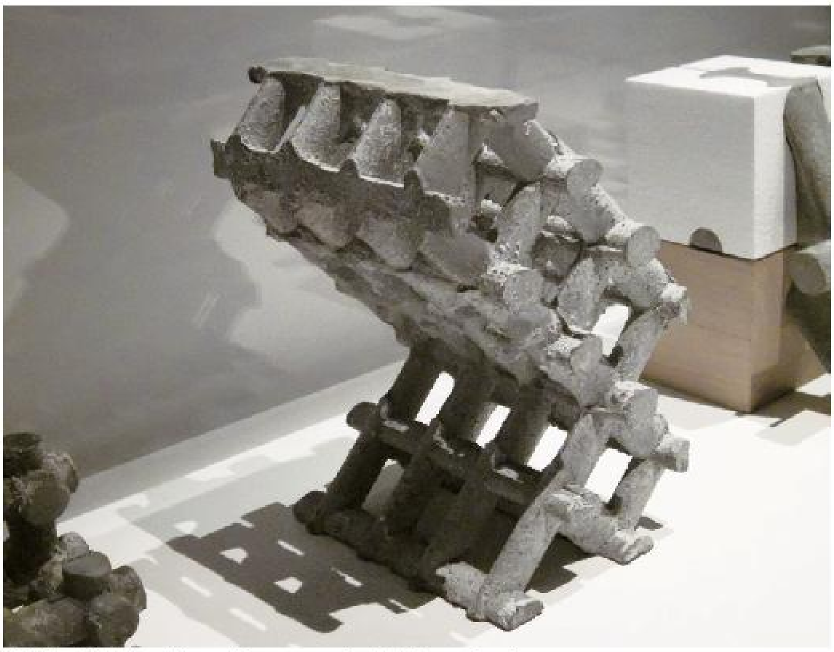
U-Cube, Cube for Universal Discrete Construction, 2012

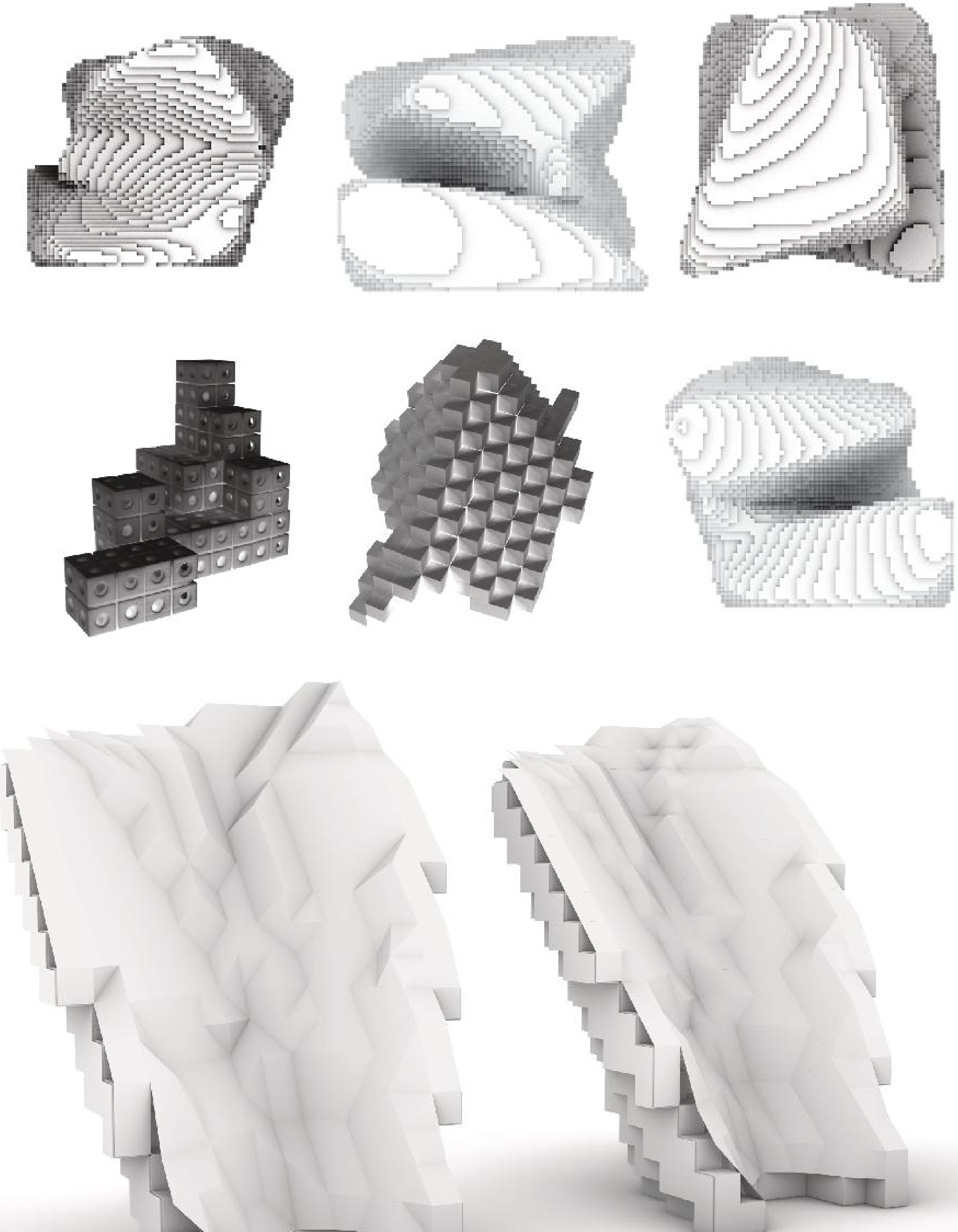
Concept Development: Philippe Morel / EZCT Architecture & Design Research
Project team: Tristan Gobin, Elodie Le Roy, Thibault Schwartz, Charles Bouyssou, Paul Poinet, Vida Chang
Manufacturing robotics: Tristan Gobin, Charles Bouyssou and Thibault Schwartz (HAL plugin), ABB Robotics
Concrete: Lafarge
Calculation: RFR
Materials: Ductal ®, styrofoam, wood and stainless steel.
Exhibition: Centre Pompidou, MNAM / CCI, inv. AM-1-PI18 EC2012

The U-Cube system is an experimental device consisting of cubic hollowed Styrofoam. The cavities are responding to specific connectivity rules where a self-compacting concrete liquid Ductal® has been poured. The resulting design presents a support structure with no outside contact, offering many advantages including excellent thermal and acoustic insulation. The different cavities have been cut by a 6-axis ABB industrial robot piloted by HAL® (a plug-in for Grasshopper® developed by Thibault Schwartz) and are reproducing a three-dimensional mesh as continuous as possible, while the cubes obey to the discrete geometry. The project aims to integrate the formal choice of the designer/user into the computer that we understand here as a "discrete state machine."

Issues related to the project are fourfold:
1. Establishing a correspondence between the construction methods and the geometry present in a computer.
2. Anticipating the massive deployment of robotics (whose logic is discrete) not by adapting the robots to the models, but adapting upstream geometric models used by the architecture to robots.
3. Explore the potential of an economical use of the Ultra High Performance Fibre-Reinforced Concrete (UHPFRC).
4. Develop a different architectural notation, which would not be based anymore on plans or continuous dimensions (metric), but on a series of numbers describing the relative positions and directions of cubes in the discrete space.



Digital fabrication of a concrete lattice structure.



Voxelized systems and generative tiling pattern

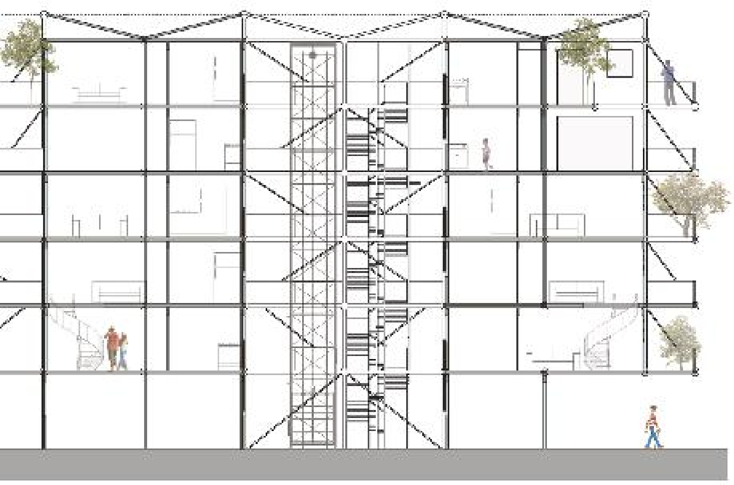
ENSAPM - P4: Modular Housing Project

Year: 2012
Location: ENSAPM (Ecole Nationale Supérieure d'Architecture de Paris-Malaquais)
Semester: SS 2012
Teacher: Jean Leonard
Concept Development: Paul Poinet

Project located in the nineteenth district of Paris, near Ourcq - Jaurès, between the Canal de l'Ourcq and the Avenue Jean Jaures, along the Rue de l'Ourcq and the railroad of the small belt. The site is characterized by, mainly, its high density and heterogeneity, it is divided into parcels for each student. Each parcel will host two housing types, the building and the townhouse. The aim is to think on different issues such as juxtapositions, overlays, sharing, crossings lots, distributions, combinations, heights, relationships, contexts, adaptations and other different constraints.

FACADE SUR RUE (ech. 1/100)

COUPE LONGITUDINALE AA' (ech. 1/100)



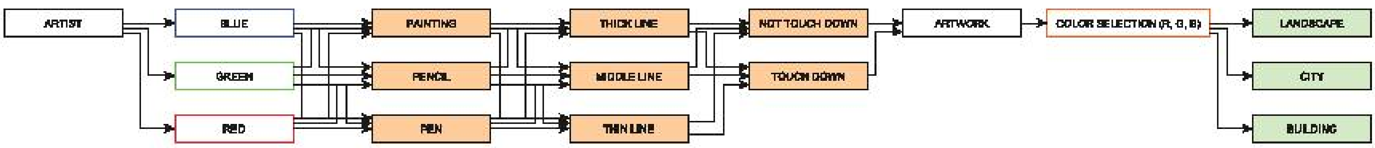
SUPERSTUDIO : THE CONTINUOUS MONUMENT (1969-1971)

ENSAPM - Workshop - Vision Machine

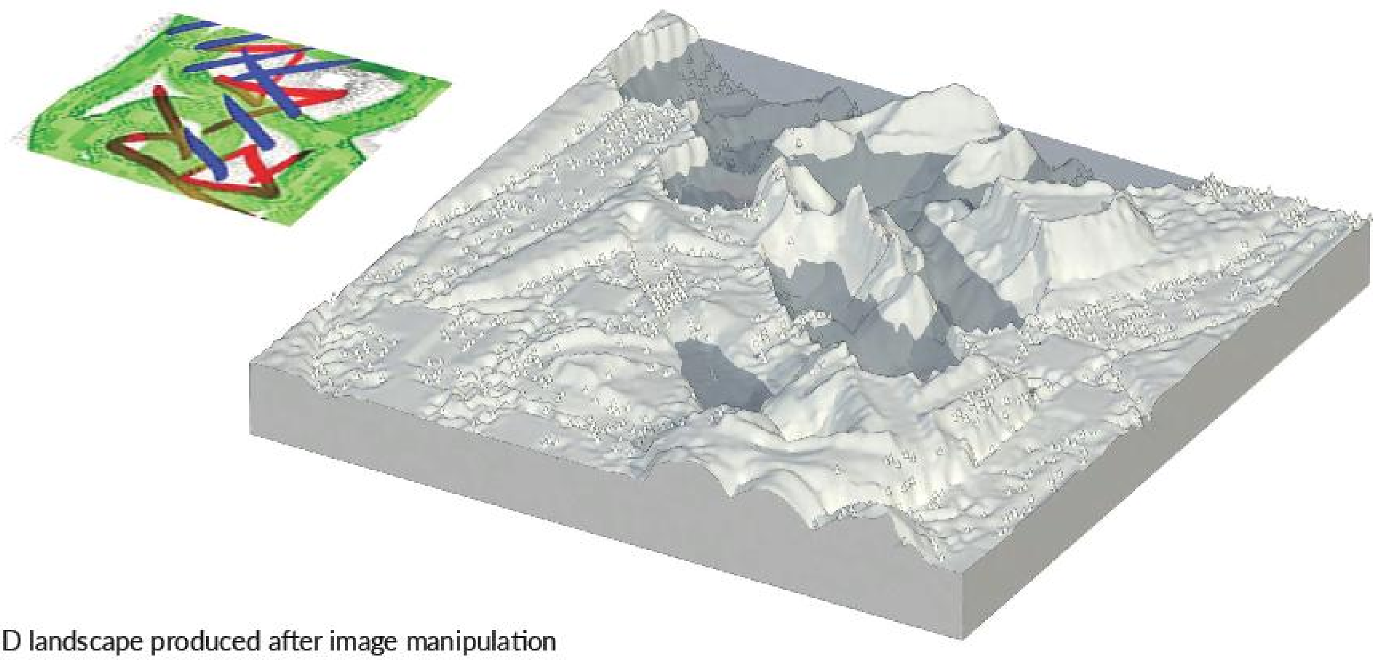
Year: 2013
Location: ENSAPM (Ecole Nationale Supérieure d'Architecture de Paris-Malaquais)
Semester: SS 2013
Teacher: Félix Agid
Tutor: Tristan Gobin
Concept Development: Clément Gosselin, Paul Poinet, Mathieu Venot

The aim of this workshop was to create an experimental protocol allowing the user to consider architectural design by replacing the traditional study of the context by iage processing, vision systems for industrial machines and robotic. The aim is to consider any territory from an algorithmic and/or robotic manipulation of an image.
The main idea of our project was to show which kind of architecture/urbanism/landscape we could obtain through an iterative (or computational) creation process.
First, we created 100 digital paintings which followed strict procedural inputs: three types of colors (red, blue or green), three types of tools (brush, pen or pencil), three types of line (thick, middle or thin) and one boolean operation (touchdown or not).
Then, each painting was analyzed by Roborealm (a software used in computer vision, image analysis, and robotic vision systems). After analysis, we gave the main information of each image to Rhino-Grasshopper and transformd these information into architectural elements (red for the floors, green for the columns and blue for the envelope), urbanism (red for the towers, green for the circulation areas and blue for the houses) and landscape (red for the mountains, green for the trees and blue for the water).

IMG_0030.jpg IMG_0031.jpg IMG_0032.jpg IMG_0033.jpg IMG_0034.jpg



Procedural algorithm for architectural design outputs

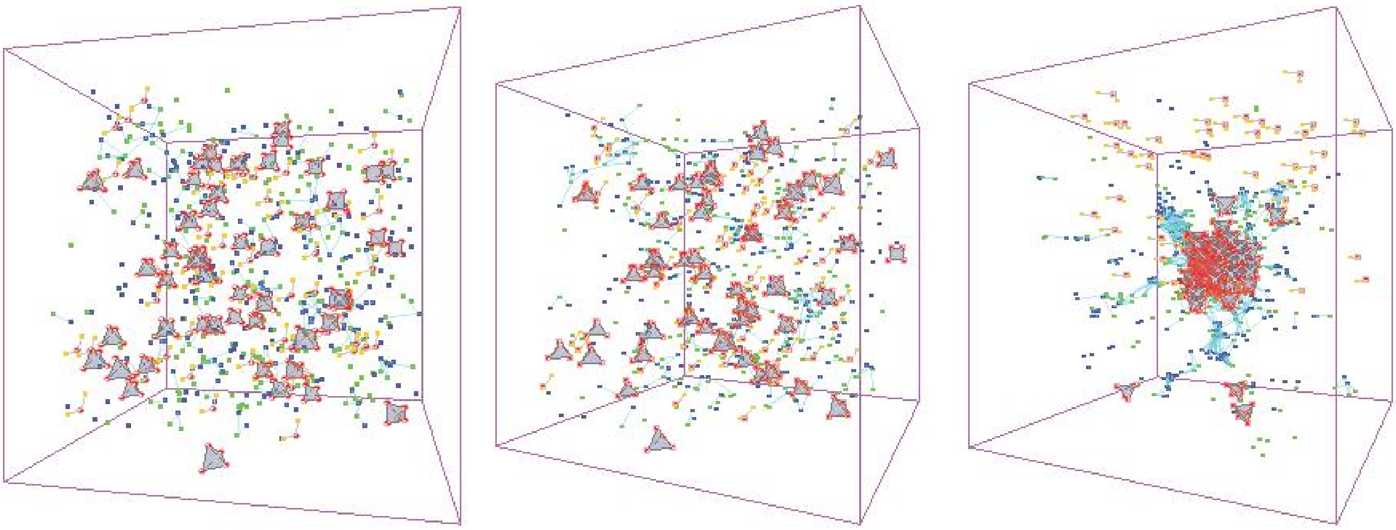


3D landscape produced after image manipulation

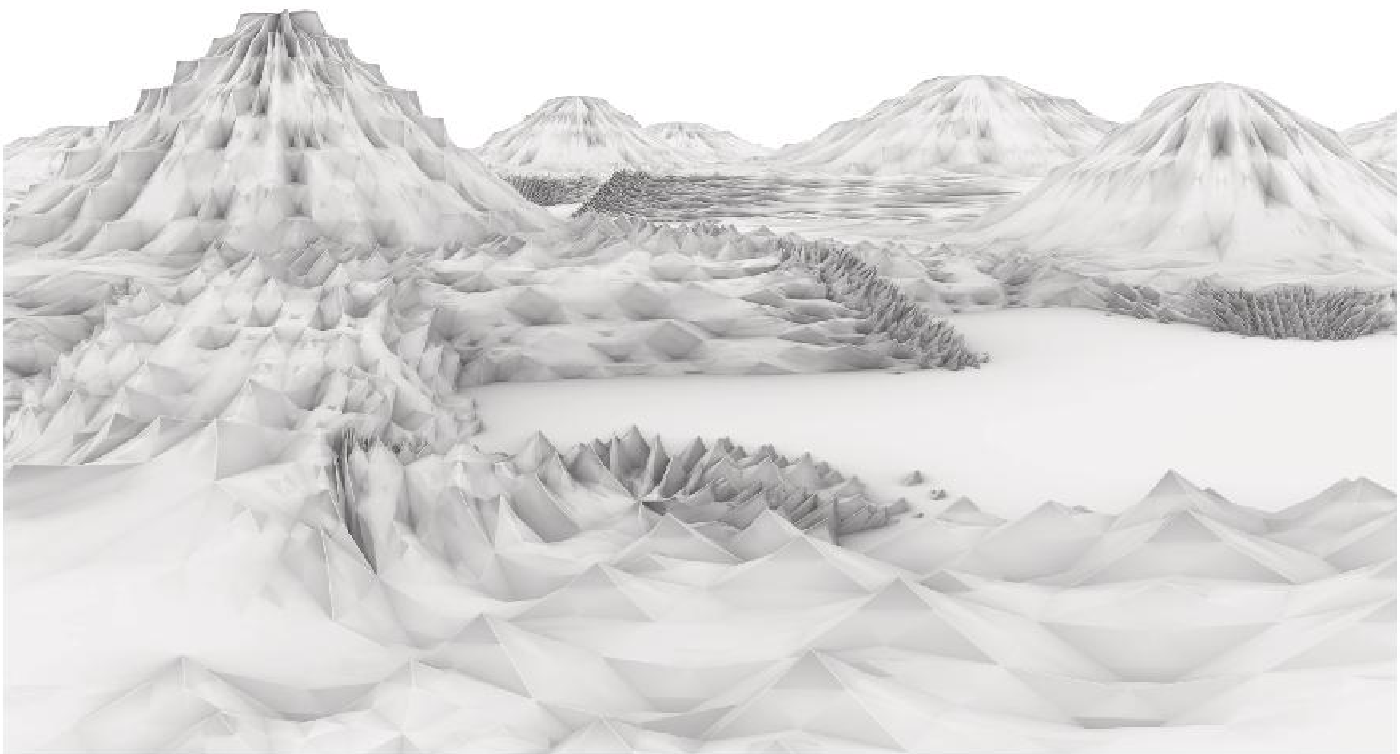
ENSAPM - Research Project - Regressive Resolutions

Year: 2013
Location: ENSAPM (Ecole Nationale Supérieure d'Architecture de Paris-Malaquais)
Semester: SS 2013
Teacher: Pierre Cutellic
Concept Development: Paul Poinet, Mathieu Venot

"This studio, starting from a lecture at the Arts Decoratifs Paris, 23 March 2012 (A Regressive Resolution in Architectural Practices, Pierre Cutellic), takes this event as the starting point of a reflection articulated between current research in integrative design and the ambient management of information and project constraints. It will focus on the experimentation and project methods, representations and conceptions architectural called "regressive". By "regressive resolution", we mean that the architectural production processus can now be polarized by its two ends, by retracting any intermediate phase to focus on the development of its extremums: the definition and control of virtual environments constraints on the first hand and intelligent physical aggregates exceeding the simple concept of assembly post-industrial on the other hand. The notion of simulation will play an important role by linking these two poles. It could be achieved by the representation of dynamic interactions, their bidirectional consequences and its own interactivity as a form of control and evaluation. Finally, these objectives will serve to address simultaneously the notions of information environments, economy of production and engineering of matter."



Sand aggregates and salt crystallization (simulation)

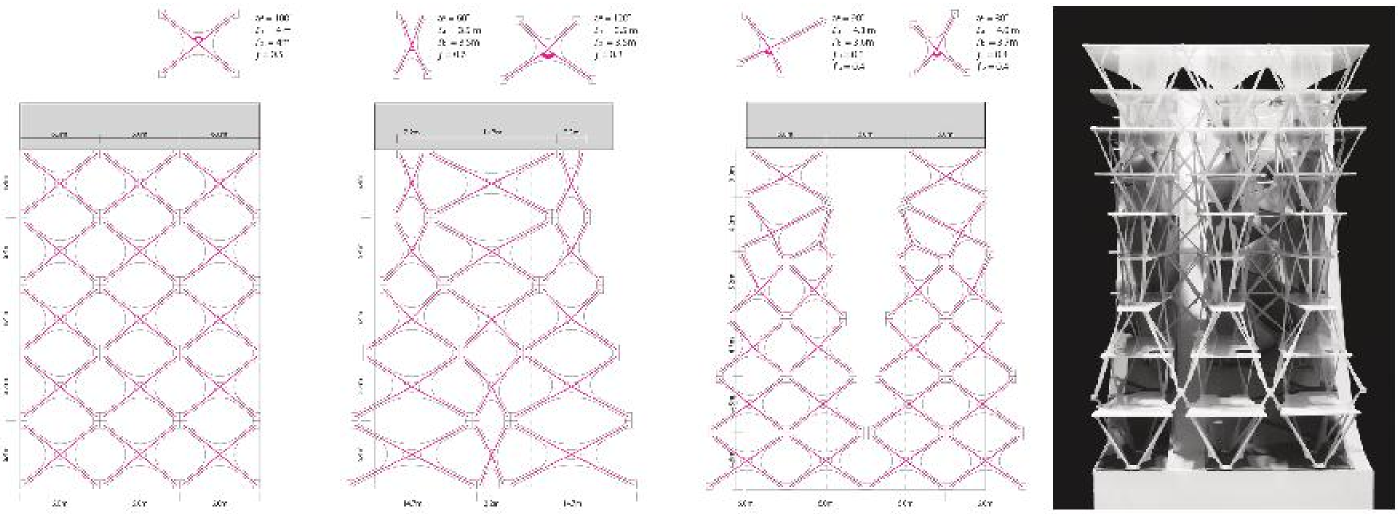


Sand aggregates and salt crystallization (digital landscape)

HKU - International Exchange - Flexible Concrete Project

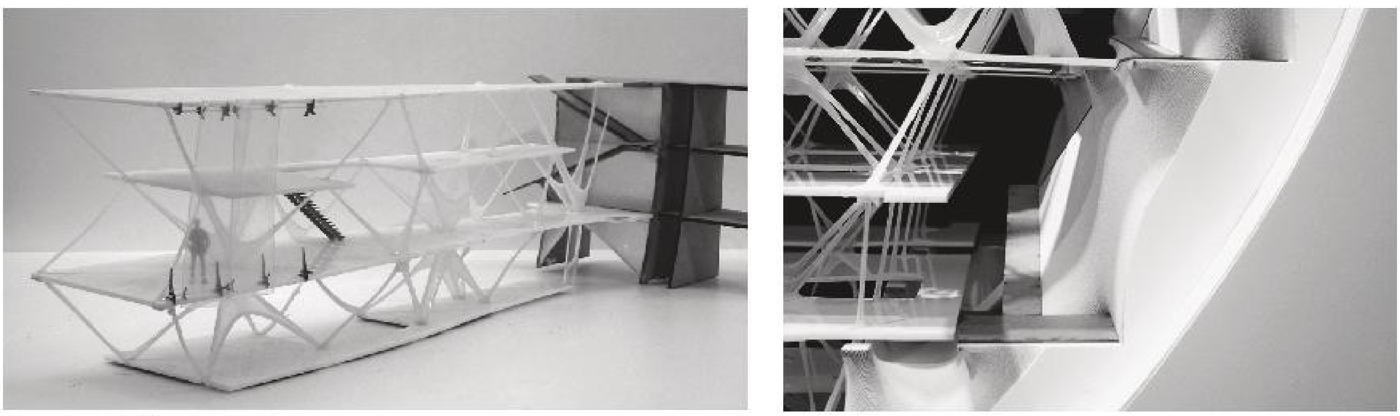
Year: 2012-13
Location: HKU (Hong Kong University)
Semester: WS 2012-13
Assistant Professor: Olivier Ottevaere
Concept Development: Anthony Chu, Paul Poinet

Through design iterations, we created an innovative structural system which could revise and transform the ground proposition (or the contact) as well as the formwork strategy. Our scale of reference and line of attack for the design of the new assembly was a 9-storey generic column-slab structure with a central circulation core. The main pursue of this design process was to challenge this banal yet efficient building skeleton by prioritizing the emergence of new spatial possibilities and inventive structural performances, both as a working result of the casting procedure of the formwork system. The final prototype is made of continuous material (concrete) and therefore its proper craftsmanship was essential focus of the project. An integrated scheme for internal and external circulation has completed a second act of occupation.

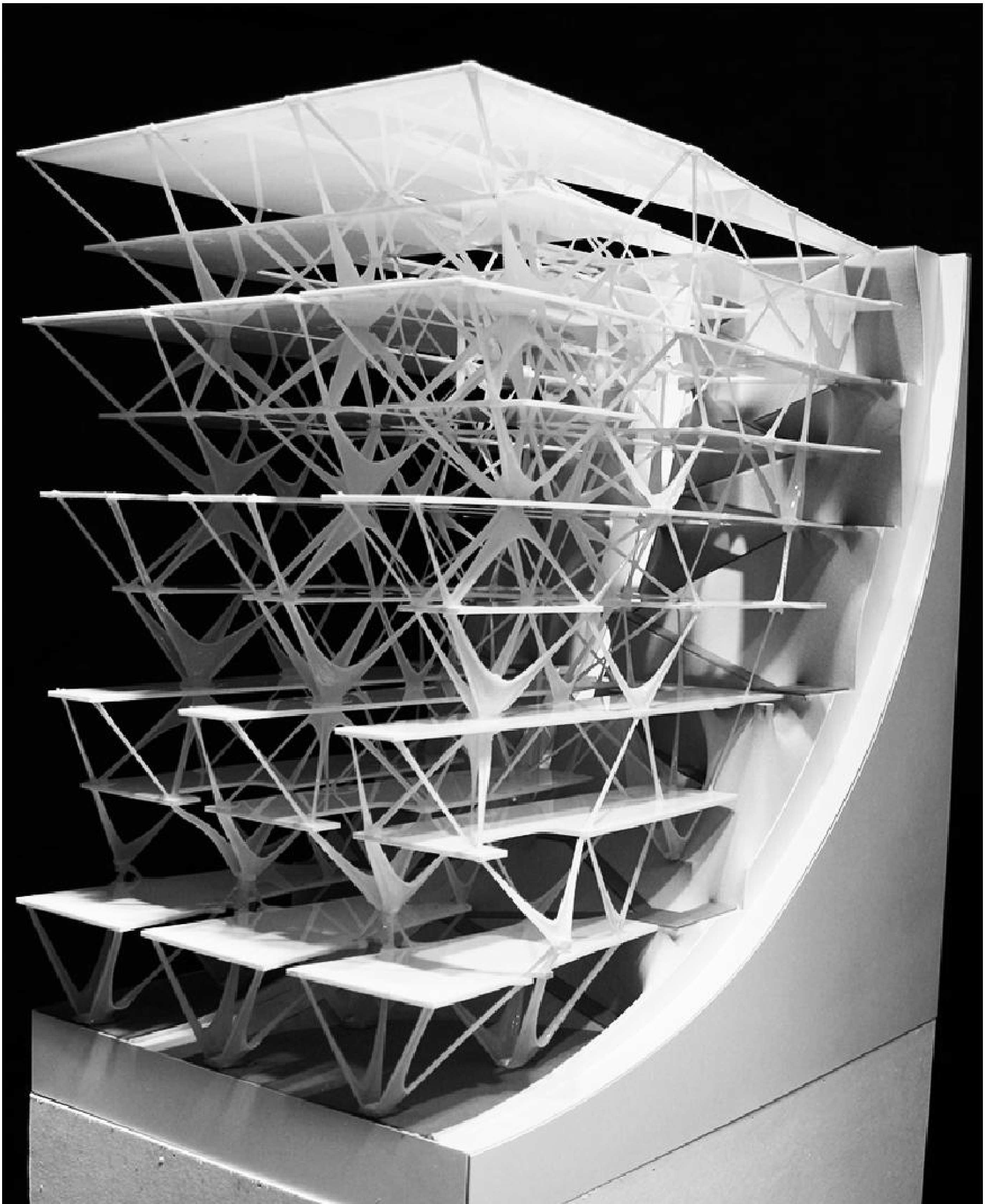


Design Strategy

Fabric formwork

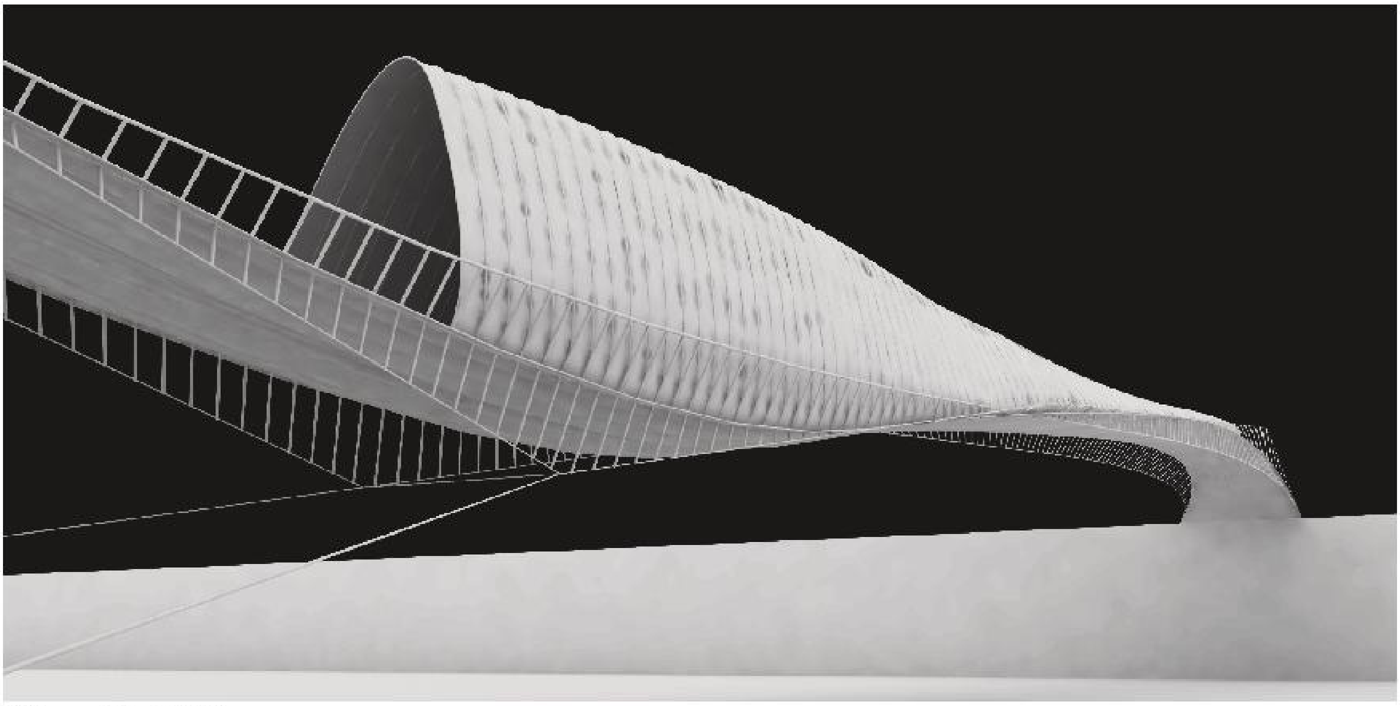


Apartment (Duplex) / Mock-up

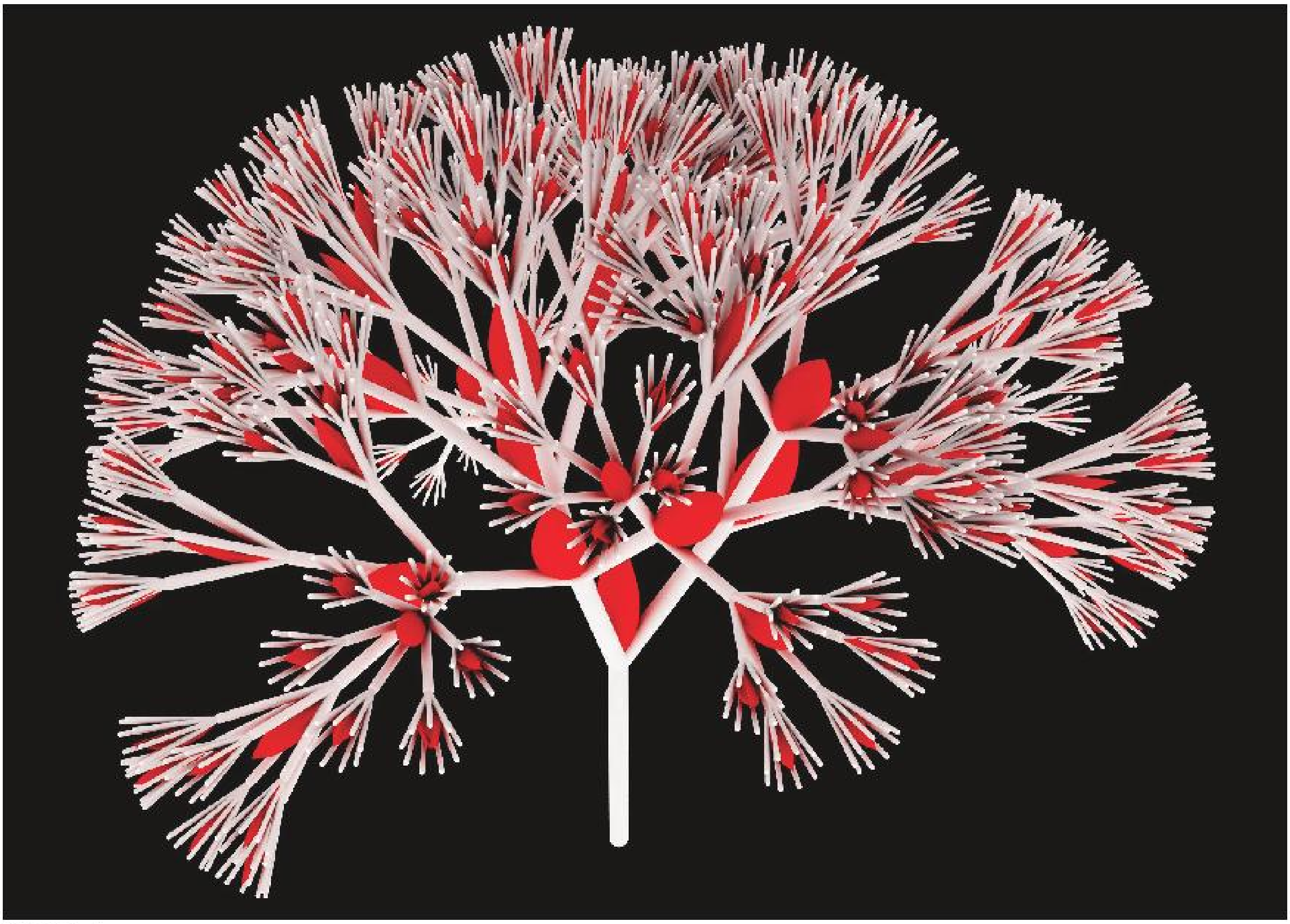

Final prototype (perspective)

ICD - Computational Design Techniques and Design Thinking

Year: 2013-14
Location: ICD (Institute for Computational Design)
Semester: WS 2013-14
Teachers: Ehsan Baharlou, Marshall Prado
Student: Paul Poinet

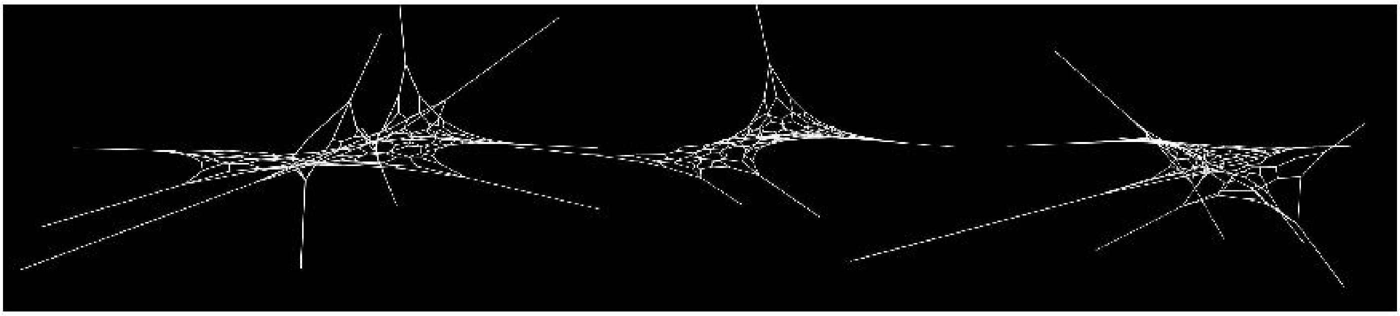


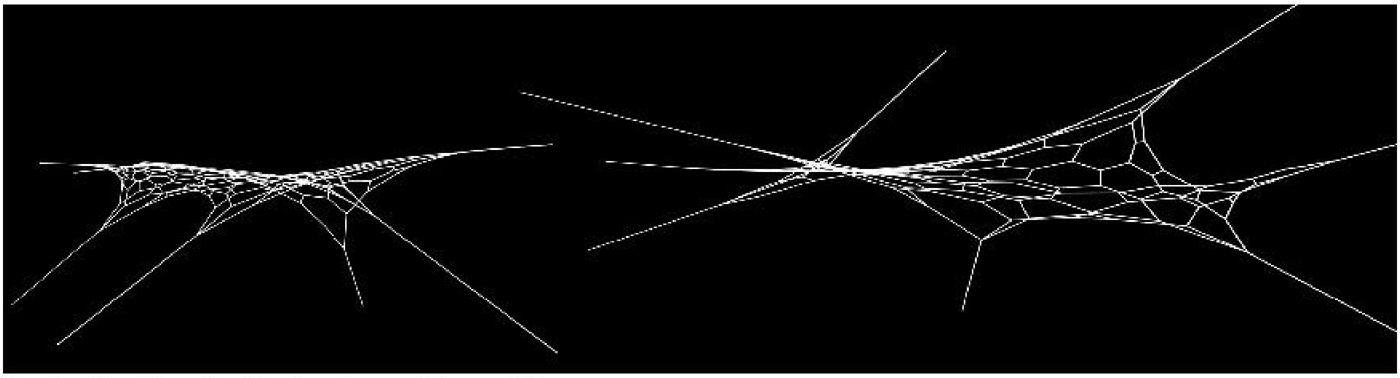
Differentiated bridge



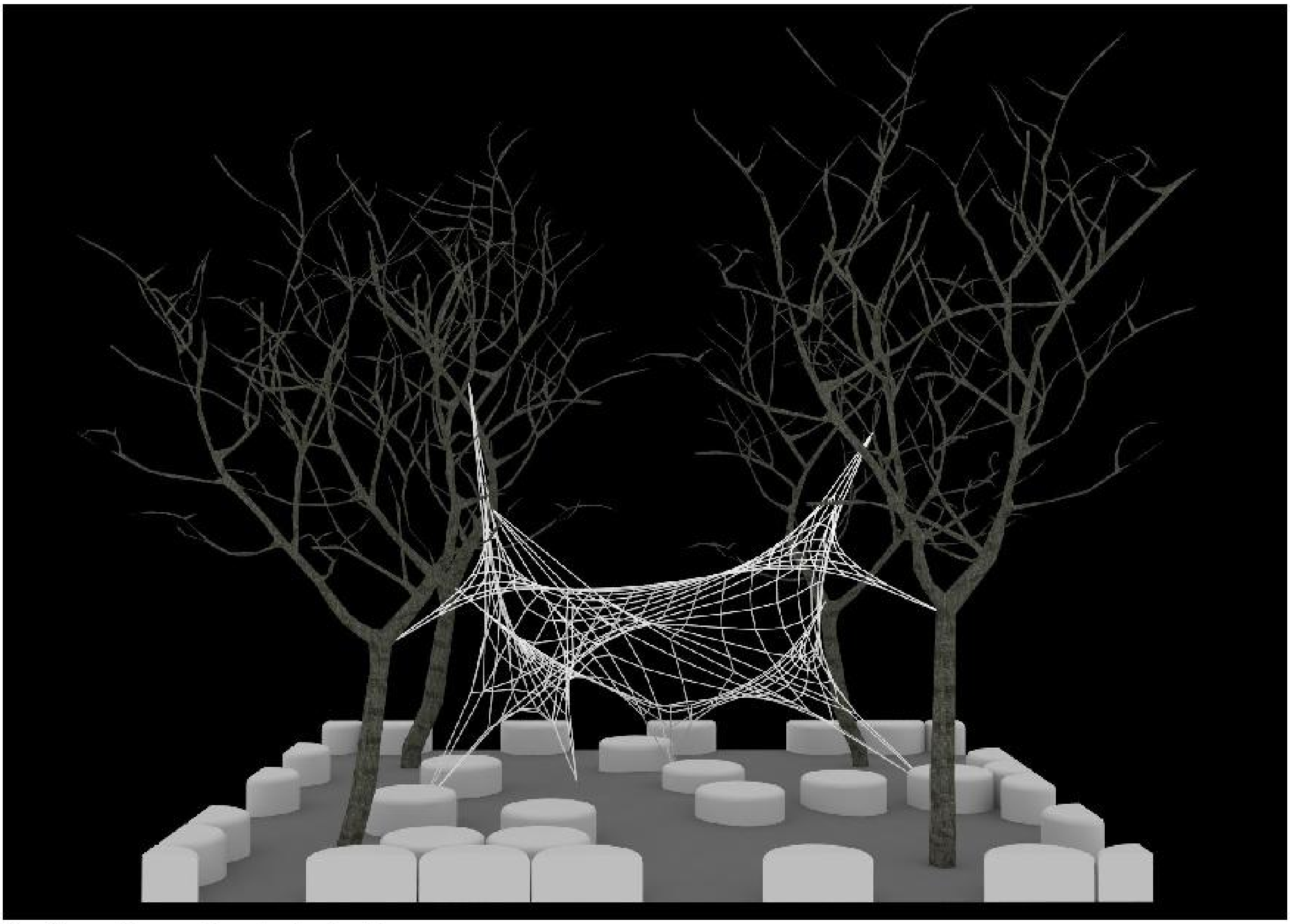
3D L-System

"This seminar will investigate the potentials of algorithmic procedures for architectural design. It will provide an opportunity for the students to enhance their knowledge of algorithms by developing practical scripting skills, understanding theoretically relevant aspects of form generation and exploring mathematical principles underlying patterns in the physical world. Based on the investigation of related mathematics, relatively simple algorithms will be developed to produce complex systems within an architectural context."





Design iterations for the tensile pavilion script

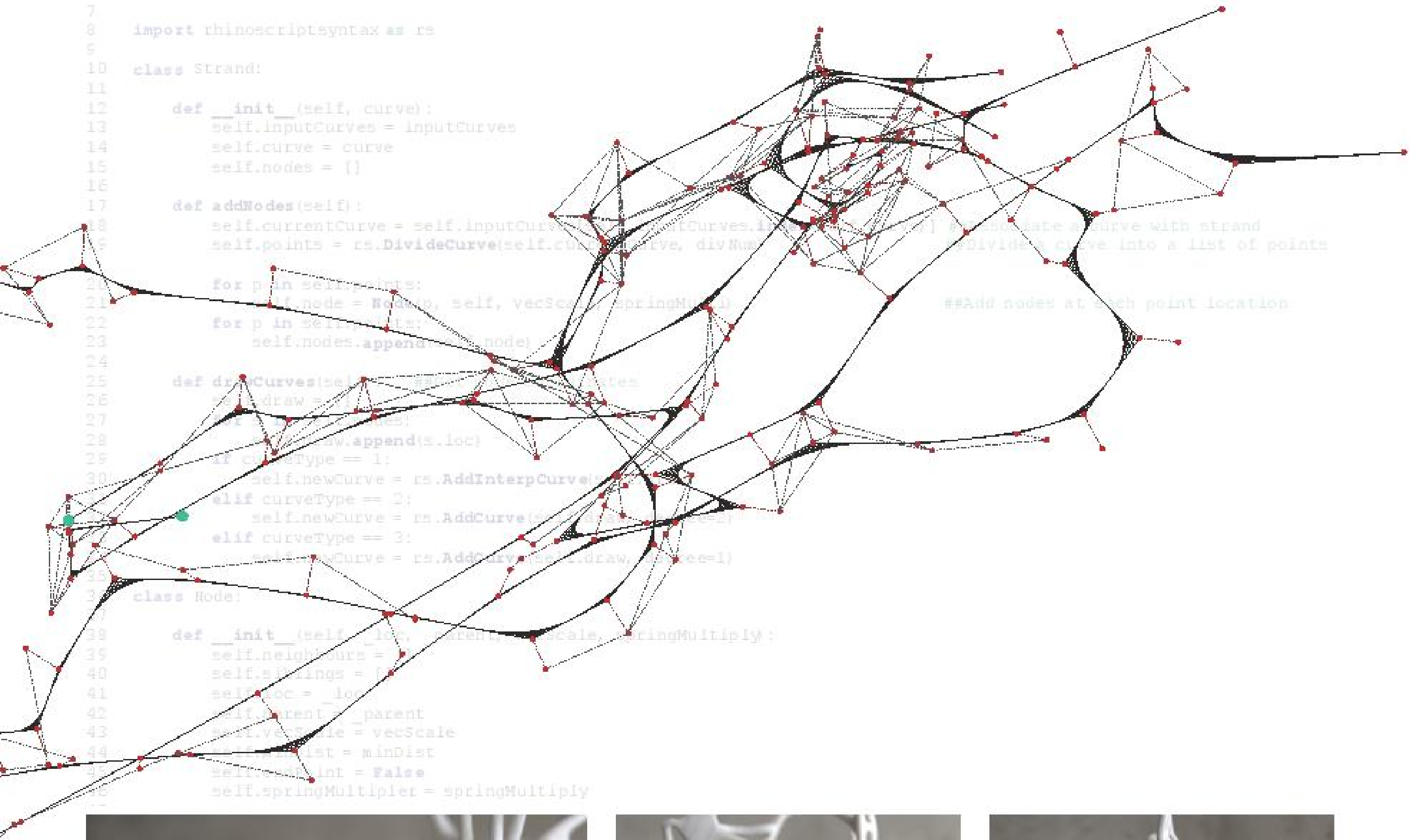


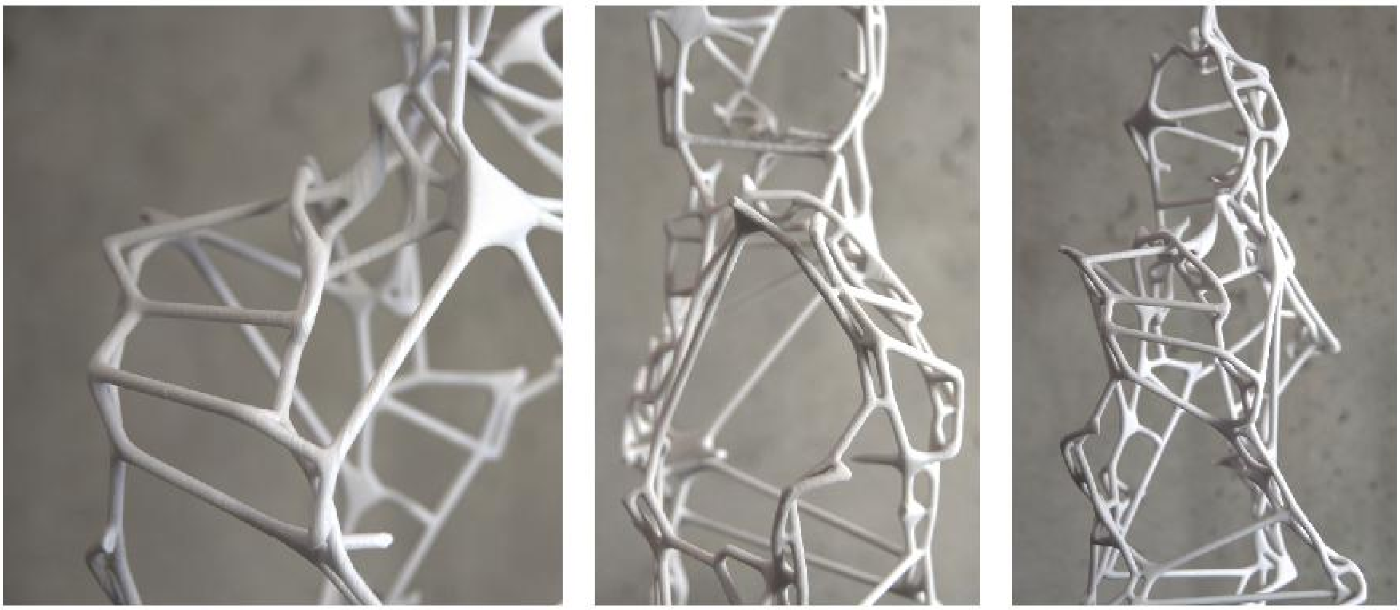
Tensile pavilion and contextualization

ICD - Computational Design Techniques and Design Thinking (final project)

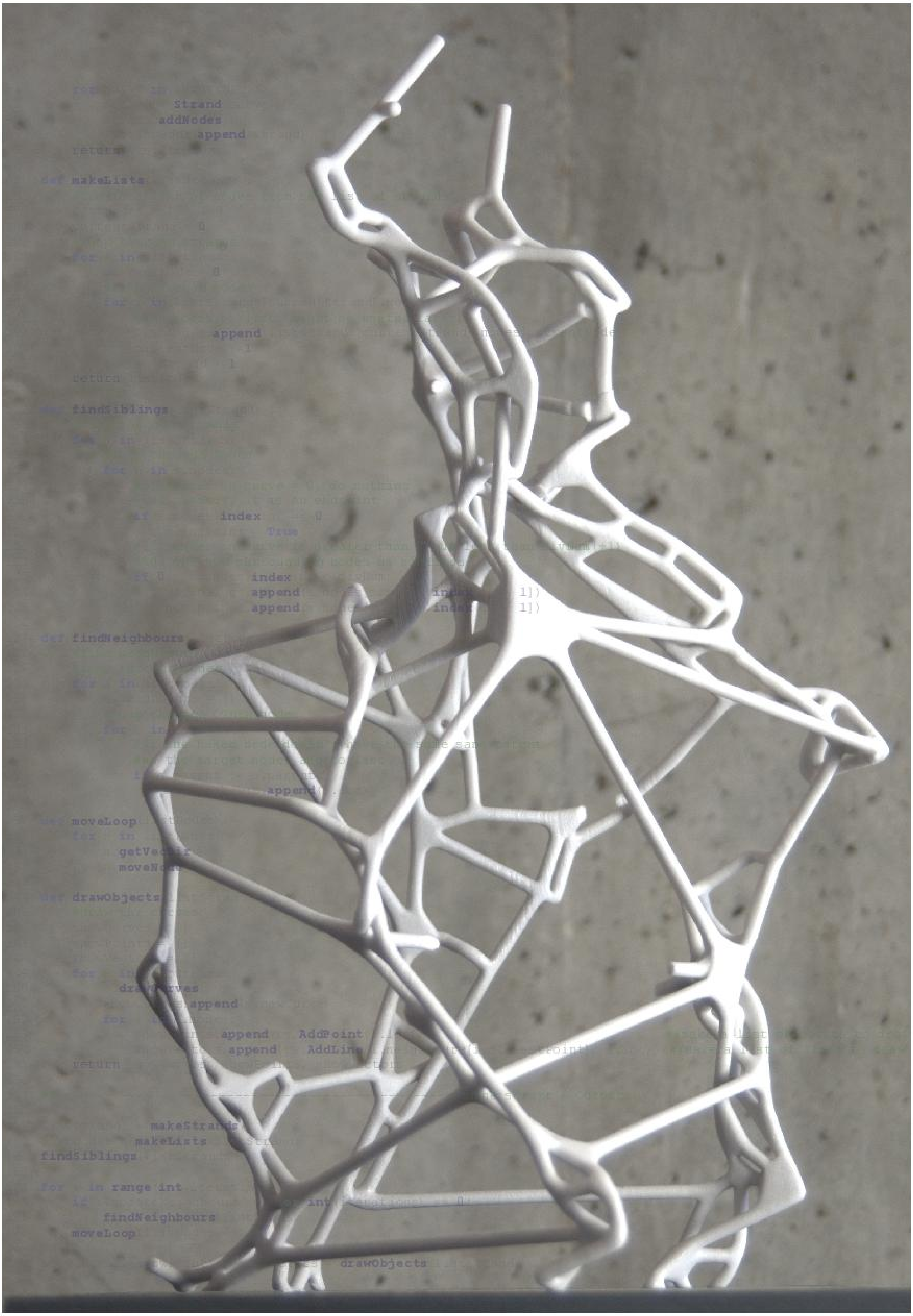
Year: 2013-14
Location: ICD (Institute for Computational Design)
Semester: WS 2013-14
Teachers: Ehsan Baharlou, Marshall Prado
Student: Paul Poinet
Final project: Redundant evolution with fibre-fibre interactions

The aim of this project was to investigate different structures made of fibres (i.e. spiderwebs) and their fibre-fibre interaction behaviour. By exploring different situations, we tried to emphasize specific spatial qualities allowed by bundlings and connections. The simulation was written in ghPython for Grasshopper. The final prototype was 3D-printed.





Final 3D printed model



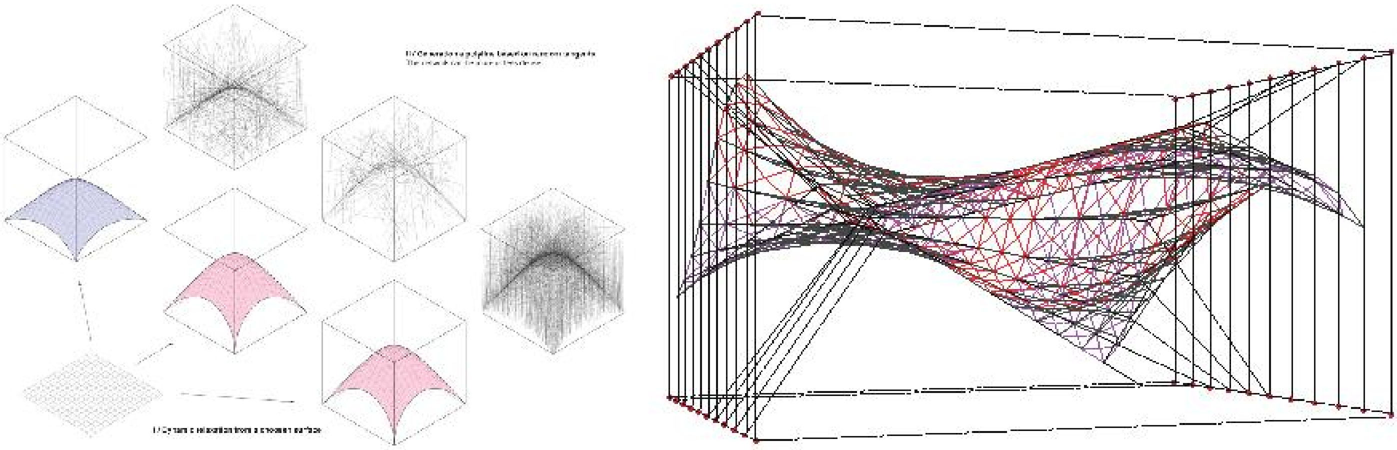
Final 3D printed model

ICD - Design Studio: Architectural Biomimetics / Spider webs investigations

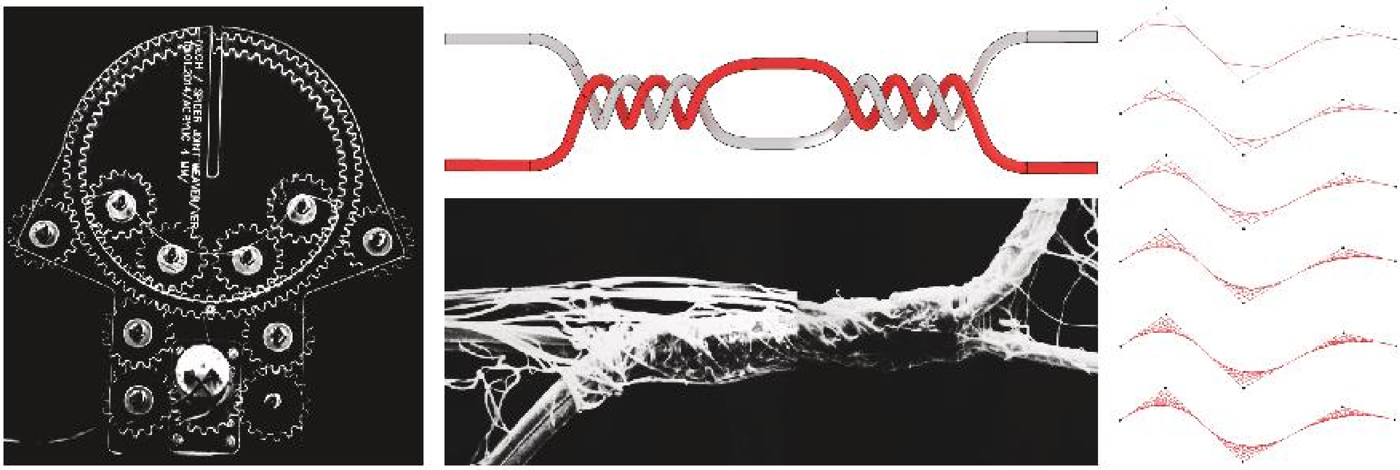
Year: 2013-14
Location: ICD (Institute for Computational Design)
Semester: WS 2013-14
Teachers: Moritz Dörstelmann, Marshall Prado
Students: Yassmin Al-Khasawneh, Yuliya Baranovskaya, Paul Poinet, Maria Yablonina

Focusing on a specific biological role model, the aim of this project was to abstract principles found in spider webs and extend their properties for design and architectural purposes. During this research, we analyzed the joints produced by the spider itself and translated them into small scale prototypes which could be built by using robotic fabrication.

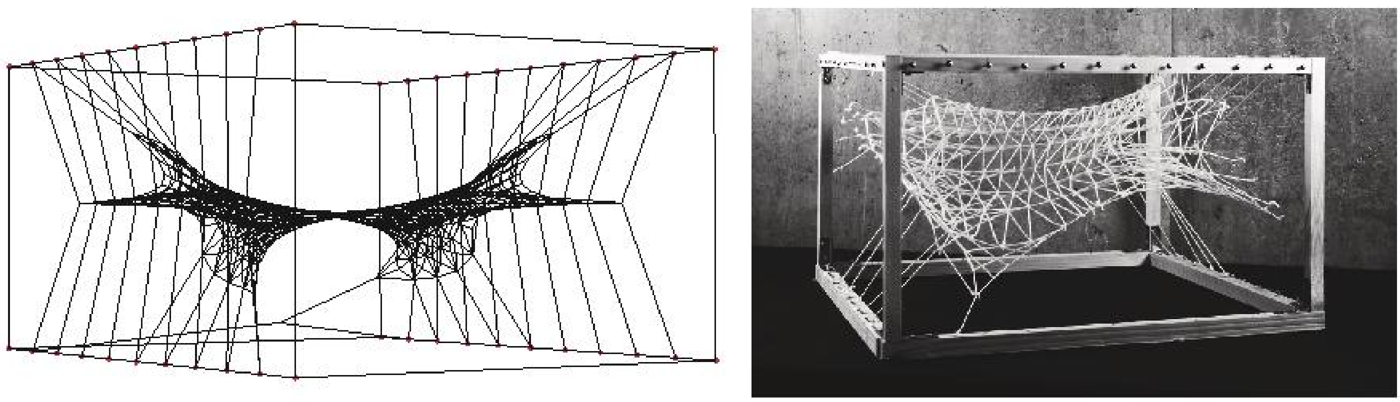
After biological researches on the spider web role model, we decided to translate into architectural principles the two most interesting aspects present in a 3D spider-web: the fibre-fibre interactions between the threads (on a local level) and the supporting threads techniques that the spider is using in order to create specific shapes that allow it to live and catch preys (on a global level).



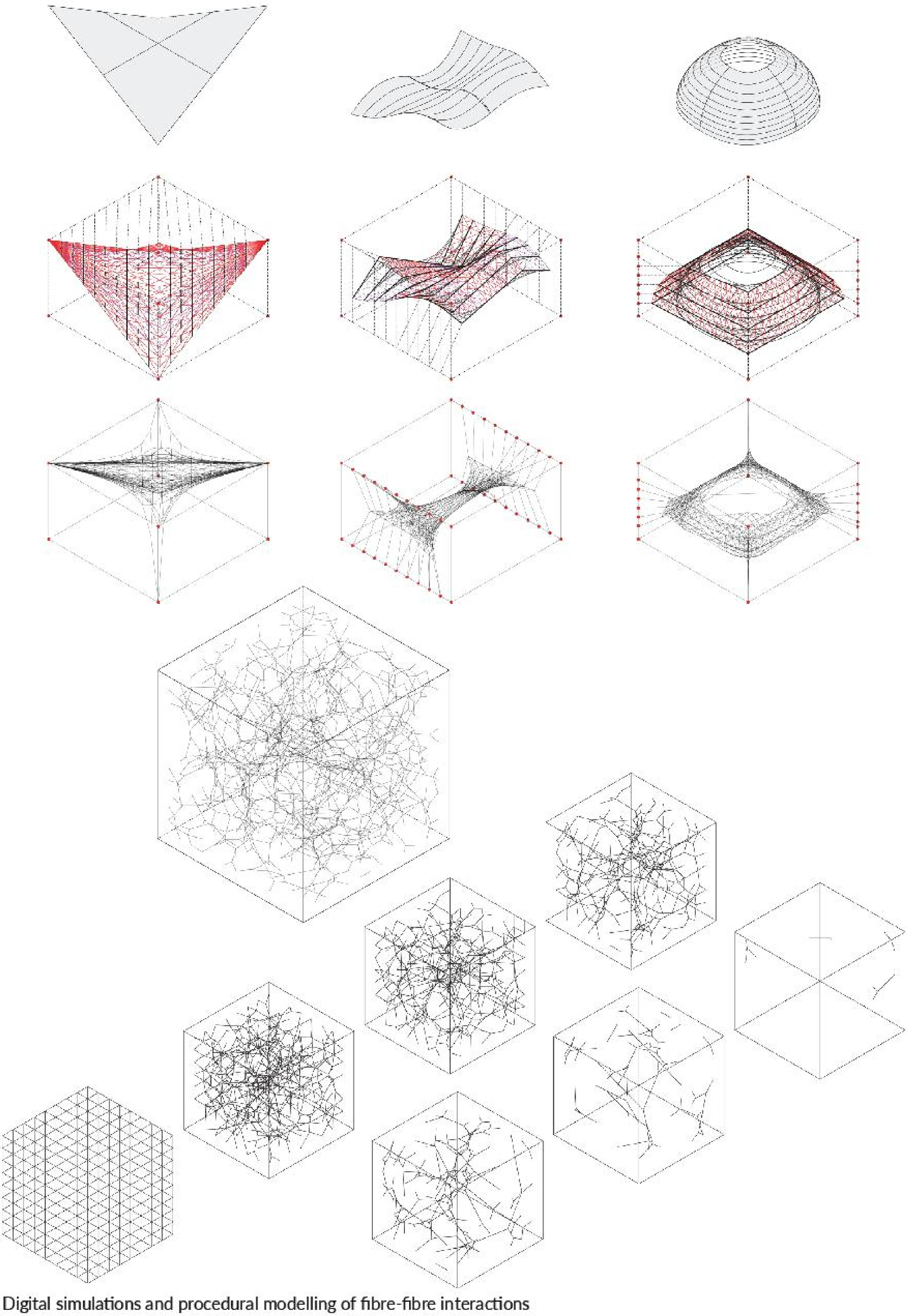
Digital simulations and procedural modelling of fibre-fibre interactions



Joint mechanism and weaving prototype



Digital simulation and physical prototype



Digital simulations and procedural modelling of fibre-fibre interactions

ICD/ITKE Research Pavilion 2013-14

ICD Institute for Computational Design – Prof. Achim Menges
ITKE Institute of Building Structures and Structural Design – Prof. Jan Knippers

The Institute for Computational Design (ICD) and the Institute of Building Structures and Structural Design (ITKE) of the University of Stuttgart have constructed another bionic research pavilion. The project is part of a successful series of research pavilions which showcase the potential of novel design, simulation and fabrication processes in architecture. The project was planned and constructed within one and a half year by students and researchers within a multi-disciplinary team of biologists, paleontologists, architects and engineers.

The focus of the project is a parallel bottom-up design strategy for the biomimetic investigation of natural fiber composite shells and the development of novel robotic fabrication methods for fiber reinforced polymer structures. The aim was the development of a winding technique for modular, double layered fiber composite structures, which reduces the required formwork to a minimum while maintaining a large degree of geometric freedom. Therefore, functional principles of natural lightweight structures were analyzed and abstracted in cooperation with the Institute of Evolution and Ecology and the department for Paleobiology of the University of Tübingen. Through the development of a custom robotic fabrication method, these principles were transferred into a modular prototype pavilion.

Scientific Development
Moritz Dörstelmann, Vassilios Kirtzakis, Stefana Parascho, Marshall Prado, Tobias Schwinn

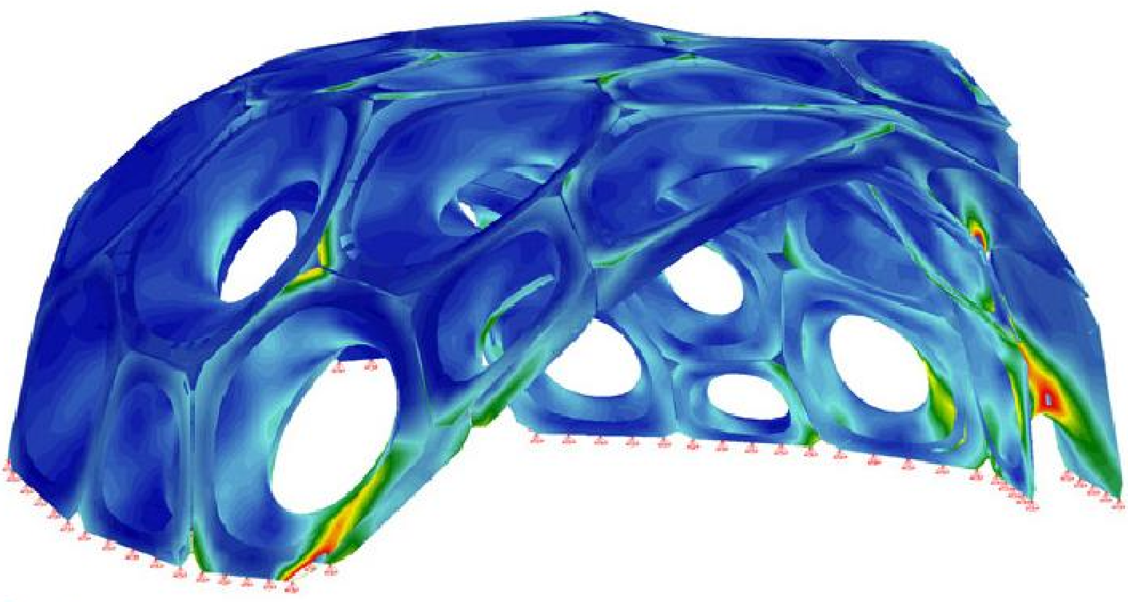
System Development, Fabrication & Construction
Desislava Angelova, Hans-Christian Bäcker, Maximilian Fichter, Eugen Grass, Michael Herrick, Nam Hoang, Alejandro Jaramillo, Norbert Jundt, Taichi Kuma, Ondrej Kyjánek, Sophia Leistner, Luca Menghini, Claire Milnes, Martin Nautrup, Gergana Rusenova, Petar Trassiev , Sascha Vallon, Shiyu Wie, Leyla Yunis, Hassan Abbasi, Yassmin Al-Khasawneh, Yuliya Baranovskaya, Marta Besalu, Giulio Brugnaro, Elena Chiridnik, Eva Espuny, Matthias Helmreich, Julian Höll, Shim Karmin, Georgi Kazlachev, Sebastian Kröner, Vangel Kukov, David Leon, Amanda Moore, Paul Poinet, Emily Scoones, Djordje Stanojevic, Andrei Stoiculescu, Kenryo Takahashi, Maria Yablonina and support of Michael Preisack and Michael Tondera.

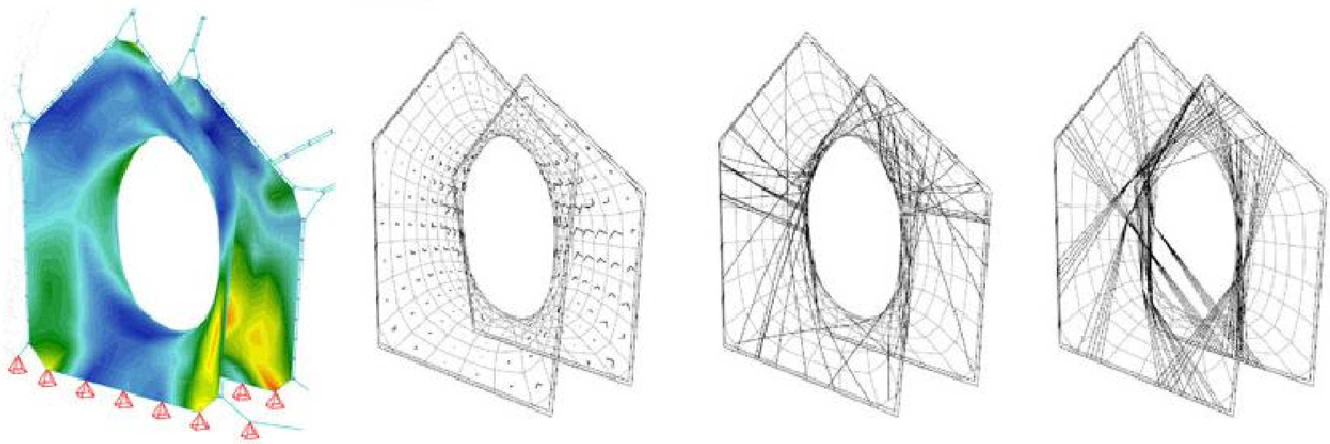
In collaboration with:
Institute of Evolution and Ecology, Evolutionary Biology of Invertebrates, University of Tübingen – Prof. Oliver Betz
Department of Geosciences, Palaeontology of Invertebrates, University of Tübingen – Prof. James Nebelsick
Module Bionics of Animal Constructions, University of Tübingen: Gerald Buck, Michael Münster, Valentin Grau, Anne Buhl, Markus Maisch, Matthias Loose, Irene Viola Baumann, Carina Meiser
ANKA / Institute for Photon Science and Synchrotron Radiation
Karlsruhe Institute of Technology (KIT) – Dr. Thomas van de Kamp, Tomy dos Santos Rolo, Prof. Dr. Tilo Baumbach
Institute for Machine Tools, Universität Stuttgart – Dr.-Ing. Thomas Stehle, Rolf Bauer, Michael Reichersdörfer
Institute of Textile Technology and Process Engineering ITV Denkendorf – Dr. Markus Milwich

Funding
Competence Network Biomimetics, KUKA Roboter GmbH, SGL Group, Sika, AFBW – Allianz Faserbasierte Werkstoffe Baden-Württemberg

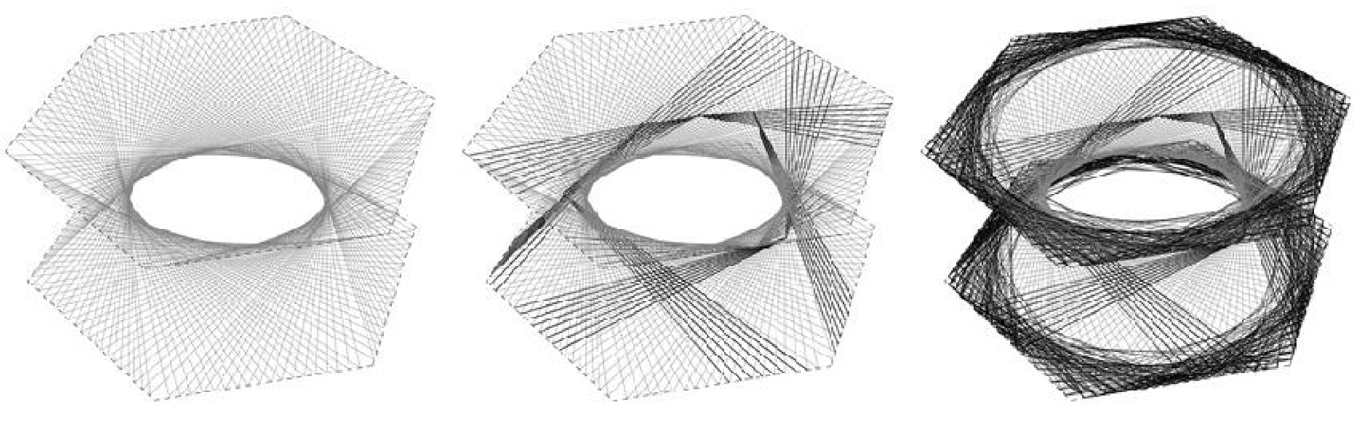
ICD/ITKE Research Pavilion 2013-14

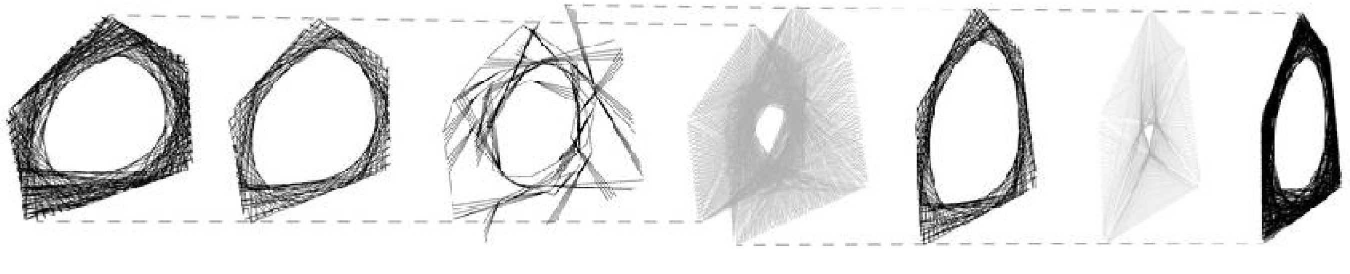
Physical prototype of a component system



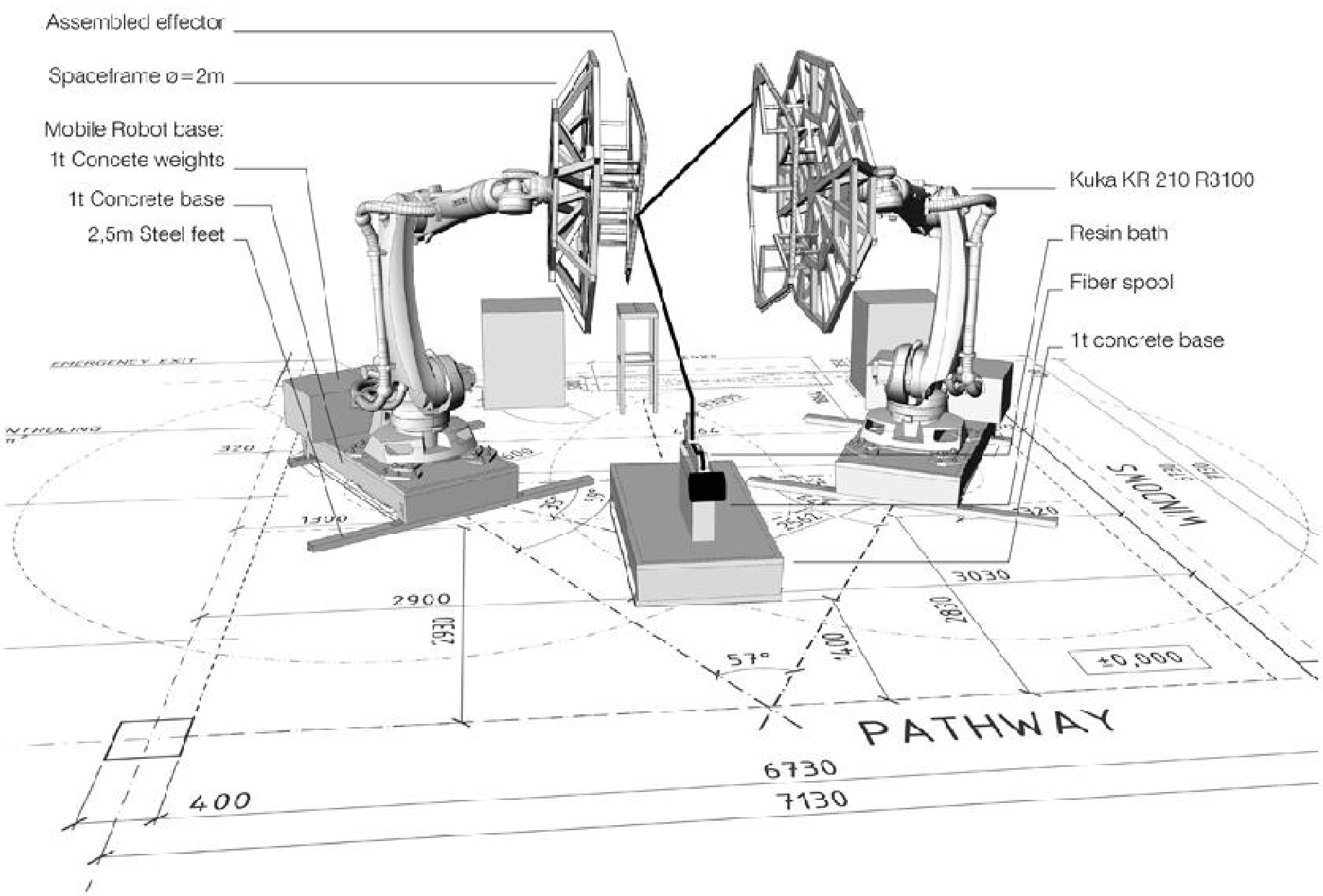


Structural analysis influencing the fibre-fibre design layout





Differentiated fiber layout based on the Elytra's biological role model

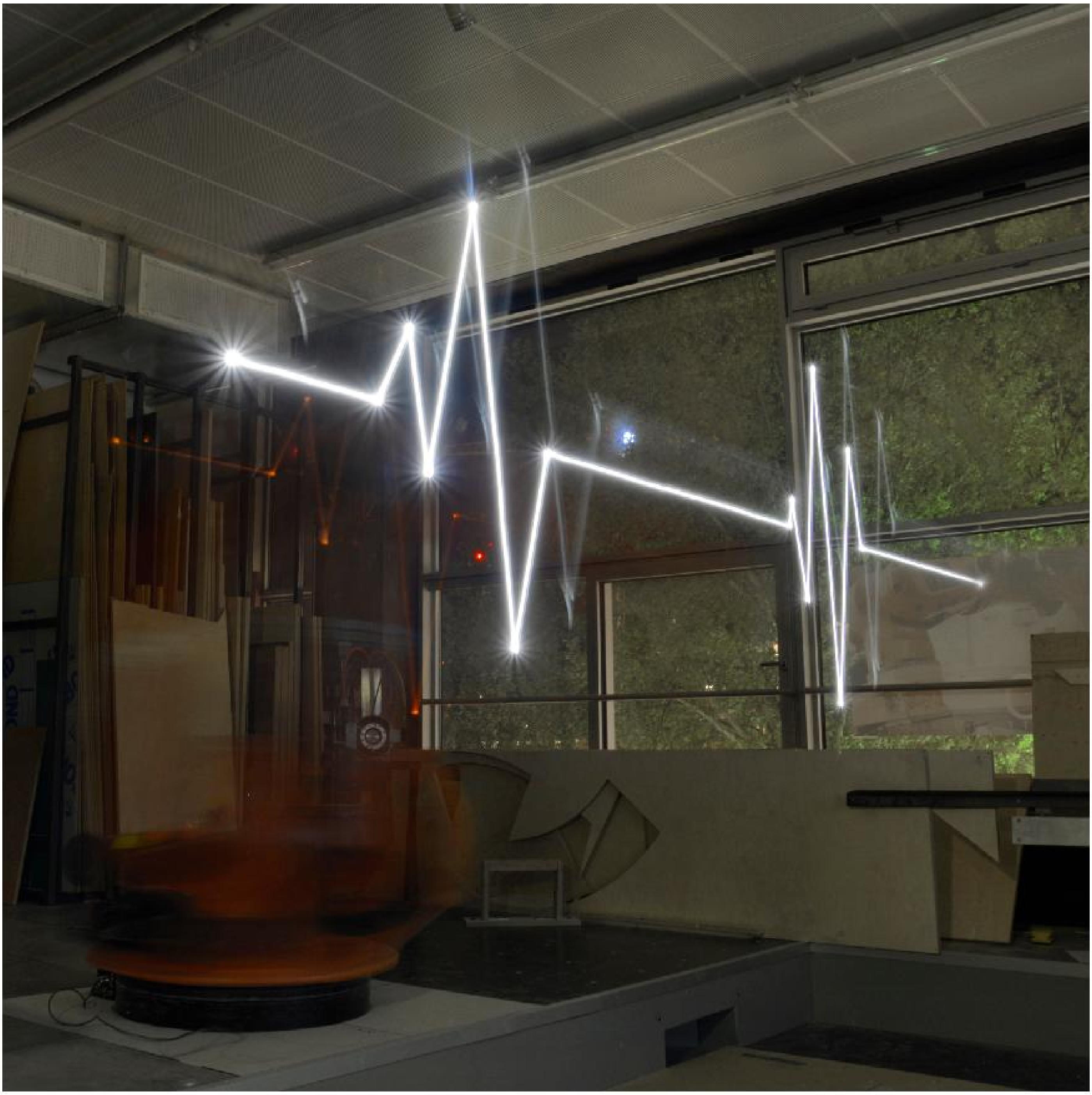


Robotic setup and winding simulation

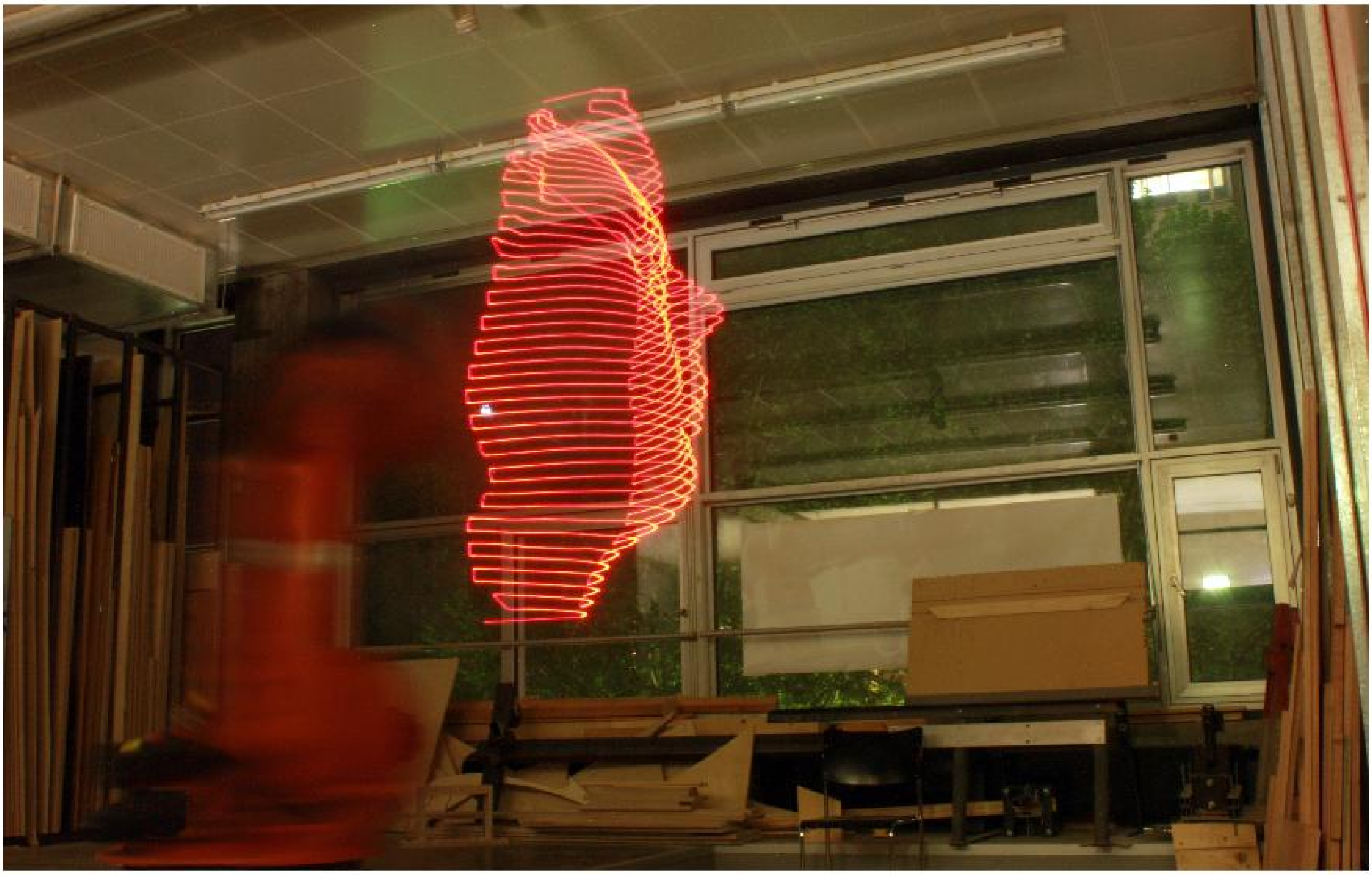

Robotic fabrication of a component

ICD - Robotic fabrication (Light Sculptures)

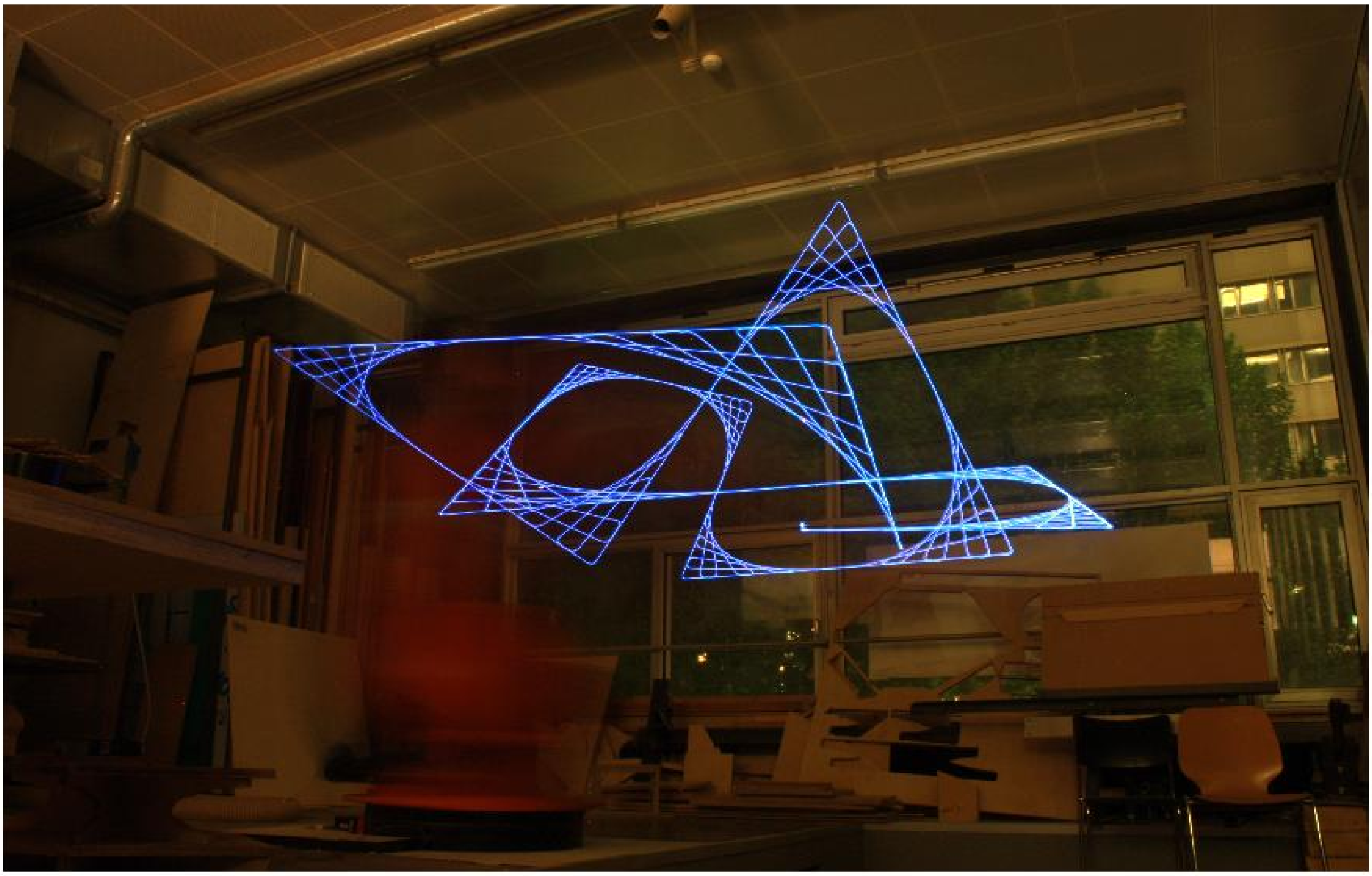
Year: 2013-14
Location: ICD (Institute for Computational Design)
Semester: SS 2014
Teachers: Tobias Schwinn, Marshall Prado, Karola Dierichs
Students: Julian Höll, Georgi Kazlachev, Paul Poinet, Djordje Stanojevic



Heartbeat
To maintain a horizontal and continuous path on the same high, the robot was moved on previously saved coordinates.



Thom Yorke
By understanding the limitation and advantages of a milling software such as Hypermill, the chosen geometry was meant to be reached by the tool with a 3 axis job. The iso file from Hypermill cointains the G-Code which is post-processed in Robomove and exported as GDSRC.

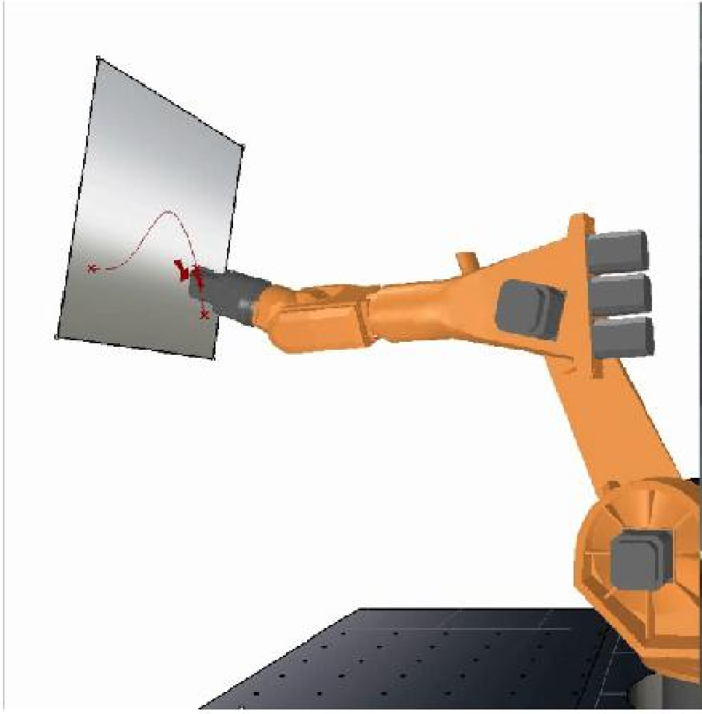


NURBS construction
The sculpture represents the method used to construct geometrically a NURBS curve. Creating directly the G-Code in Grasshopper, it gives to the robot the possibility to draw a polyline freely in space without software constrains. The G-Code is postprocessed in Robomove and exported as GDSRC.

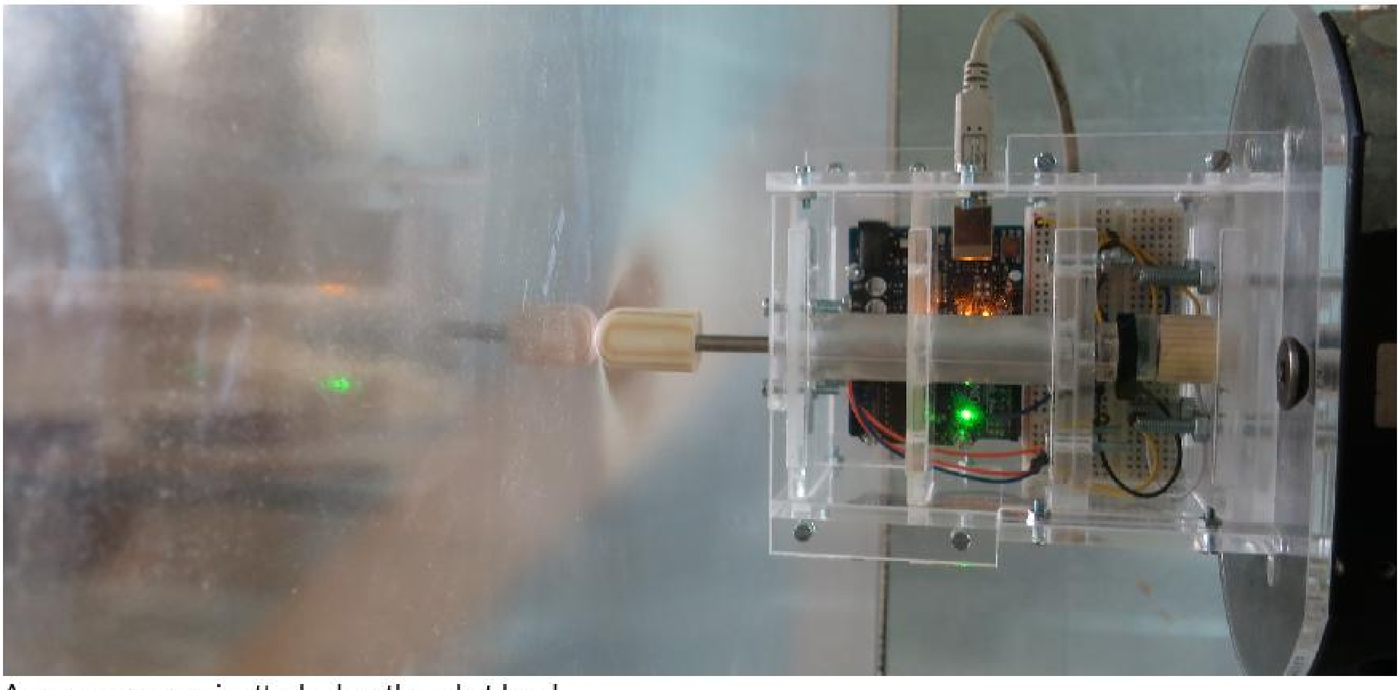
ICD - Robotic fabrication (Live Robotic Path Correction)

Year: 2013-14
Location: ICD (Institute for Computational Design)
Semester: SS 2014
Teachers: Tobias Schwinn, Marshall Prado, Karola Dierichs
Students: Julian Höll, Georgi Kazlachev, Paul Poinet, Djordje Stanojevic

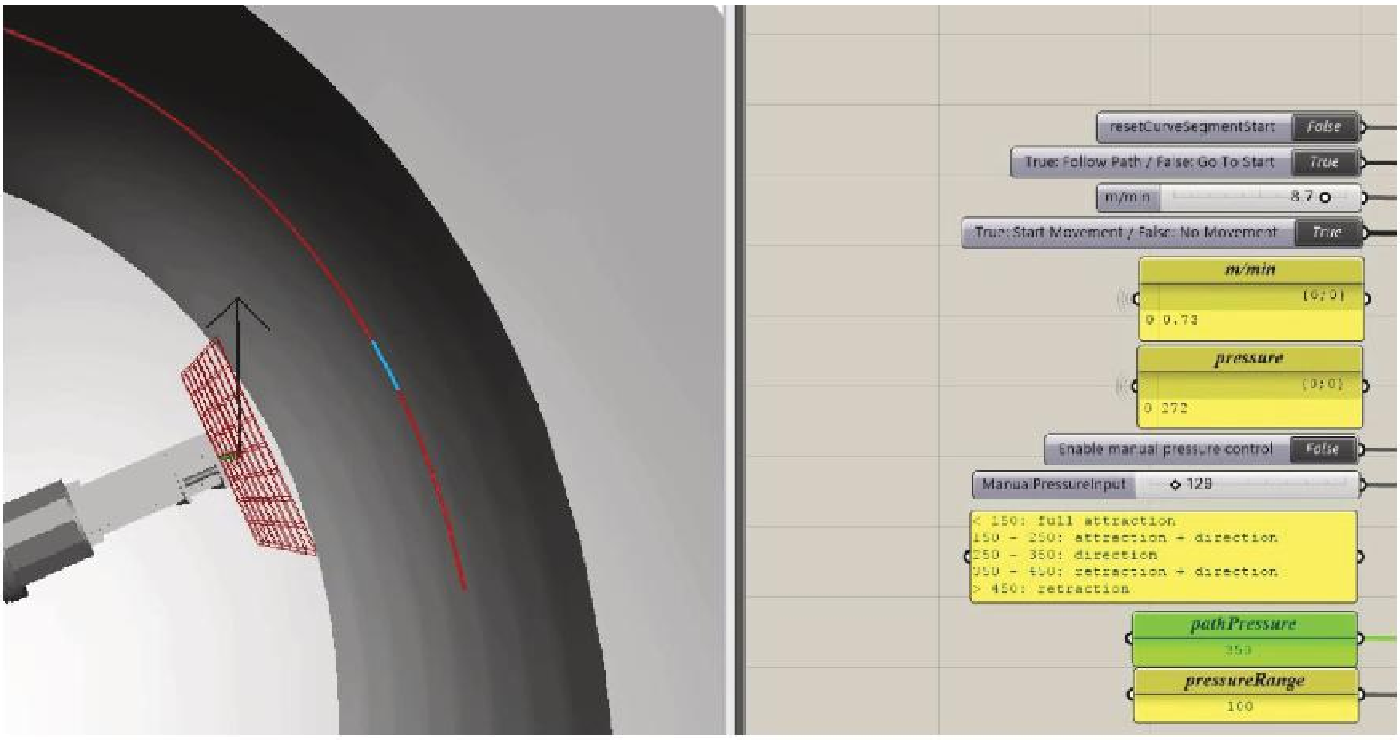
The Research Pavilion 2013-14 is emerging from a extensive biomimetic research of the insect water spider. This animal forms a pneumatic bubble of air underwater and reinforces it from inside with its spider webs. Our intent is to apply the same building principle in a small-scale structure. A glass/carbon fibre pattern should be applied by a robot on a inflated foil membrane, thus reinforcing this pneumatic. The machine would be positioned on the inside and working in an isolated envelope without a human interference. In order to achieve this, a concise method of controlling the robot movement is needed while the exact amount of applied force on the membrane is calculated and adjusted. This increases the tasks complication, as much input from the environment is fed in the process. Our groups particular goal is to achieve a smooth integration of the force sensor in the software system and in the robot controls logic and a performative interpretation of the received data, which alters and adjust the robot movement in the inflatable.

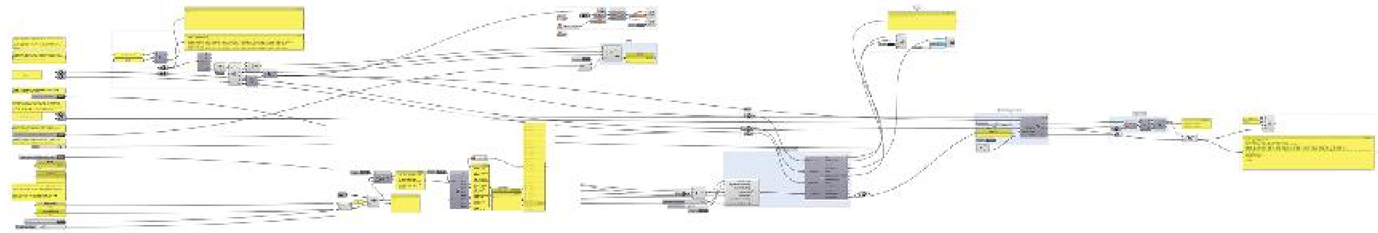


First physical test with the force sensor showing and extracting pressure data



A pressure sensor is attached on the robot head





The RSI script has been written in C# and the feedback loop in ghPython

Physical test - carbon fiber layout

ICD/ITKE Research Pavilion 2014-15

The ICD/ITKE Research Pavilion 2014-15 investigates the robotically-controlled placement of carbon- and glassfiber filaments onto full scale pneumatic formwork as a novel and material efficient on site fabrication strategy for light weight constructions. A major challenge in developing this technique is the constantly changing shape of the pneumatic form-work under the influence of external climate conditions and live applied loading during the fiber placement process. Therefore the ICD/ITKE team was provided with a Kuka KR 120 R3900 K ultra equipped with the Kuka Robot Sensor Interface (RSI), fascilitating online path corrections of the robot based on iterative sensor data input.

ICD Institute for Computational Design – Prof. Achim Menges
ITKE Institute of Building Structures and Structural Design – Prof. Jan Knippers

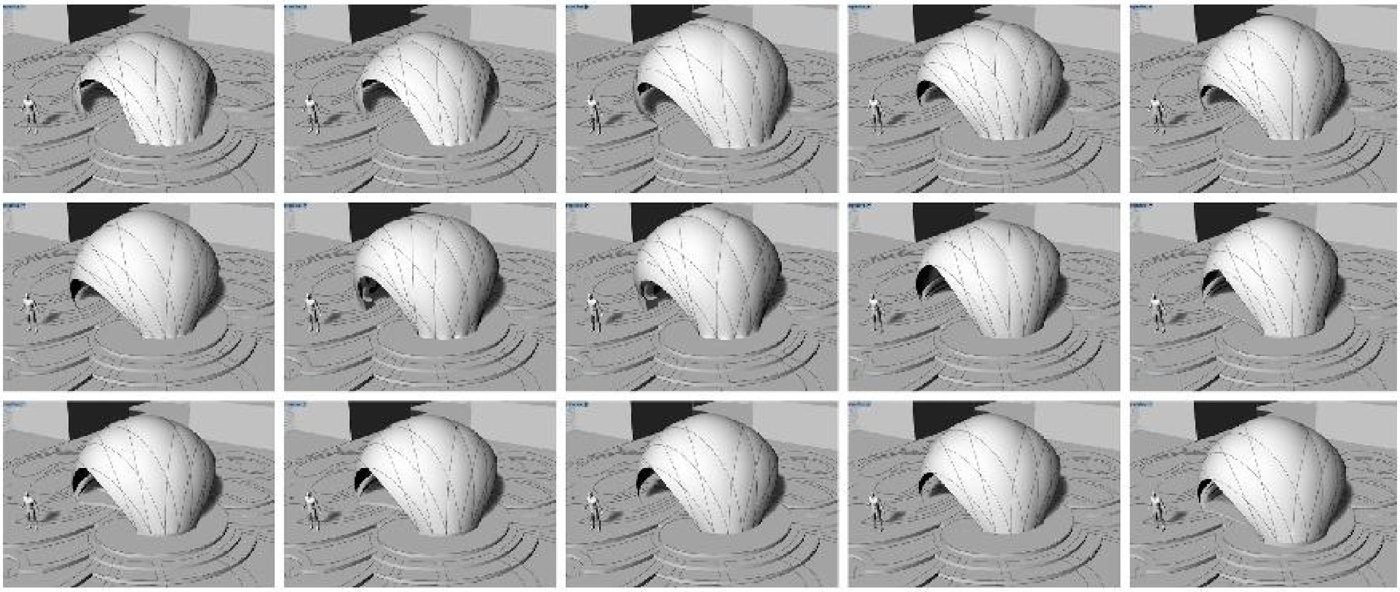
Scientific Development
Moritz Dörstelmann, Valentin Koslowski, Marshall Prado, Gundula Schieber, Lauren Vasey

System Development, Fabrication & Construction
Hassan Abbasi, Yassmin Al-Khasawneh, Yuliya Baranovskaya, Marta Besalu, Giulio Brugnaro, Elena Chiridnik, Tobias Grun, Mark Hageman, Matthias Helmreich, Julian Höll, Jessica Jorge, Yohei Kanzaki, Shim Karmin, Georgi Kazlachev, Vangel Kukov, David Leon, Kantaro Makanae, Amanda Moore, Paul Poinet, Emily Scoones, Djordje Stanojevic, Andrei Stoiculescu, Kenryo Takahashi and Maria Yablonina with the support of Michael Preisack and Michael Tondera

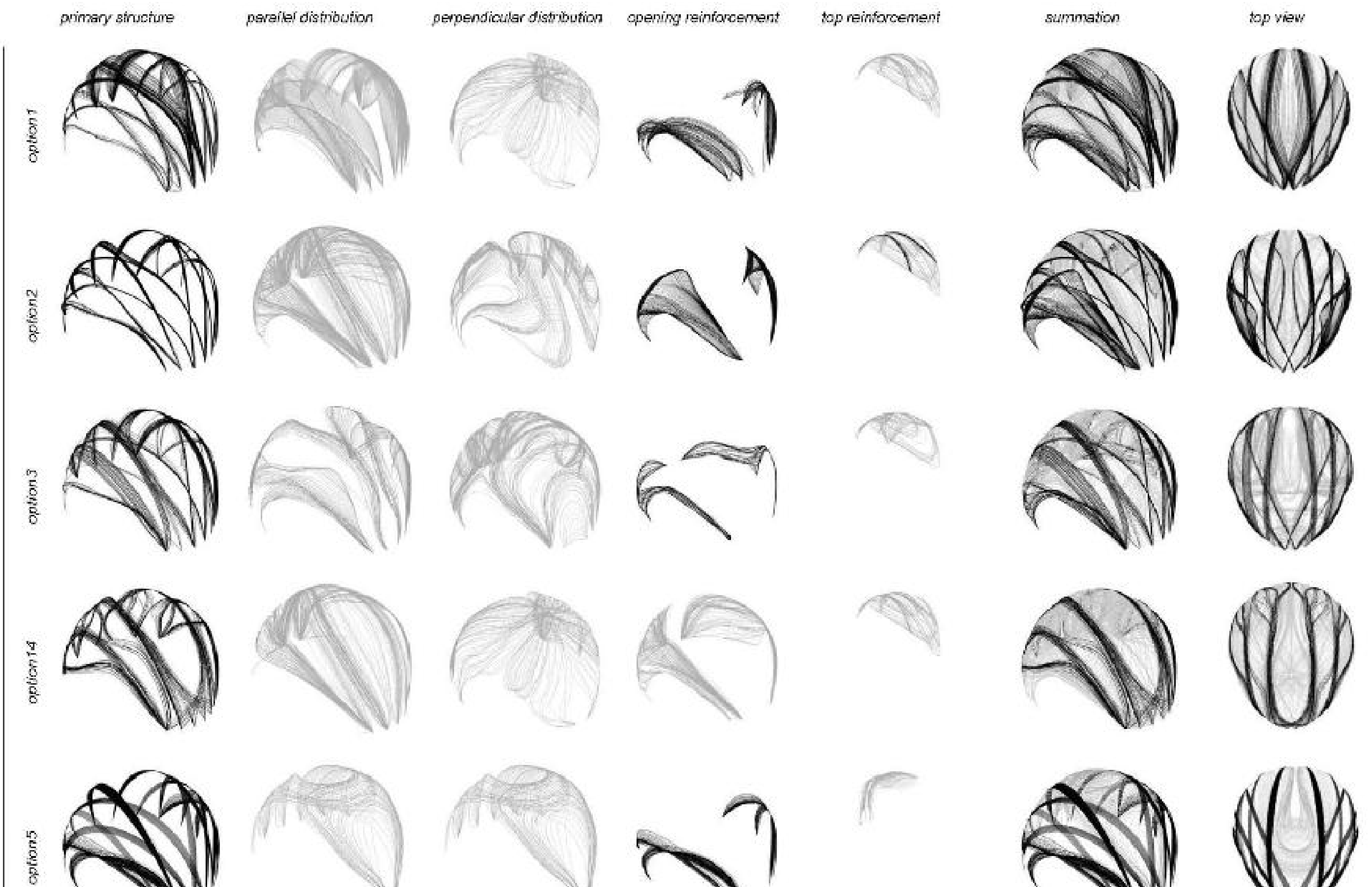
In collaboration with:
Departement of Evolutionary Biology of Invertebrates, University of Tuebingen – Prof. Oliver Betz
Departement of Palaeontology of Invertebrates, University of Tuebingen – Prof. James Nebelsick
Institute of Aircraft Design, University of Stuttgart – Prof. Dr.-Ing. P. Middendorf
Institute for Machine Tools, University of Stuttgart – Dr. Thomas Stehle, Rolf Bauer, Michael Reichersdörfer
Institute for Photogrammetry , University of Stuttgart – Prof. Dieter Fritsch, Alessandro Cefalu

Funding
KUKA Roboter GmbH, Daimler AG, tat aiRstructures, SGL Carbon SE, Reinhausen Plasma GmbH, Reka Klebetechnik, GmbH, Airtech Europe S.A., Mack Gerüsttechnik GmbH, RentES, Stahlbau Wendeler GmbH + Co. KG, CARU Containers GmbH, EmmeShop Electronics, STILL GmbH

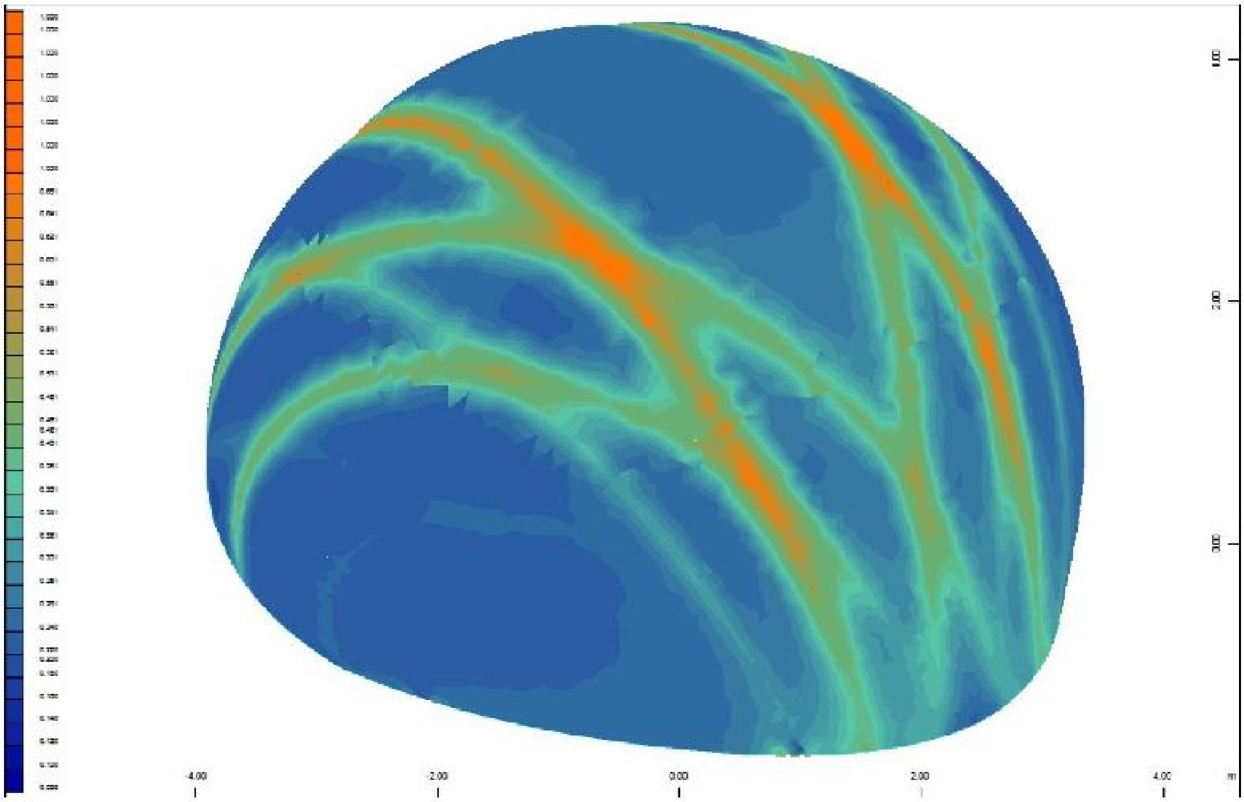
ICD/ITKE Research Pavilion 2014-15



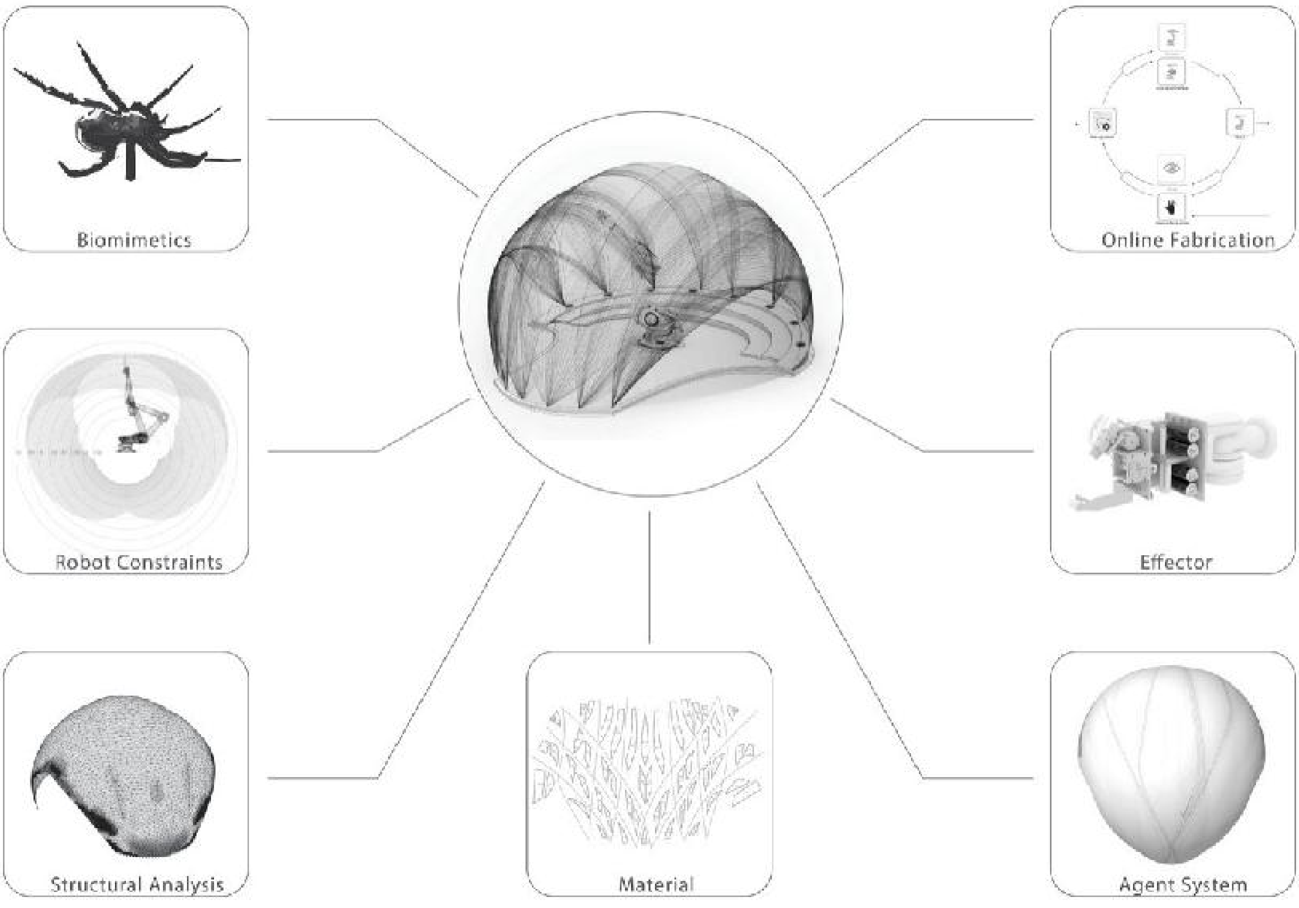
Global design
The global geometry for the ICD/ITKE Research Pavilion 2014 was simulated with Rhino Membrane, a software capable of integrating material properties and specific pressures for inflation processes.



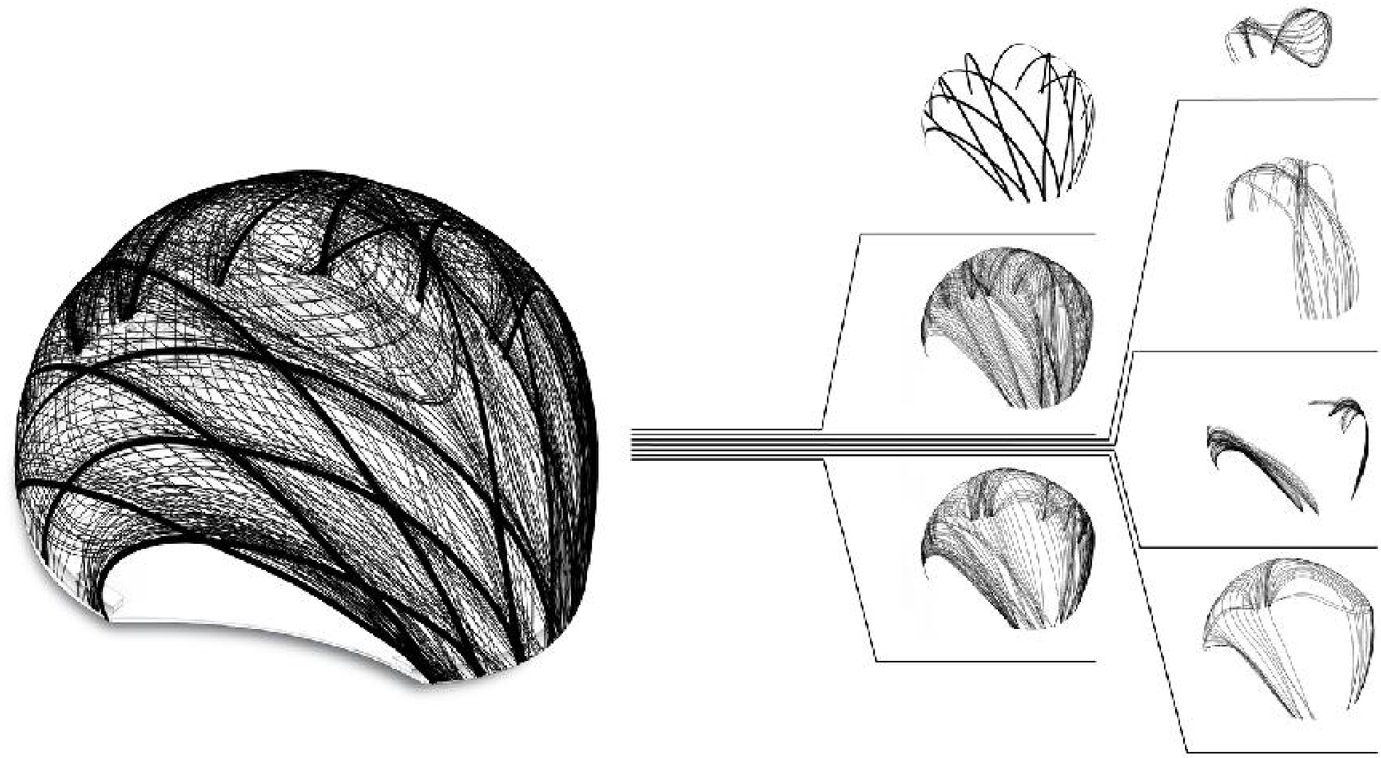
Differentiated fiber layout options



Structural analysis
The geometry for the ICD/ITKE Research Pavilion 2014 was developed to perform in both an initial inflated state as well as a final compression load bearing condition. The present structural analysis as been calculated within SOFiSTiK.

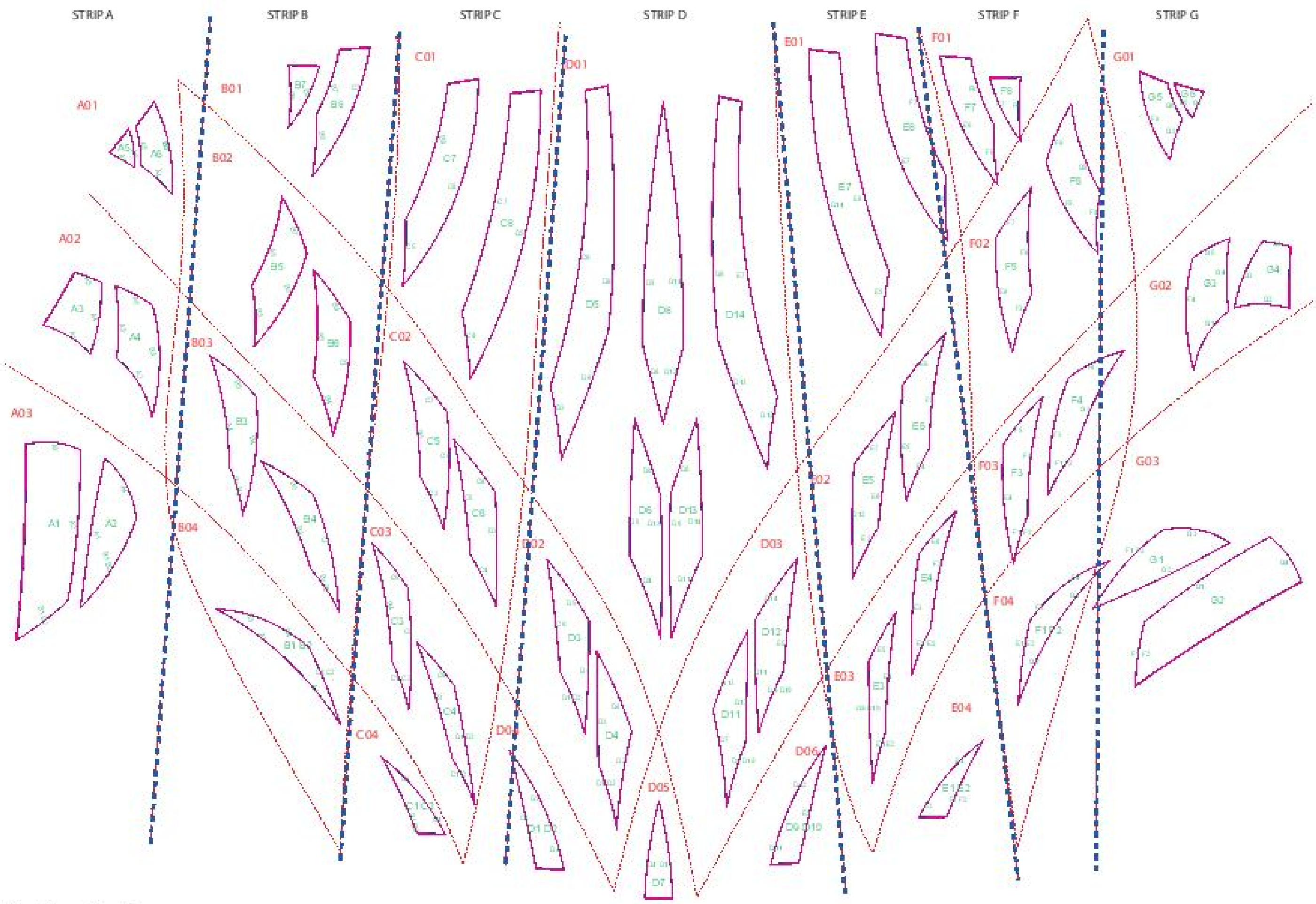


Integrative design process



Fiber laying process

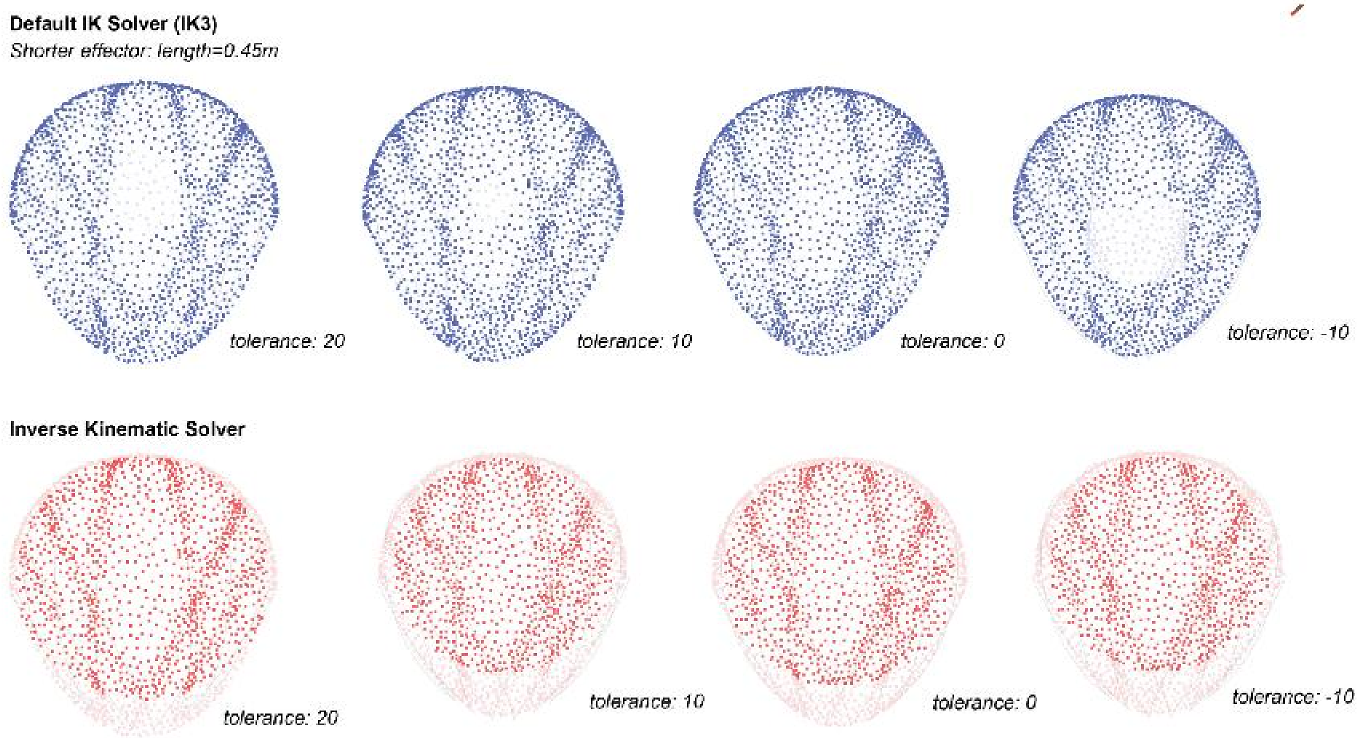
The fiber layout of the pavilion has been optimized in order to minimize the robot path length, while maintaining a structural stability. The overall layout has been organized into separate layers so that the fiber laying process is happening gradually.



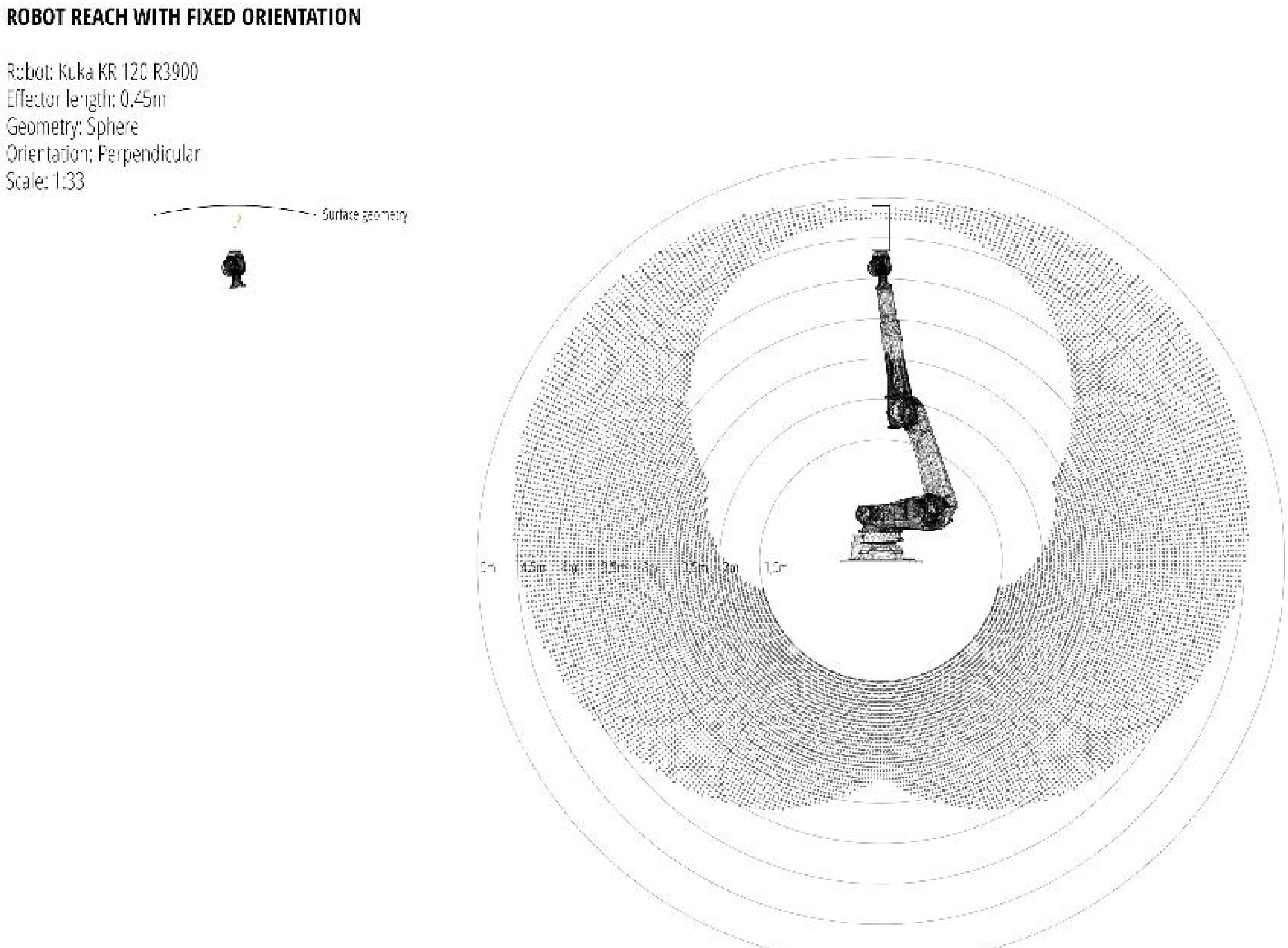
Cutting Pattern

Robotics and fabrication constraints

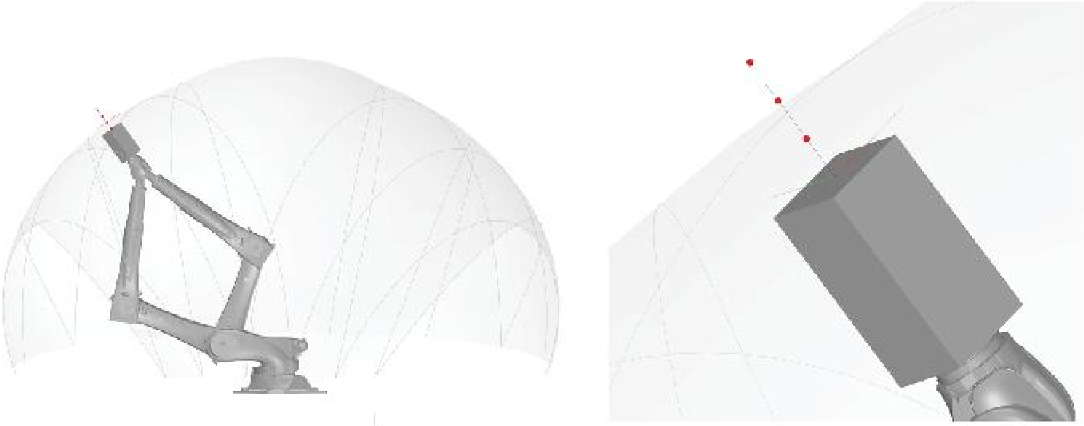
The global design was also shaped by the robot's minimum and maximum boundiing reach. The following diagrams illustrate the technical limitations of the Kuka industrial robot arm KR 120 R3900.



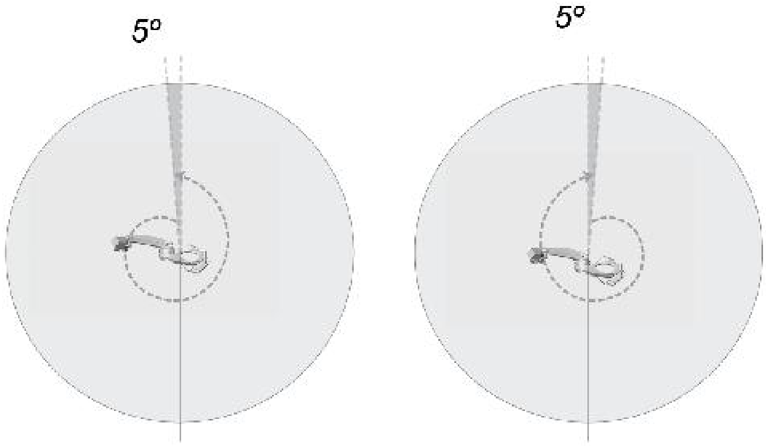
Reachable points diagrams on the global design (Inverse Kinematic solver 1 & 2)



Reachable points diagram (Inverse Kinematic solver 1)



A deflection of the membrane is considered while the fibers are being laid (implementation of a pressure sensor)



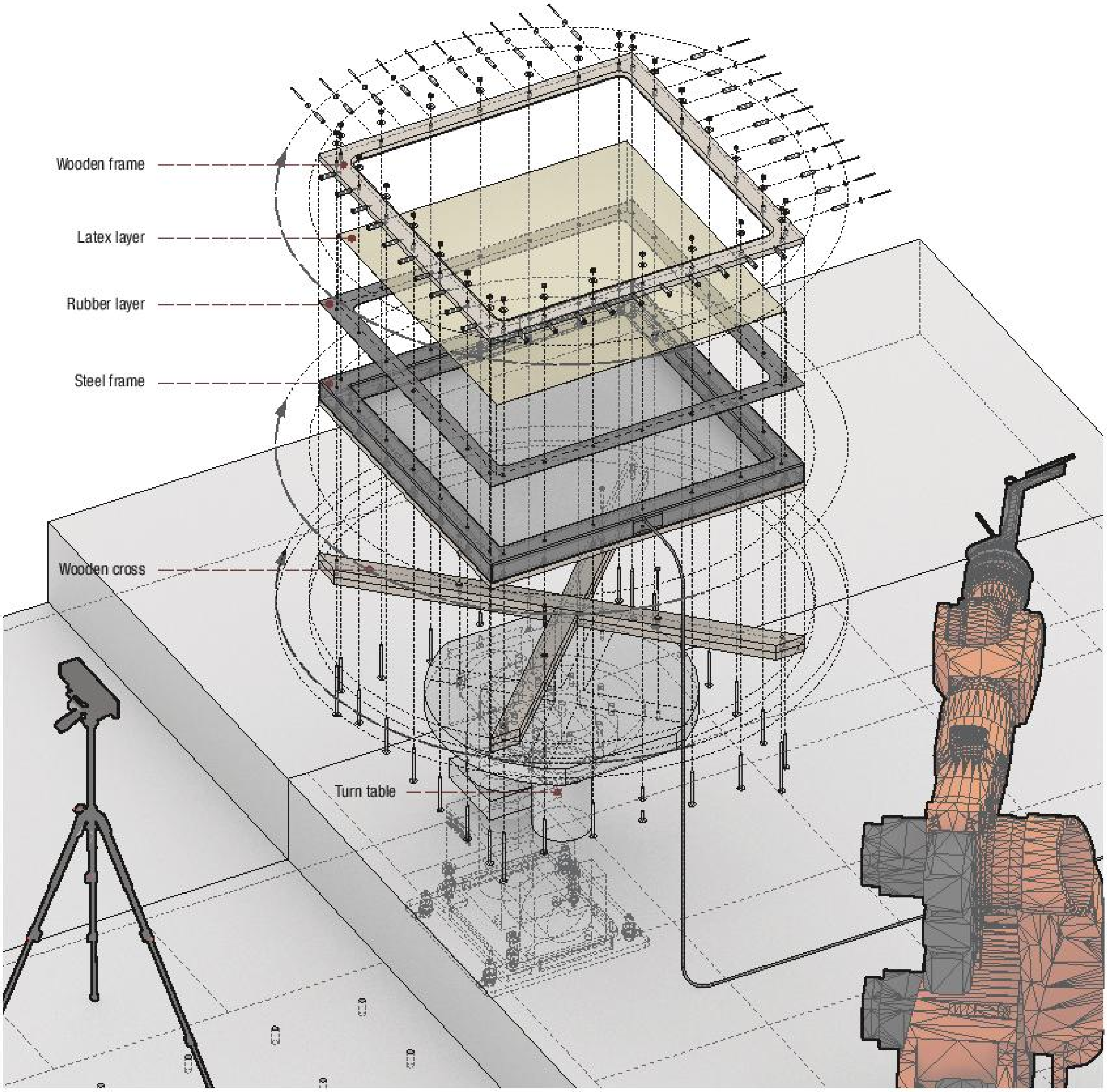
No continuous path can cross the area where the A1 Axis position goes from -185 to 185°

ICD/ITKE Research Pavilion 2014-15, fabrication process

Adaptive Pneumatic Shell Structures: Feedback-driven robotic stiffening of inflated extensible membranes andfurther rigidification for architectural applications.

Year: 2015
Location: ICD (Institute for Computational Design)
Semester: WS 2014 - SS 2015
Supervisor: Tobias Schwinn, Lauren Vasey, Ehsan Baharlou
Master thesis submitted by: Paul Poinet

The master thesis presents the development of a design framework that aims to reduce the complexity of designing and fabricating free-form inflatables structures, which often results in the generation of very complex geometries. In previous research the form-finding potential of actuated and constrained inflatable membranes has already been investigated however without a focus on fabrication (Otto 1979). Consequently, in established design-to-fabrication approaches, complex geometry is typically post-rationalized into smaller parts and are finally fabricated through methods, which need to take into account cutting pattern strategies and material constraints. The design framework developed and presented here aims to transform a complex design process (that always requires further post-rationalization) into a more integrated one that simultaneously unfolds in a physical and digital environment - hence the term cyber-physical (Menges 2015). At a full scale, a flexible material (extensible membrane, e.g. latex) is actuated through inflation and modulated through additive stiffening processes, before being completely rigidified with glass fibers and working as a thin-shell under compression.



Global setup V2

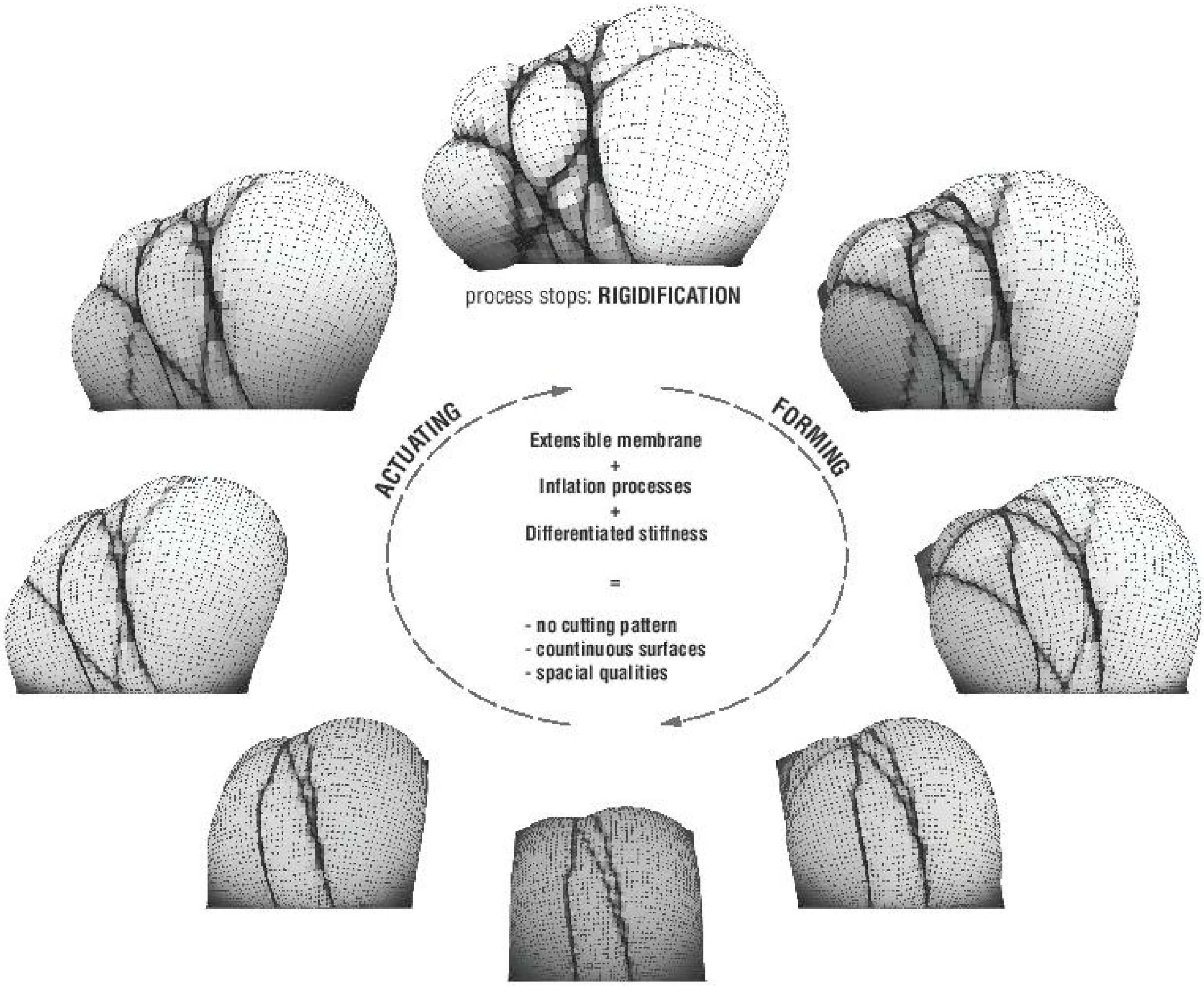
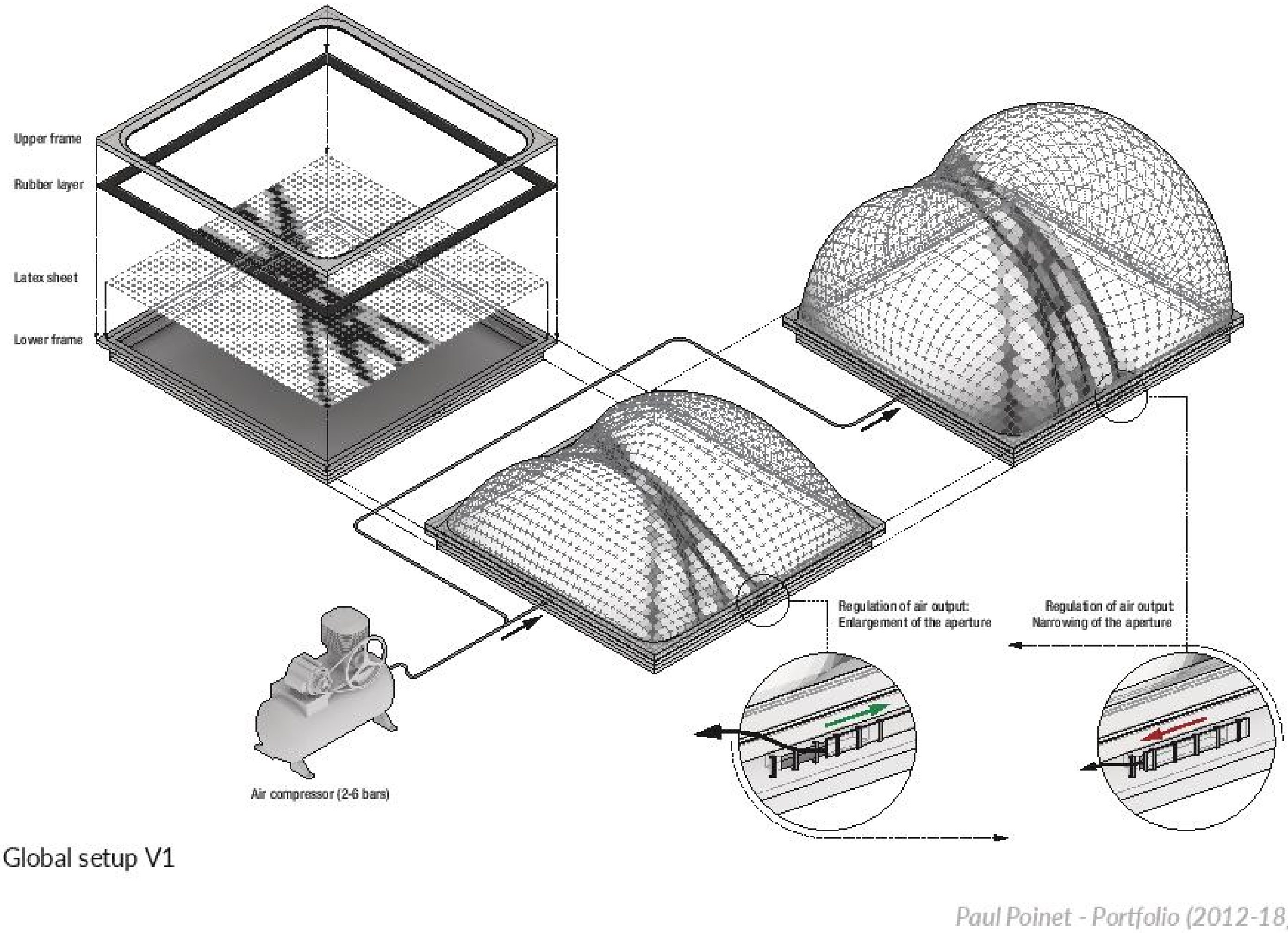
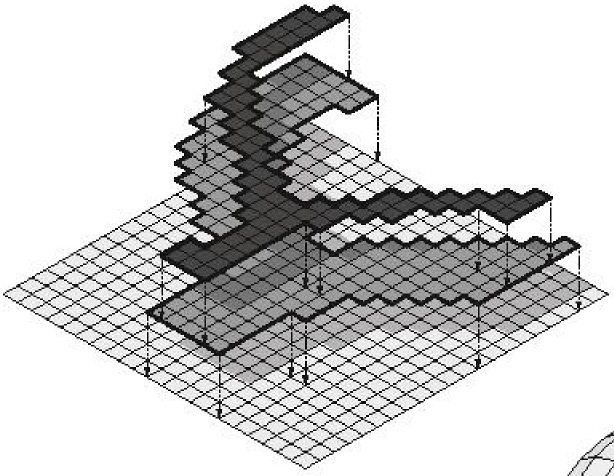


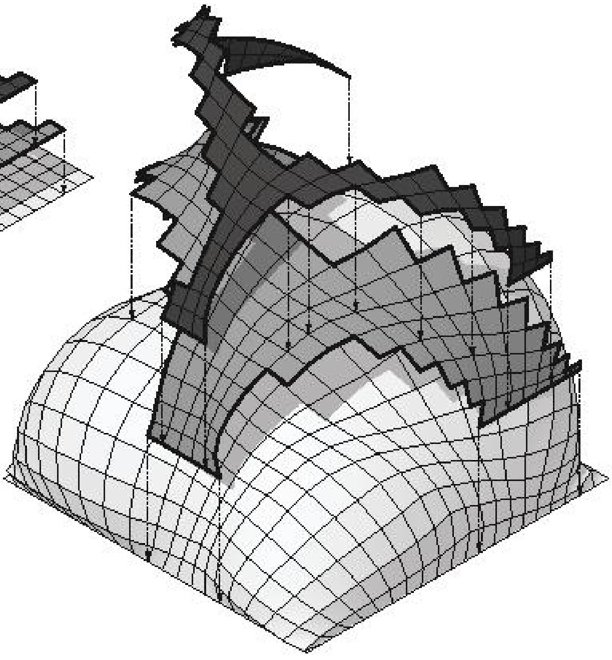
Diagram illustrating the actuation and formation of an inflatated extensible membrane through additive stiffening

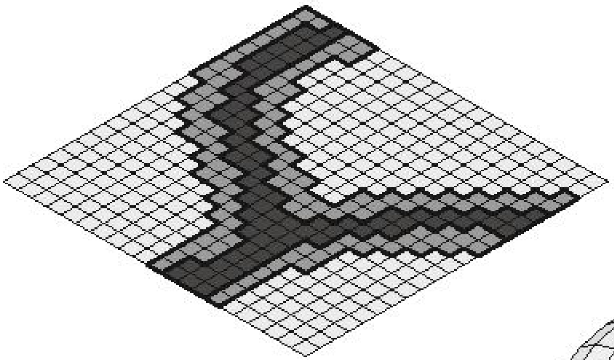


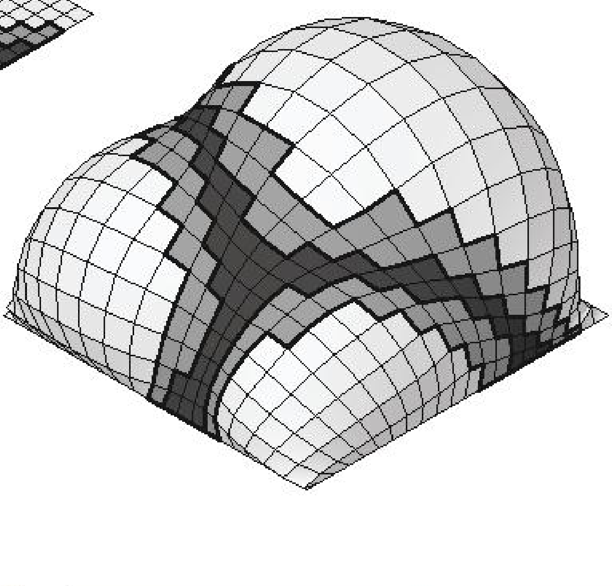
Global setup V1

Glued layers and local differentiated stiffening
This experiment is the second that investigate gluing layers with latex gel in order to modify locally the stiffness of the latex. The digital and physical models have presented very similar behaviors.

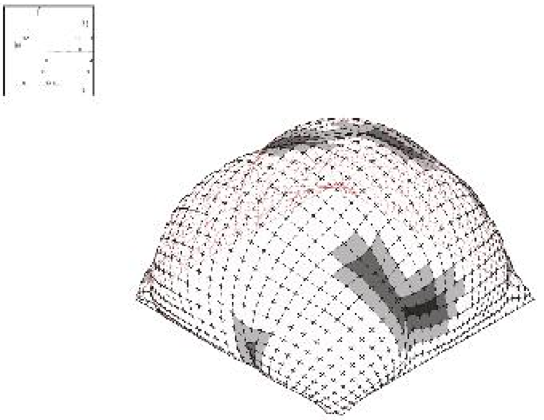


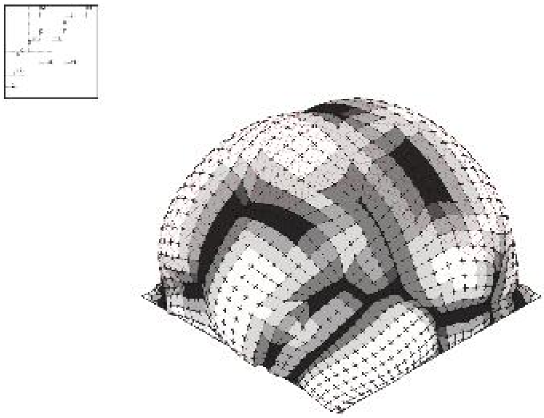


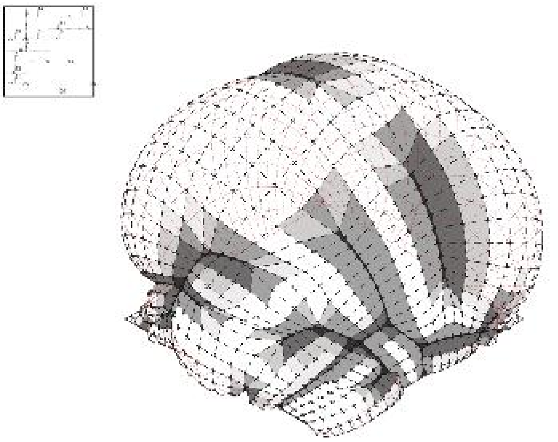


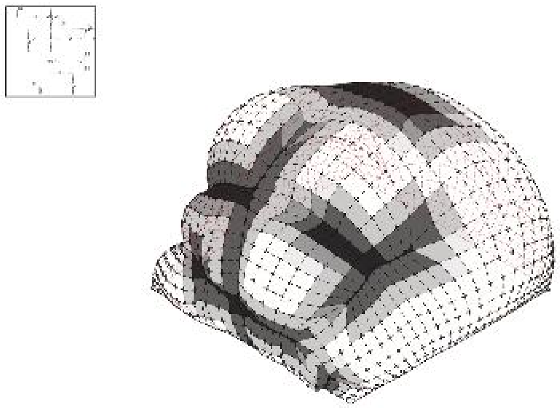


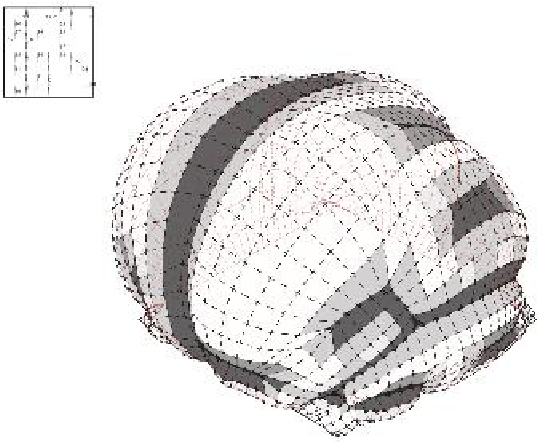
Procedural stiffening
The next series of simulations shows the formal potential of additive stiffening techniques. For each iteration, a 2D map represents the locations that have been iteritavely stiffened.

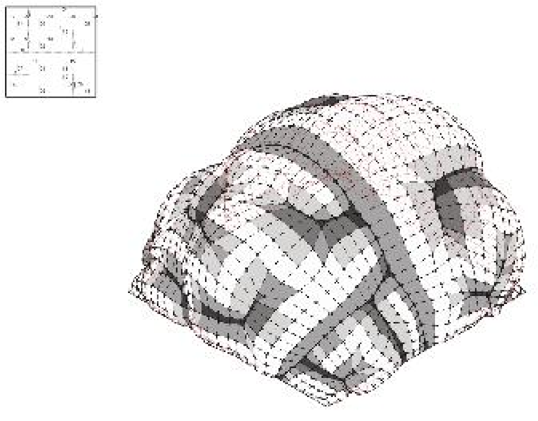


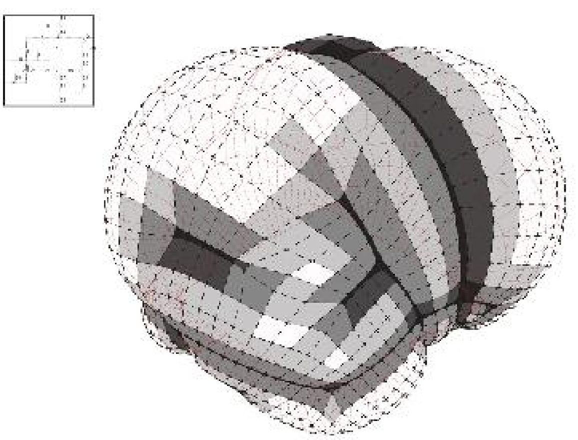


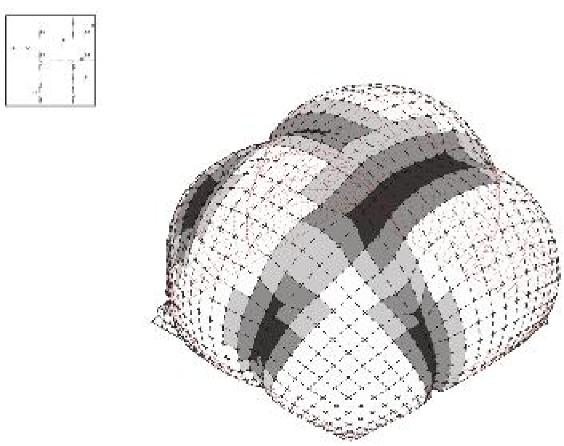


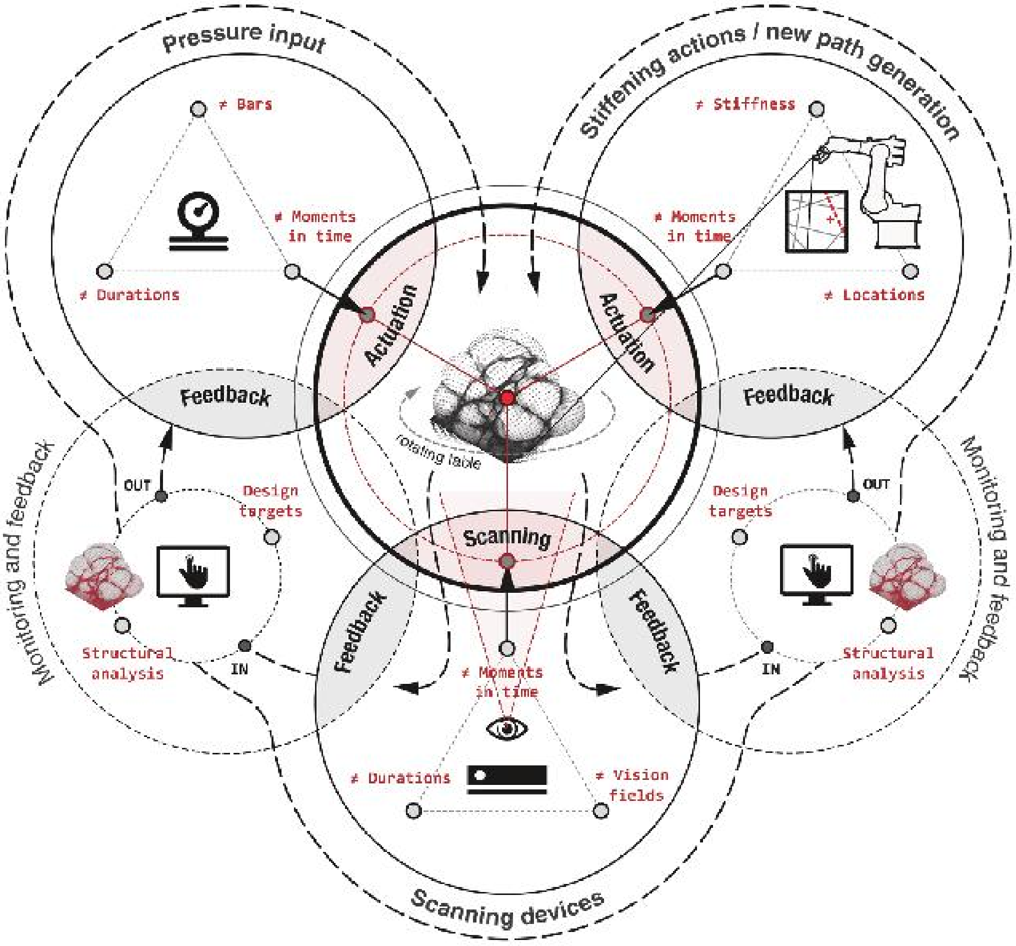




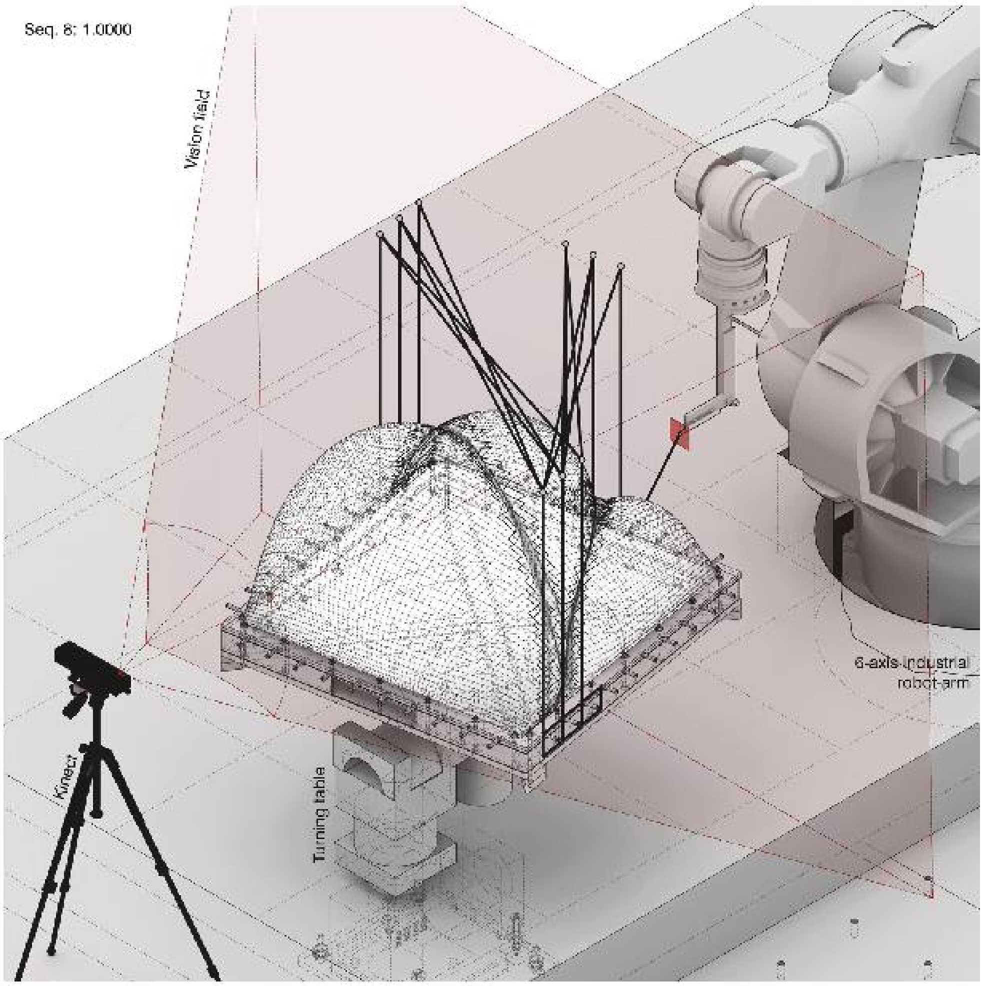




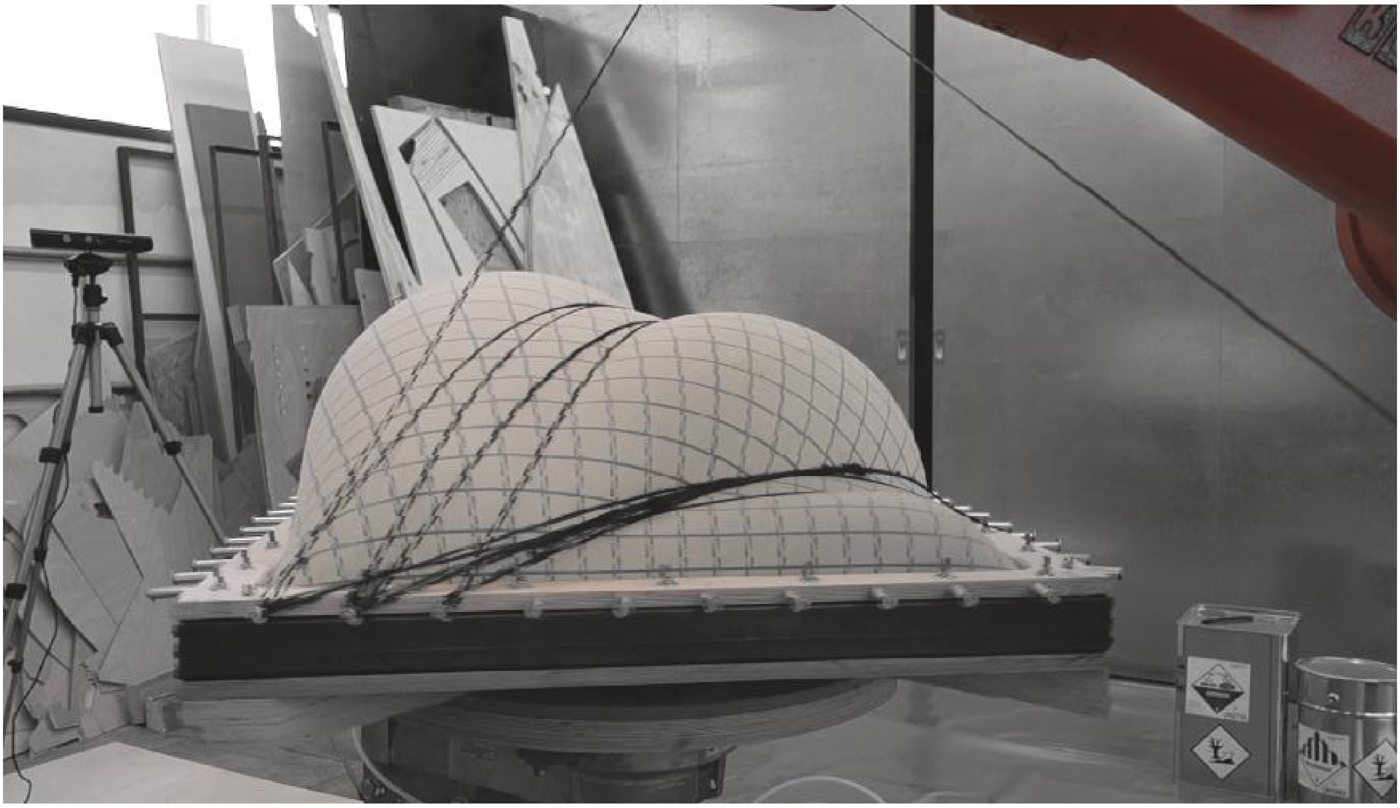




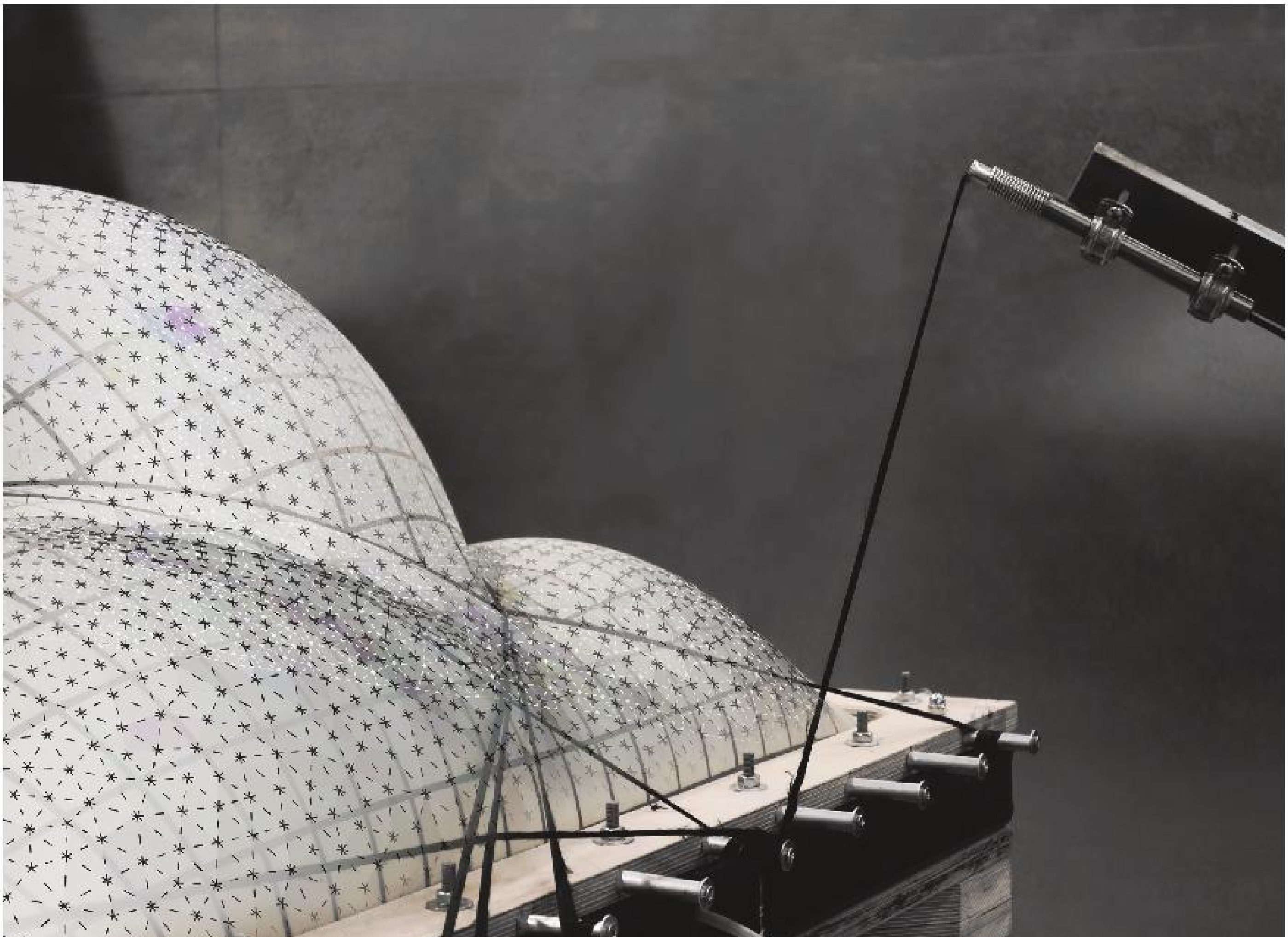
Cyber-physical environment



Fabrication agency proposal



First prototype investigating iterative stiffening processes using a fiber extruder attached on a robot arm



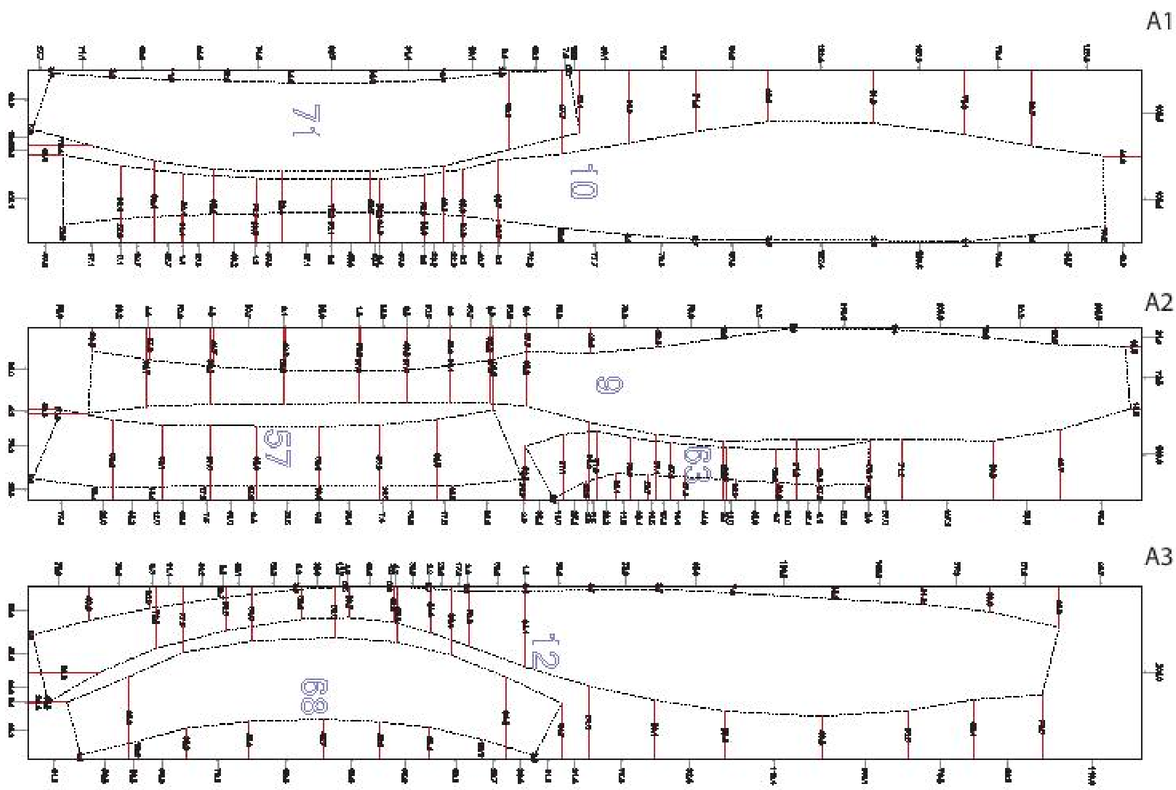
Overlap between the actual physical membrane and the scanned geometry

Invent, Inflate, Inhabitate (III) - European Architecture Students Assembly (EASA)

Year: 2015
Location: Malta, Valletta
Teachers: Paul Poinet, Fabrice Wack, Julian Hoell
Students: Jano Vyšný, Antreas Biros, Laoura Tziourrou, Mark Distanov, Krista Skujiņa, Fabrice Kcaw, Elis Haçkaj, Aleksandra Wróbel, Denis Tantsyura, Özlem Yazgan, Marcos Anton Kowalski, Rachel Graham, Nikita Abanin

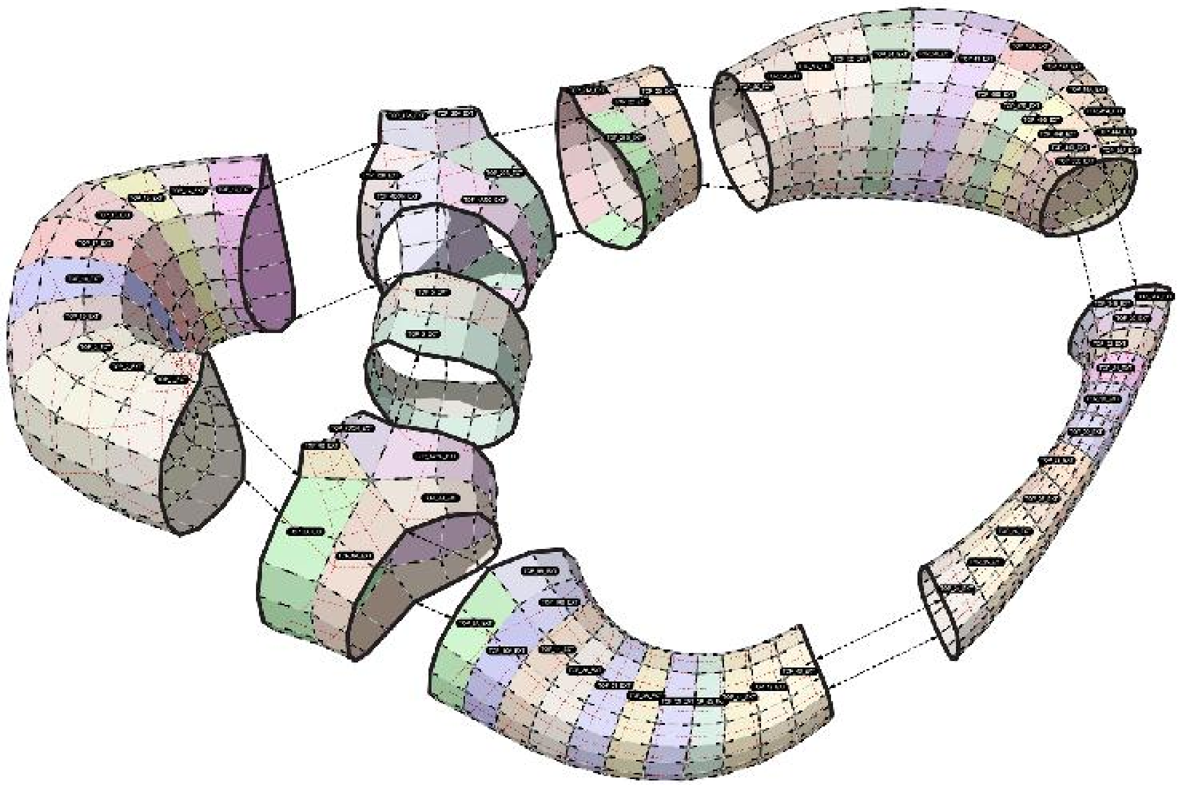
This workshop, organized in the context of the European Architecture Students Assembly (EASA) by myself and Fabrice Wack, focused on the design and fabrication of a large scale inflatable structure who served as a temporary art installation in Valletta's St George's Square, at the very center of Malta's capital. Over the span of two weeks, the students learned the computational tools and fabrication processes, developed the global design and fabricated it.

Final inflated installation (exterior view)



Strips nesting and quotes (fabrication files)

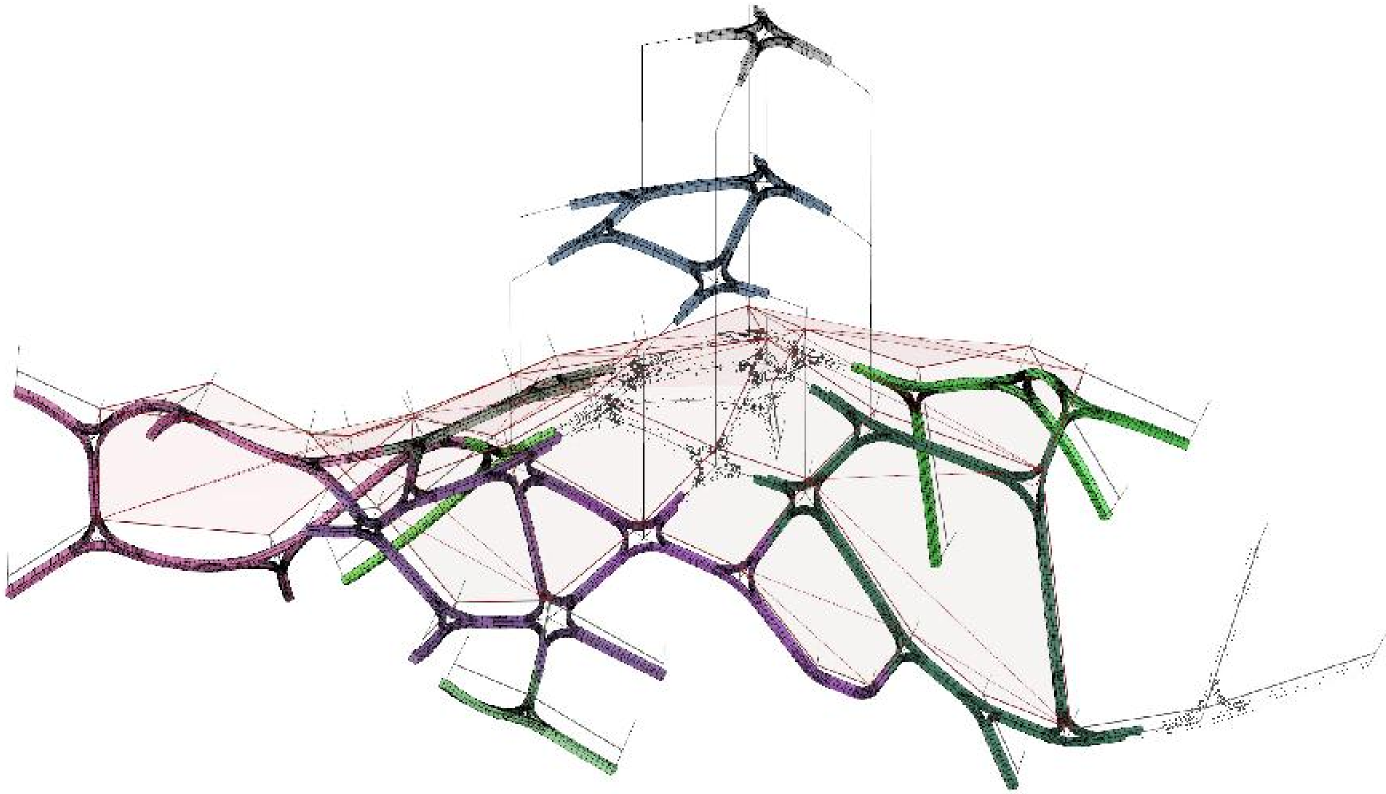
Final inflated installation (interior view)



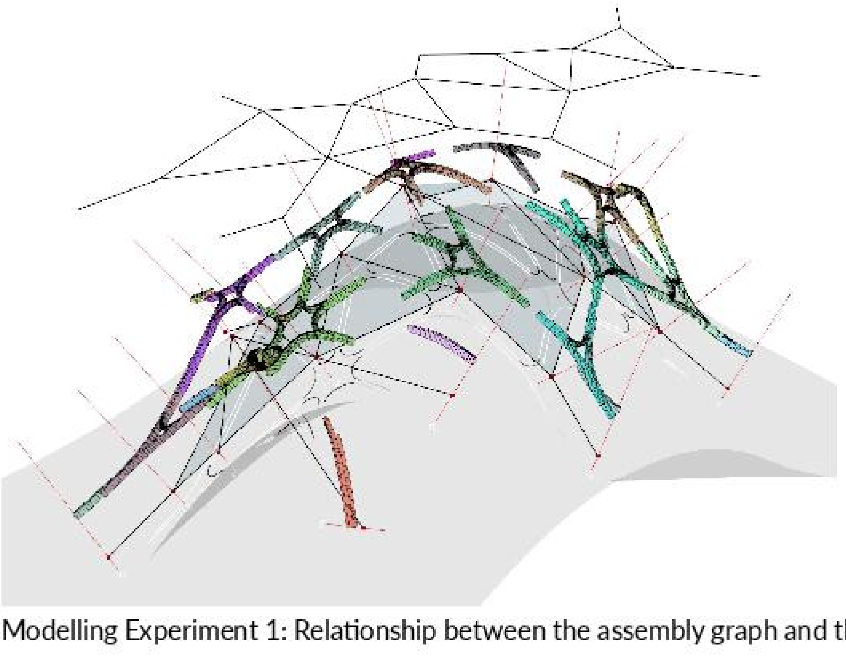
3D view of the assembly process

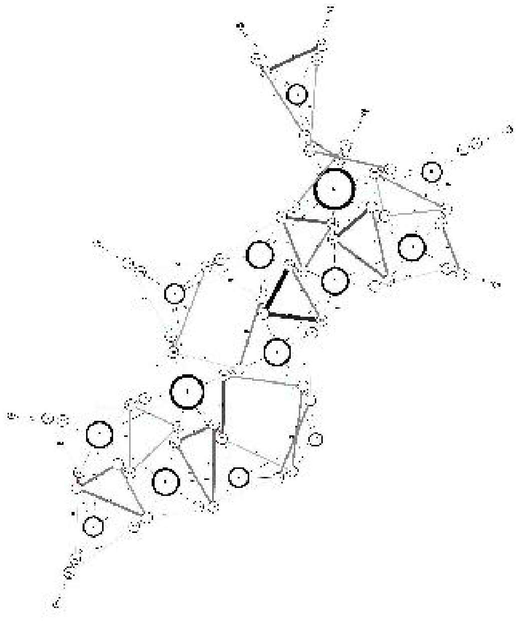
Multi-Scalar Modelling for Building Design

Year: 2015-2018
Location: CITA (Centre for Information Technology and Architecture)
Supervisor: Mette Ramsgaard Thomsen, Martin Tamke
Industrial Supervisors: Fabian Scheurer (Design-to-Production), Al Fisher (Buro Happold)
PhD thesis by: Paul Poinet



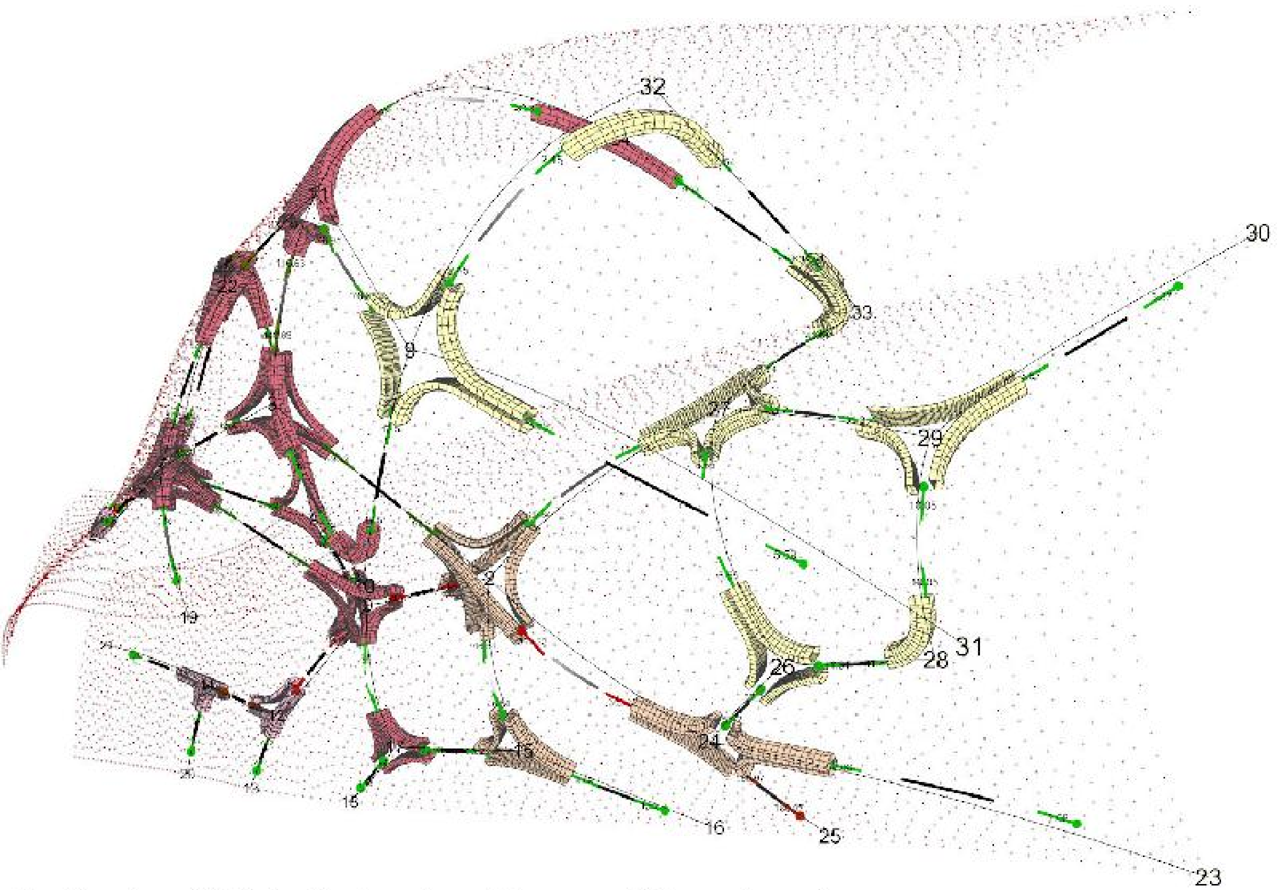
Modelling Experiment 1: Projection-based modelling onto a master surface



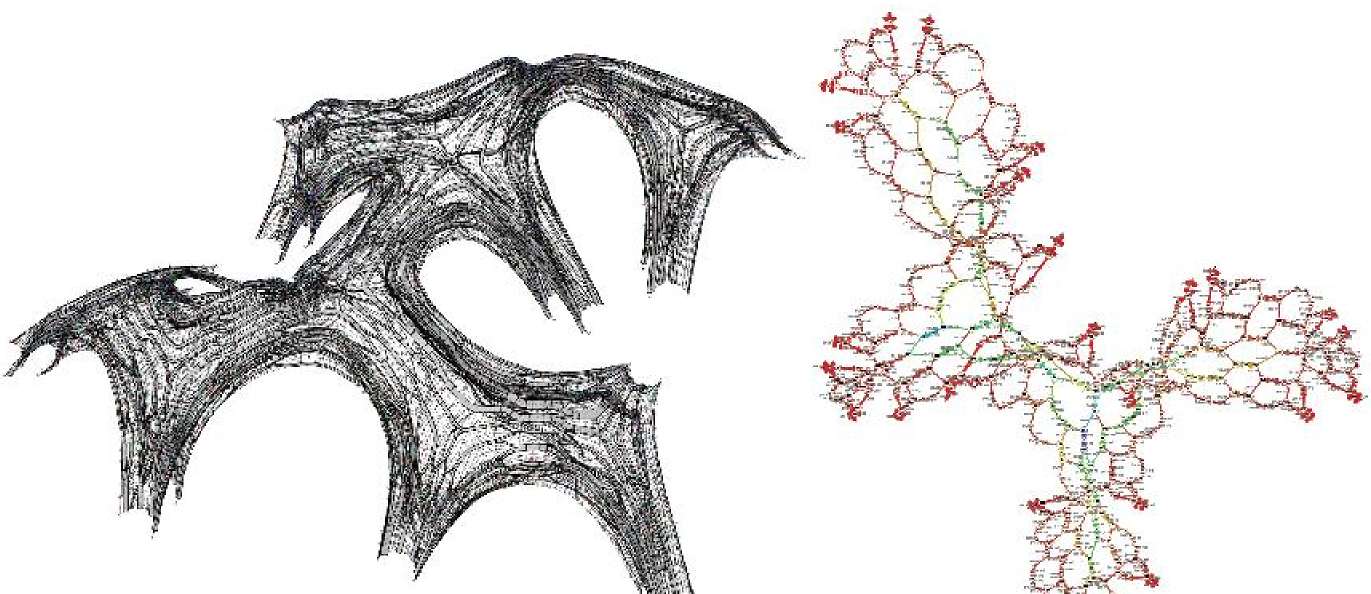


Modelling Experiment 1: Relationship between the assembly graph and the 3D model

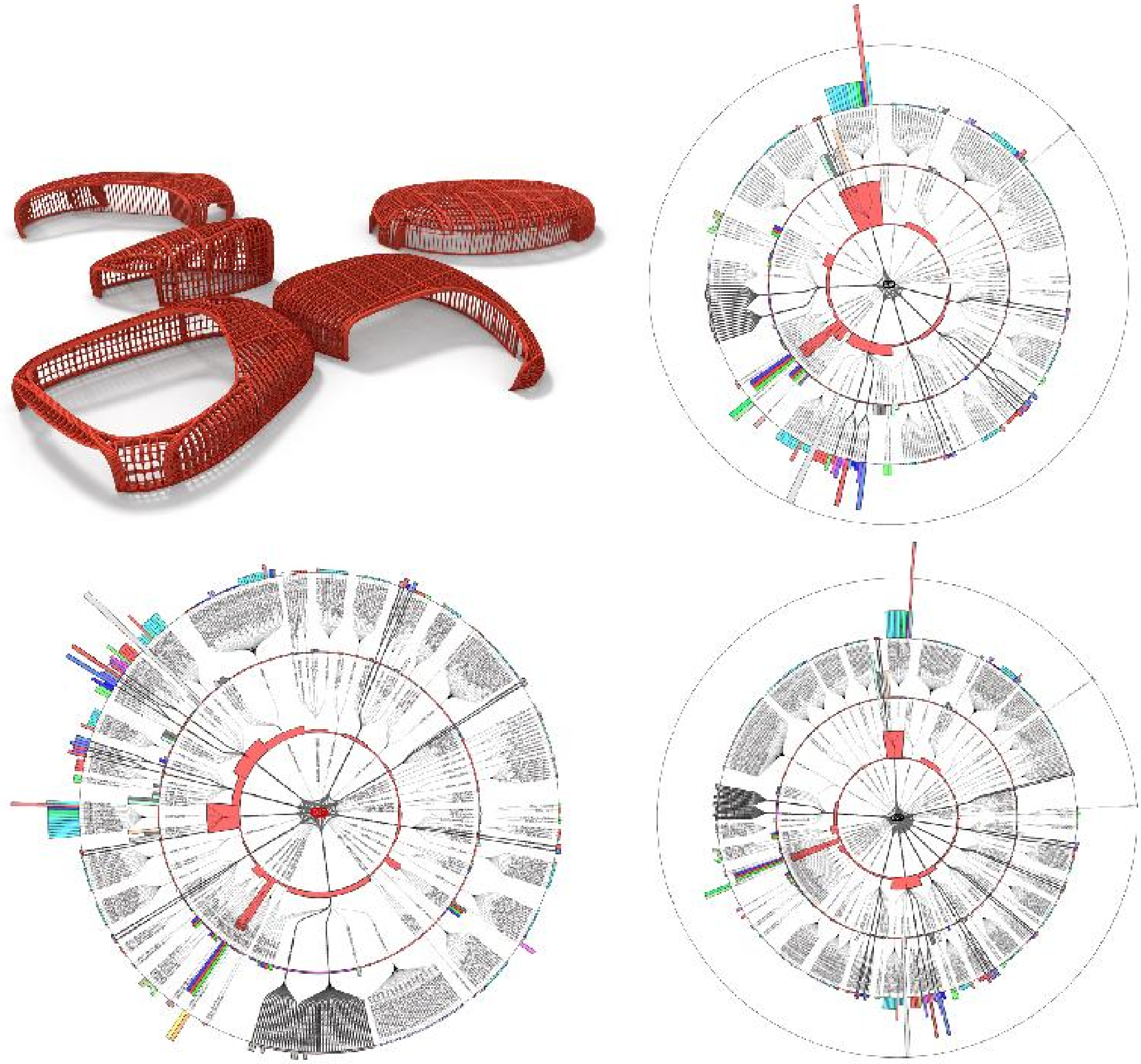
Goal: Investigating multi scale modelling principles for architectural design. Multi-scale modelling is an interdisciplinary research topic in which systems are modelled at multiple scales and interfaced enabling the modelling of low scale systems to parametrisise and inform high scale systems . The project investigate multi scalar modelling as a means to support iterative build-up of knowledge in the design process in which highly specified material simulations interface with open ended design models. Using timber (sustainable and renewable material resource) the project will examine how simulating material performance at low level can be used to inform structural performance at high level. The project is highly interdisciplinary and uses event based simulation frameworks from mathematics, computer science and engineering to analyse and interface domain specific knowledge.



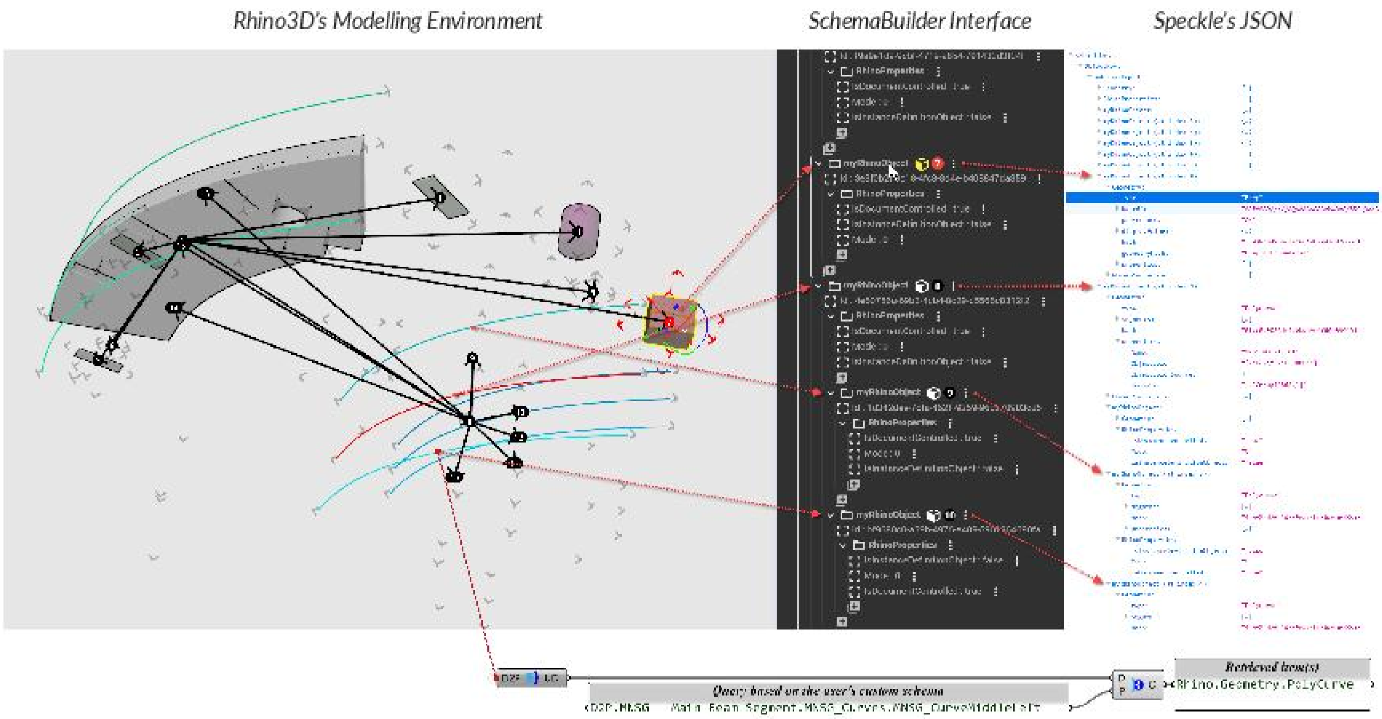
Modelling Experiment 2: Projection-based modelling on multiple master surfaces



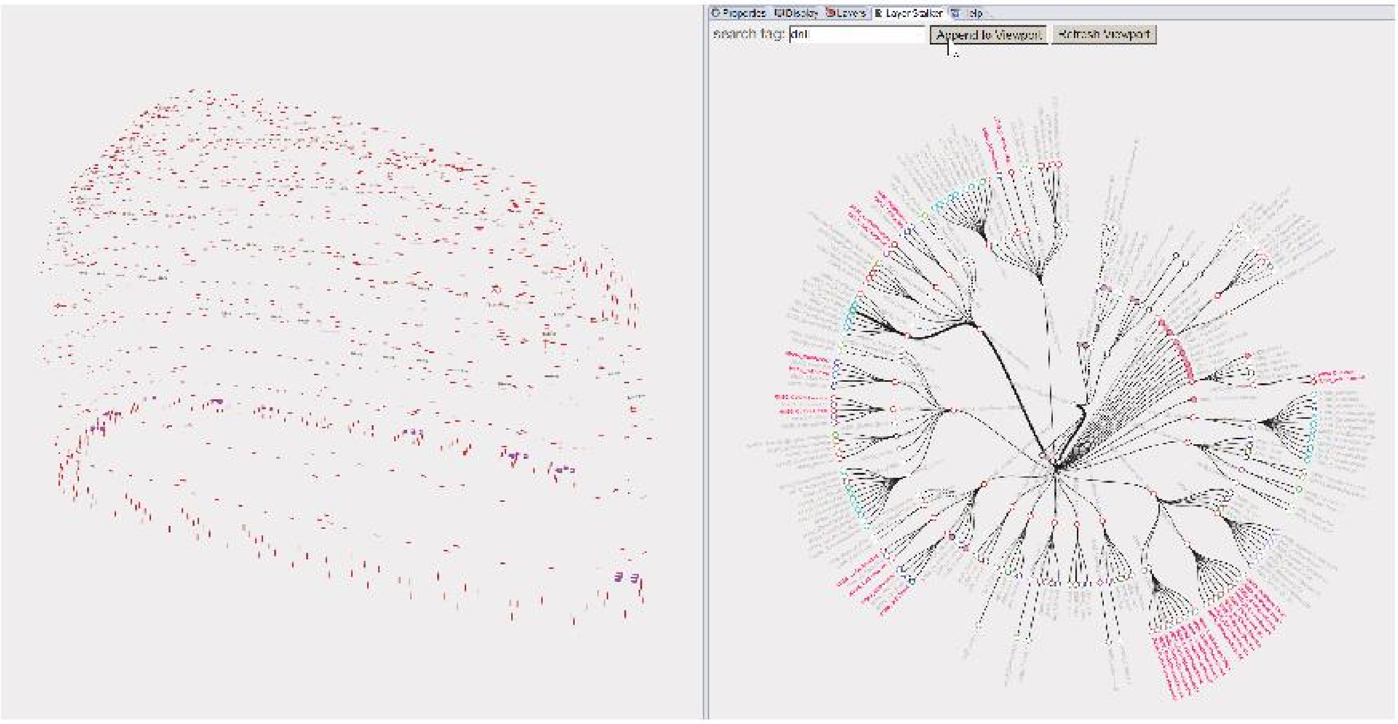
Modelling Experiment 3 (TAB Installation Competition): Relationship between the assembly graph and the 3D model



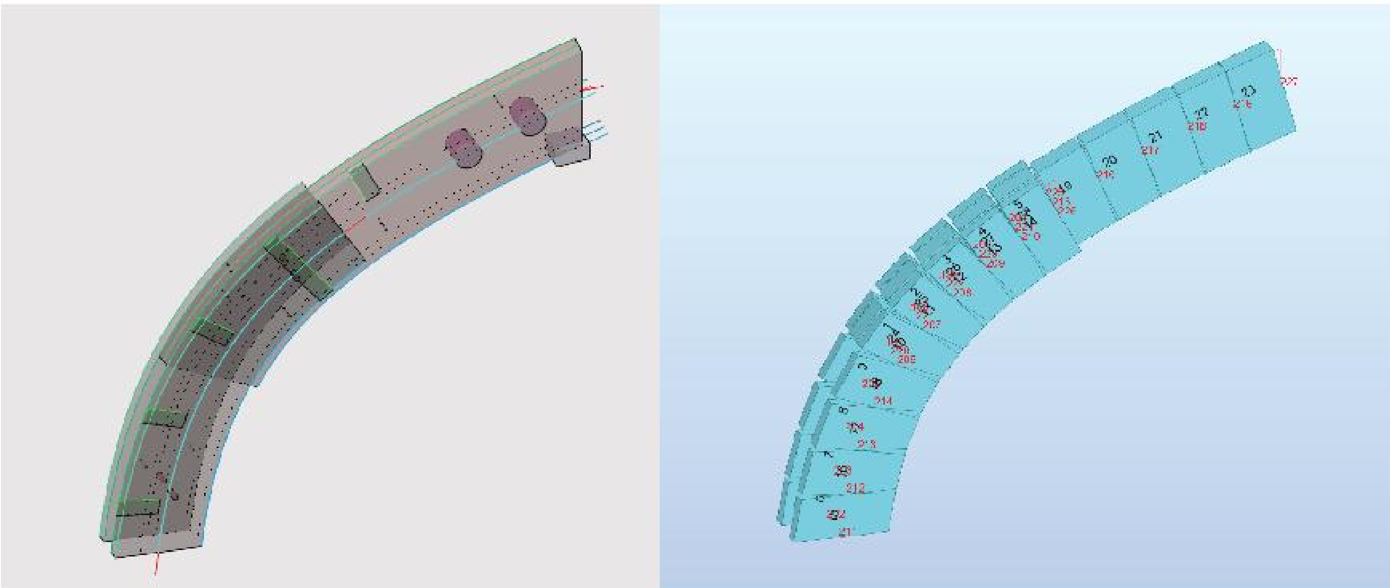
The TPO Pavilions modelled by Design-to-Production with their respective Layer Tables represented here as a Sunburst Diagrams

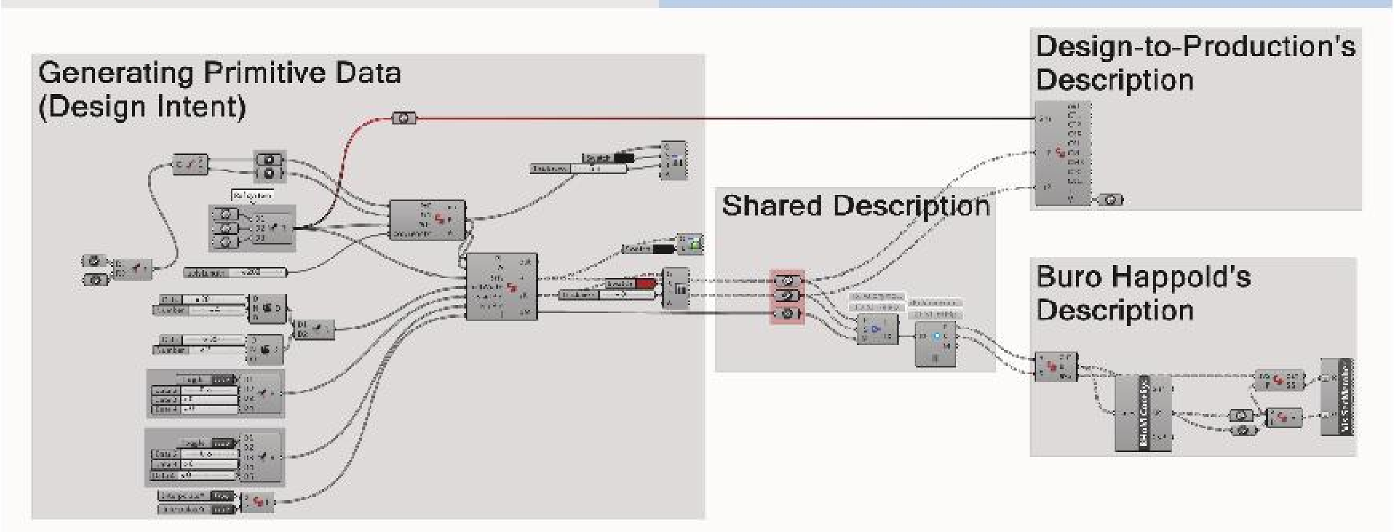


SchemaBuilder's current User-Interface

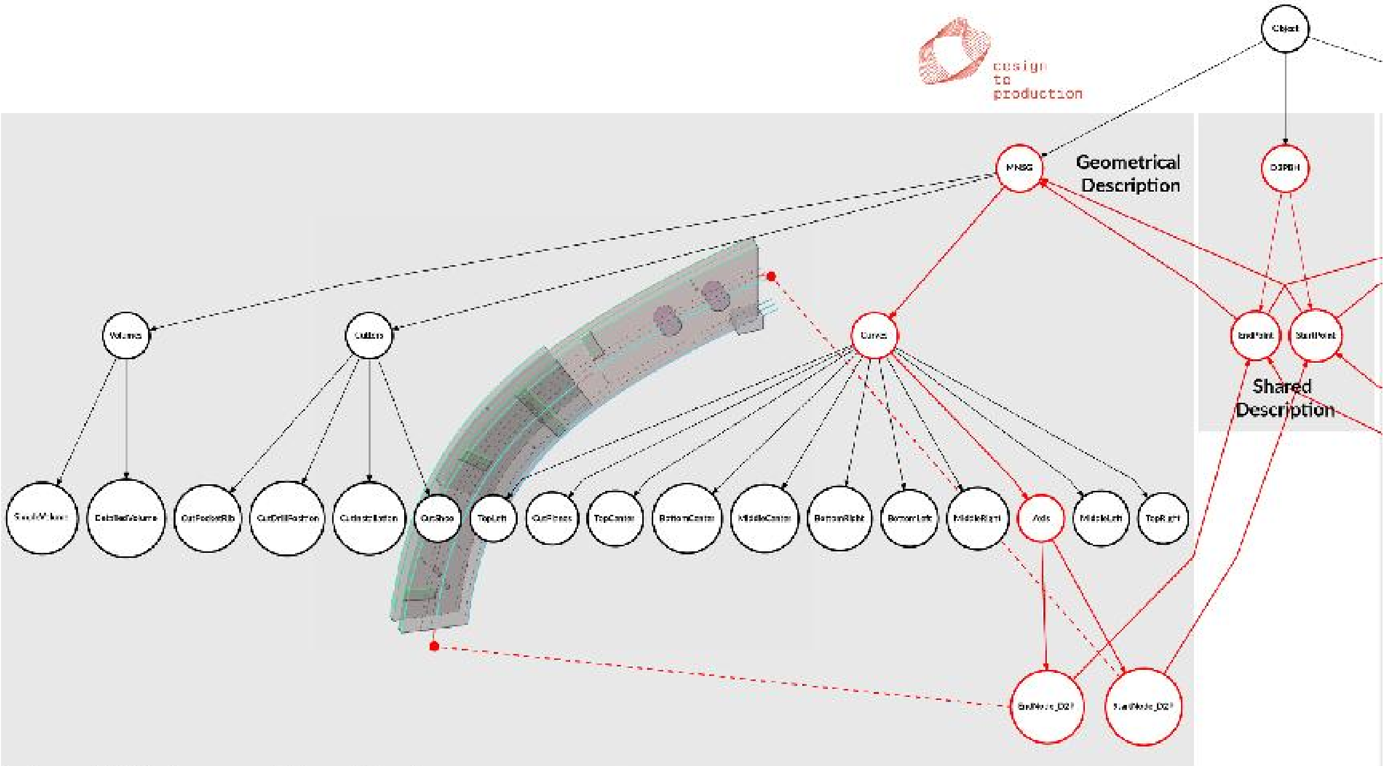


One of the Terminal Oslo Pavilions modelled by Design-to-Production and its respective interactive Layer Table represented as an interactive Sunburst Diagram. Here, the value "drill" is called, displaying all objects whose respective layer names containthe exactsame tag.

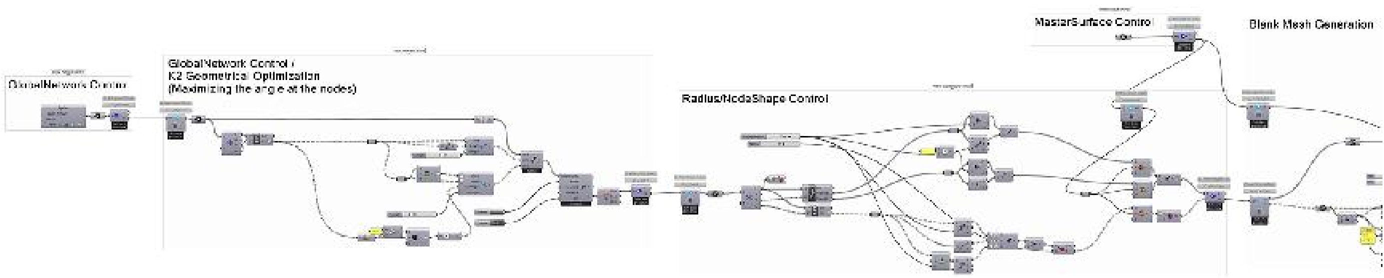


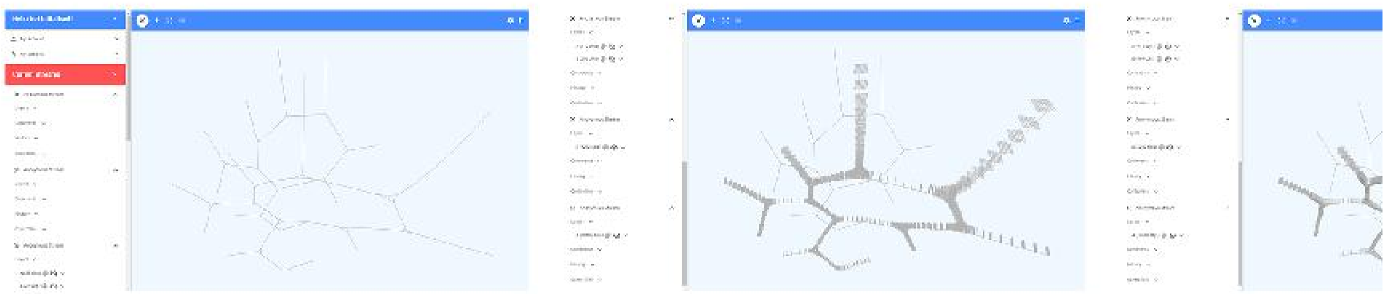


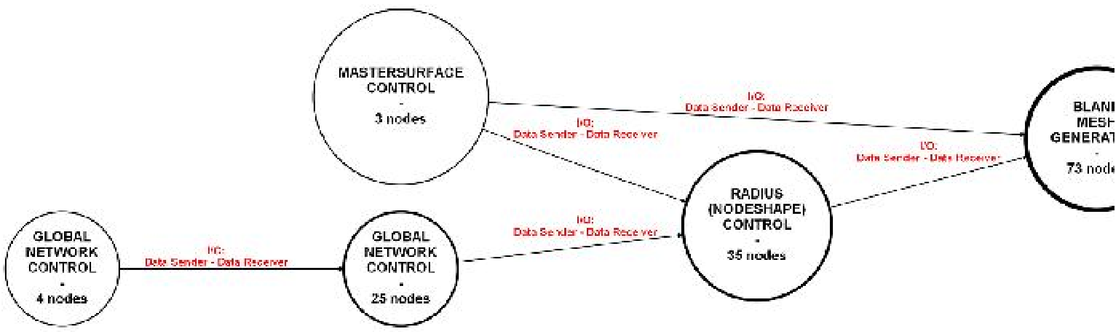
A Grasshopper definition demonstrating a digital design workflow between data generated by Design-to-Production within Rhino3d (right) and shared through a common schema via Speckle to Buro Happold, from which can be retrieved just the necessary information to run a structural analysis within Robot (right) using their BHoM interface.



SchemaBuilder's current User-Interface

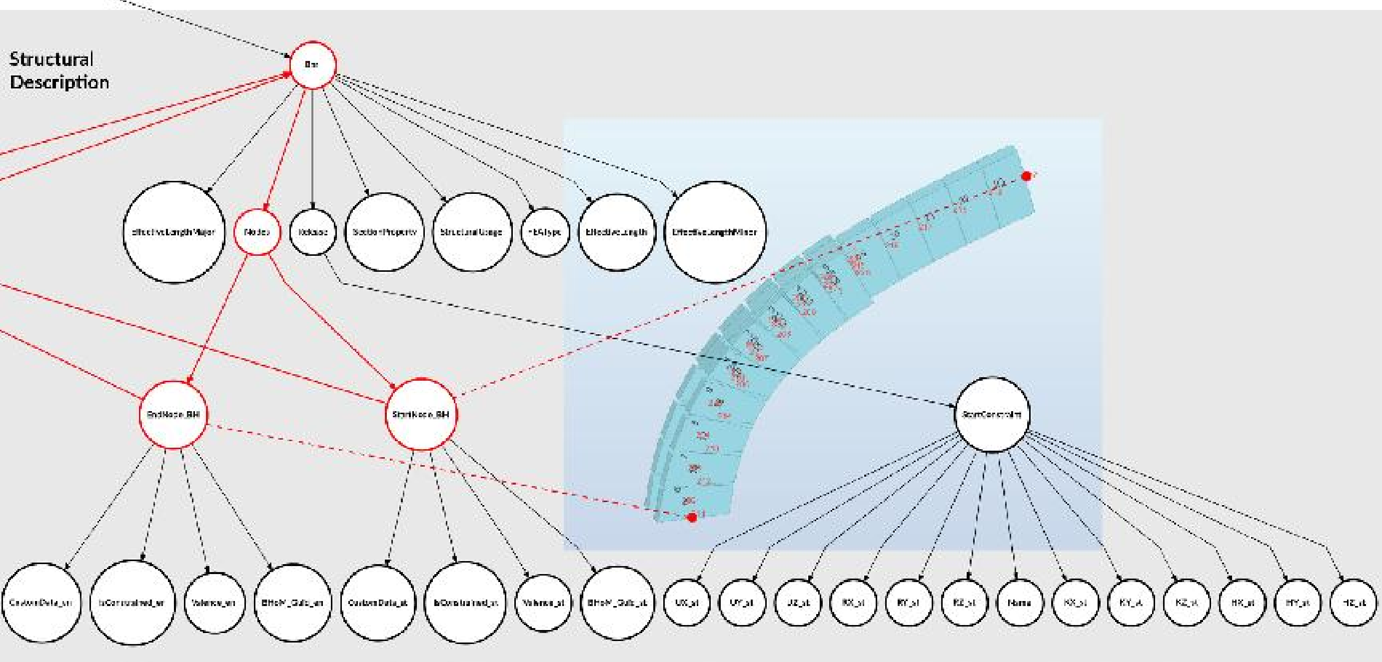


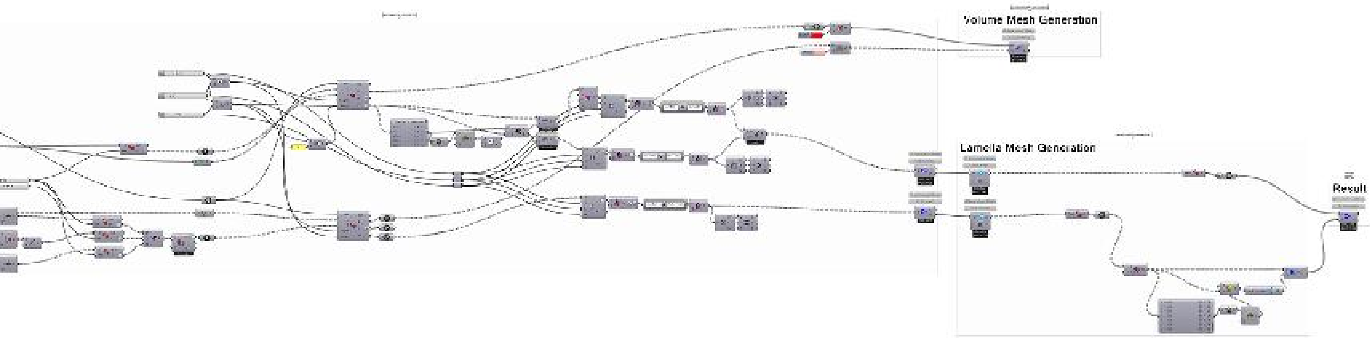


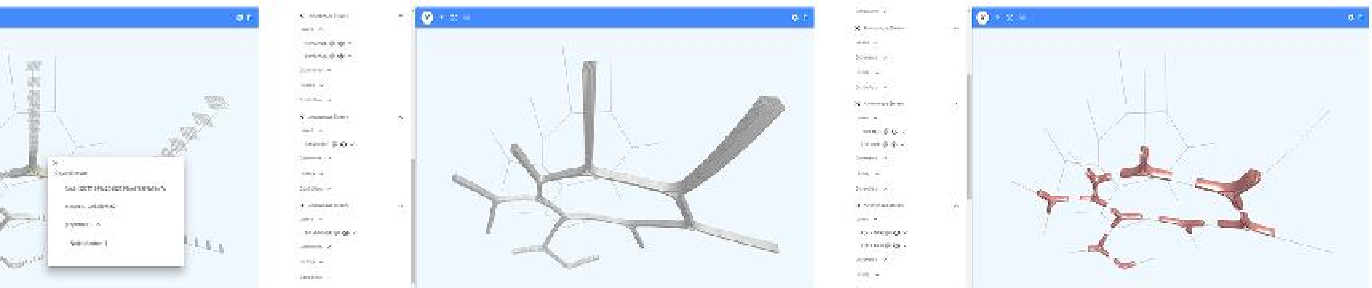


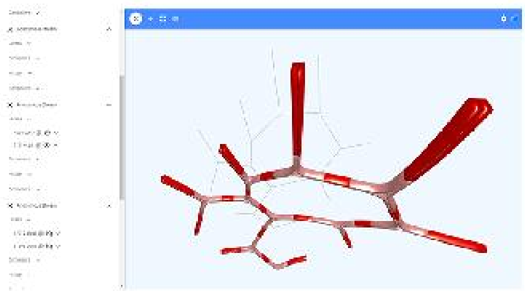
This diagram represents the "metagraph" of a digital design workflow, and is based on the existing connections betwe the user to get to get a better overview on the overall design process of a building project. In such framework, it would design or structural criteria set by the designer/user.

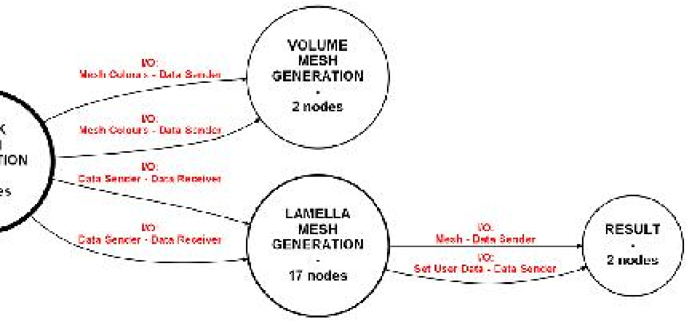
BUROHAPPOLD
ENGINEERING











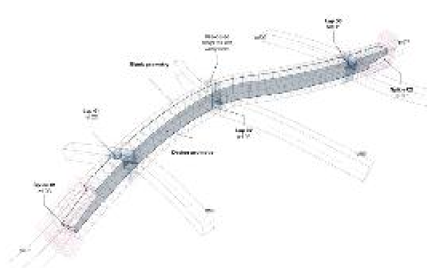
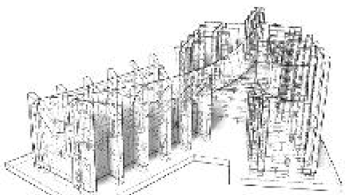
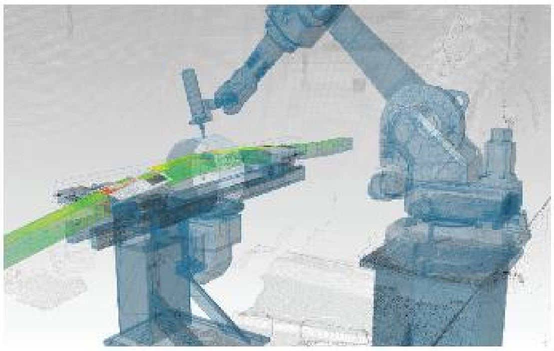
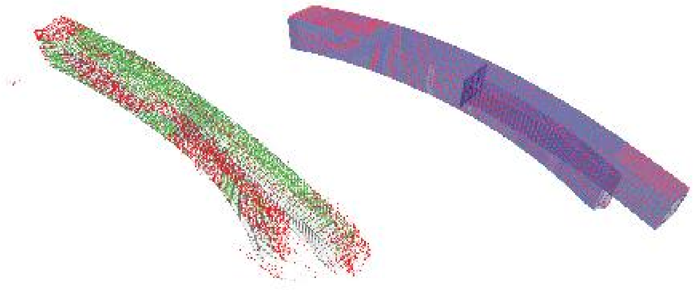
een the groups (or modelling pipelines) which communicate through SpeckleSenders and SpeckleReceivers. This allows be possible to introduce feedback loop processes that could trigger again parent modelling pipelines, based on different

Tallin Architecture Biennale 2017: Installation Competition

Year: 2017
Location: Tallin, Estonia
Submission proposal by: Paul Poinet, Tom Svilans, CITA
Award: 2nd place (amongst more than 300 participants)

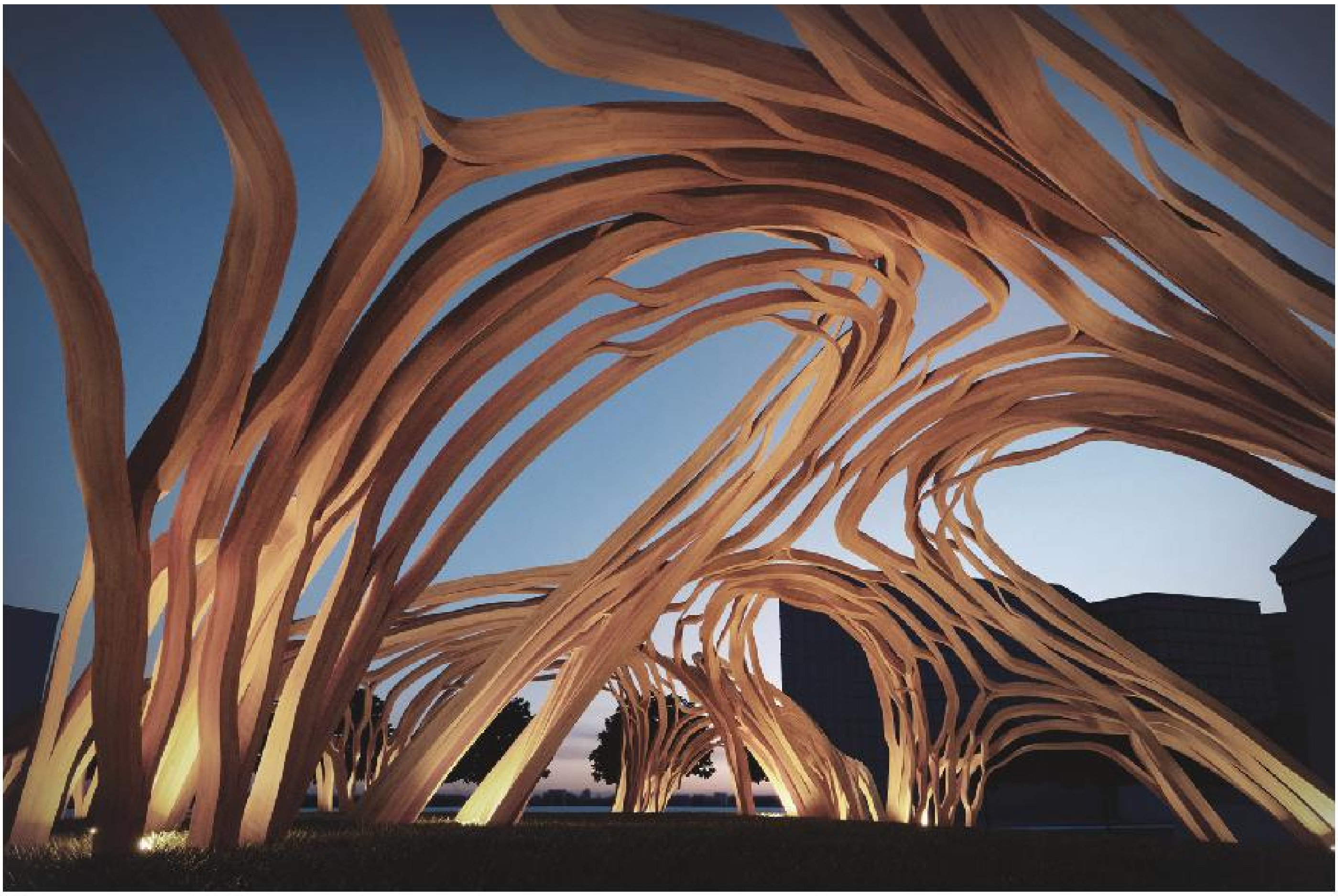
The Grove is the result of a common research elaborated with Tom Svilans (ESR2), that aimsto elucidate and formalize the connection between material performance, multi-scalarmodelling, and early-stage architectural design, in the context of free-form glue-laminatedtimber structures. While the design and production of architectural objects deals with multiplescales and resolutions of data and information, this is typically weighted towards either atop-down or a bottom-up approach. The ability to consider multiple scales at once and createbidirectional links between them offers the opportunity to even out this relationship and designmore efficiently, thoroughly, and intelligently. This research uses this method to embedlow-level material performance of glue-laminated timber into early-stage design processes.This is situated in an applied architectural and industrial context, which looks at whatearly-stage design means for multi-disciplinary architectural practices, and what materialperformance means for industrial timber fabricators.

The implementation of this method requires new ways of encoding and modeling therelationships between these two ends, and a graph-based, object-oriented approach isproposed. As such, a software library has been developed which facilitates the modeling andrepresentation of glue-laminated timber assemblies along with their material data, and whichprovides flexible production data such as workplanes and member-to-member relationships.This library and modeling workflow is tested and demonstrated through the design andconstruction of a physical prototype. Through its conception and execution, the prototypeshows how material properties and behaviours are managed throughout the whole process,and how fabrication parameters and constraints inform and alter the broader design.


Manufactering joint details and scanning processes

Exterior perspective at night



Interior perspective at night

Piped Assemblies Workshop

Year: Dec. 2018
Location: CEDIM School of Architecture
Academic Director: David Durán
Visiting Professor: Paul Poinet
Teacher Assistants: Djordje Stanojevic & Yessica Mendez
Students: Z. Esther Cepeda, Grecia C. Cortes, Iván A. Durán, A. Karen Garza, Fabrizio Hernández, Denise Llano, Mayalen Martínez, Lina I. Mejía, Carlos A. Muñoz, Ernesto Torralba and Jesus Villalobos.
Sponsors: STM Robotics, Abacril

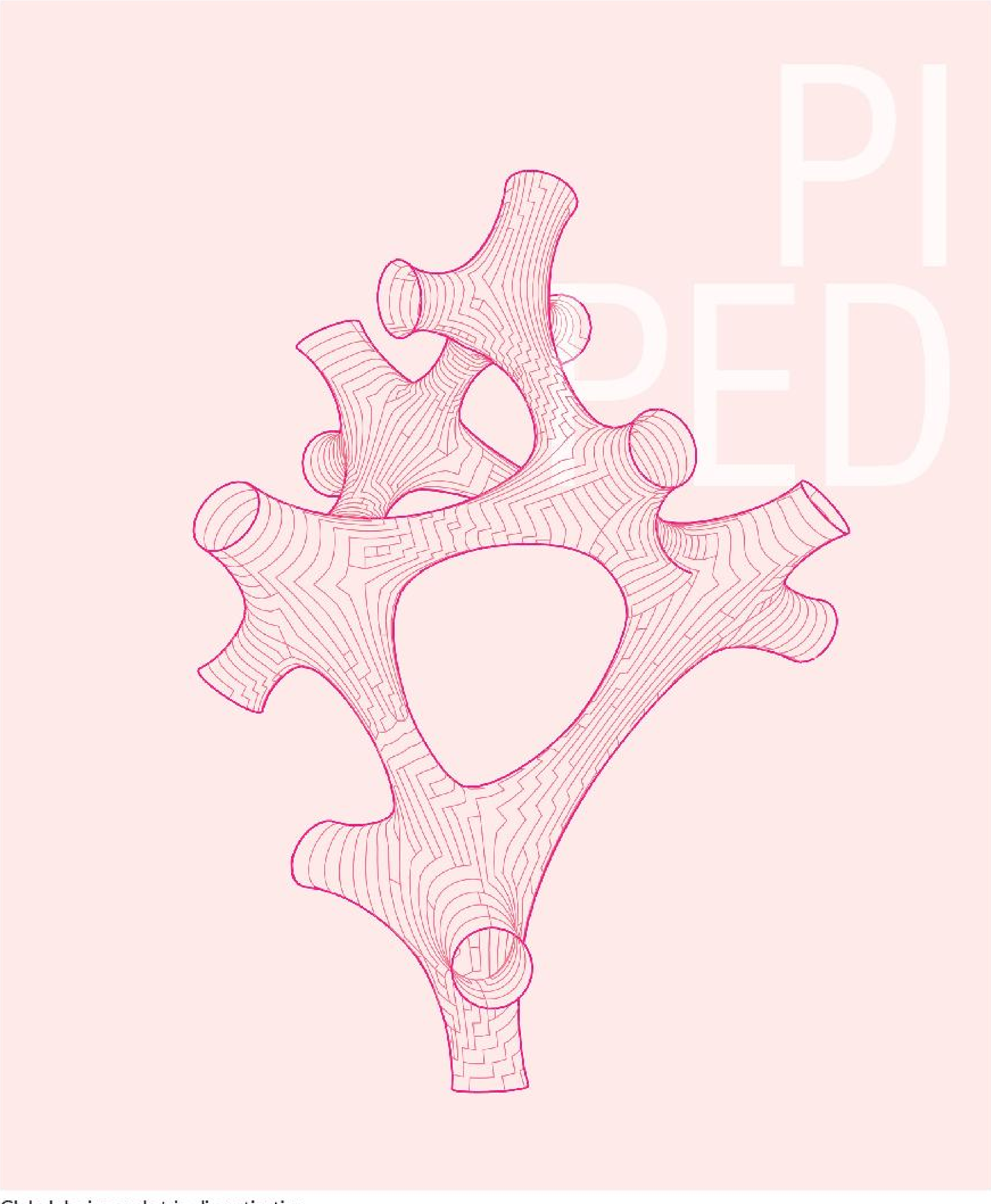
The Piped Assemblies workshop conducted at CEDIM from the 26th of November to the 7th of December takes the challenge of introducing state of the art computational design and fabrication workflows to undergraduate students in architecture.

The overall free-form structure is built from developable polypropylene plastic strips connected with the help of rivets. Its aesthetics and morphology (local high curvature) is strongly inspired by the existing state of the art of free-form and organic installations designed and built by both MARC FORNES THEVERYMANY practice and Jens Pedersen's yearly AA Visiting School workshops in Aarhus. The strip discretization of the structure finds also inspiration in prior research and graph-based computational design tools developed by both Andrei Nejur (i.e. the Ivy plug-in for Grasshopper) and Anders Holden Deleuran (i.e. the implementation of the NetworkX library in ghPython and exposition of its main functionalities).

The main goal of the workshop was to set up an integrative, file-less collaborative design workflow in which data is constantly streamed from student(s) to student(s) during all phases of both the conception and construction processes. The overall design-to-fabrication workflow relied on a waterfall methodology in which each discrete pipeline depends on its predecessor. At any stage in the workflow, the local pipeline's design technologist is able to communicate some changes to a colleague situated upstream in the process in order to drive and achieve better output within its own local design space situated downstream. Such feedback loops can take place at any time during the process until all desired requirements are met. The design-to-fabrication workflow of the Piped Assemblies workshop has been segregated into 7 distinct pipelines which are all connected through Speckle streams:

1. Definition of the overall abstract network.
2. Base mesh generation and stitching automation between each node.
3. Mesh relaxation and planarization (Kangaroo 2).
4. Strips generation algorithm based on an existing method developed by Anders Holden Deleuran and modified for the purpose of this workshop.
6. Labelling, unrolling and sorting of the strips.
7. Nesting of the strips (OpenNest).
8. Export of the fabrication data to dxf for machine-ready deliverables and laser-cutting (STMRobotics).

After the fourth pipeline, the overall workflow grafts into six different branches as the students have organized themselves into six different teams in order to fabricate separately the six different nodes, thus reducing the complexity of the future assembly process (Separation of Concerns). The six nodes have been constructed parallely and progressively assembled one after the other, facilitating the reach of the connections from both inside and outside the nodes during the manual placement of the rivets. The final assembled physical prototype has been hanged with nylon in the main entrance of CEDIM, between the first and the ground floor through the mezzanine aperture. The tension of the structure was adjusted empirically by calibrating the tensile force and anchor location of each thread.



Global design and strip discretization