

Introduction to Computational Design

#gsd6338

fall 2019

Instructor

Jose Luis García del Castillo y López

Student Projects Catalog



Harvard University
Graduate School of Design

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SCI-6338: Introduction to Computational Design
Fall 2019
<https://www.gsd.harvard.edu/course/introduction-to-computational-design-fall-2019/>

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INTRODUCTION

GSD6338 is an *introductory course to computational design*. This course is primarily intended for designers with little background in programming who are interested in developing their skills in order to be able to better understand, interface with, and customize the digital tools they are using, or develop their own software and interactive applications.

The course introduces students to fundamental concepts and techniques in computational design as well as the relevant mathematics. By the term *computational design* we mean an ad hoc set of methods borrowed from computer science, computational geometry, and other fields, and adapted to specific design problems such as design development, fabrication, analysis, interaction, and communication. The fact that most design related fields, including, structural engineering, environmental engineering, fabrication and others rely increasingly on digital tools opens the possibility for a cross disciplinary integration of techniques and data.

The goal of the course is dual:

- To help students develop the skills necessary for developing computational solutions for specific design problems. This includes geometry generation and manipulation, analysis of data from external sources, output of information and design evaluation.
- To explain in simple terms how commercial software used in architecture and design works. This is important for students to both master the tools that they are using in their day to day work, but also develop a critical approach to the conventions and assumptions embedded in such design environments.

From Prof. Panagiotis Michalato's syllabi

Introduction to 01 Computational Design Datum, Data and Points



GSD SCI 6338
2019.09.05

Introduction to 02 Computational Design Introduction to C#



GSD SCI 6338
2019.09.10

Introduction to 03 Computational Design Flow Control



GSD SCI 6338
2019.09.10

Introduction to 07 Computational Design Object-Oriented Programming



GSD SCI 6338
2019.09.26

Introduction to 08 Computational Design Object-Oriented Programming Curves



GSD SCI 6338
2019.10.01

Introduction to 09 Computational Design RhinoCommon



GSD SCI 6338
2019.10.01

Introduction to Computational Design Object-Oriented Programming Curves Surfaces Meshes



GSD SCI 6338
2019.10.22

Introduction to Computational Design Object-Oriented Programming Curves Surfaces Fabrication



GSD SCI 6338
2019.10.24

Introduction to Computational Design Object-Oriented Programming Curves Surfaces Assignment[1]



Introduction to Computational Design Object-Oriented Programming Curves Surfaces Code Libraries



GSD SCI 6338
2019.11.11

Introduction to Computational Design Object-Oriented Programming Curves Surfaces Continuous Execution



GSD SCI 6338
2019.11.11

Introduction to Computational Design Object-Oriented Programming Curves Surfaces Assignment[2]



04 Vectors

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2019.09.17

05 Objects & Lists

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2019.09.19



06 Functions

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2019.09.24



RhinoCommon II

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2019.10.03



GSD SCI 6338
2019.10.08

Assignment[0] Review



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2019.10.10

Curves & Surfaces

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2019.10.13



Transformations

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2019.10.31



Code Libraries

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2019.11.05



Continuous Execution

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2019.11.07



GSD SCI 6338
2019.11.14



GSD SCI 6338
2019.11.19

Generative Design



Python



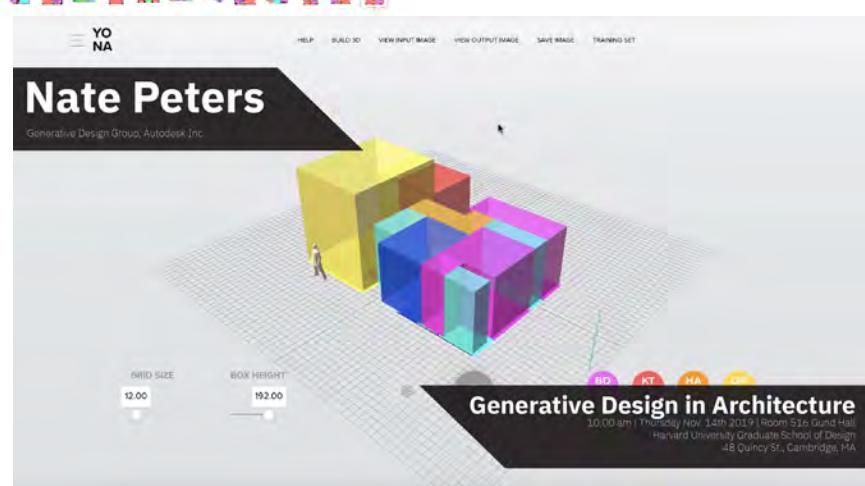
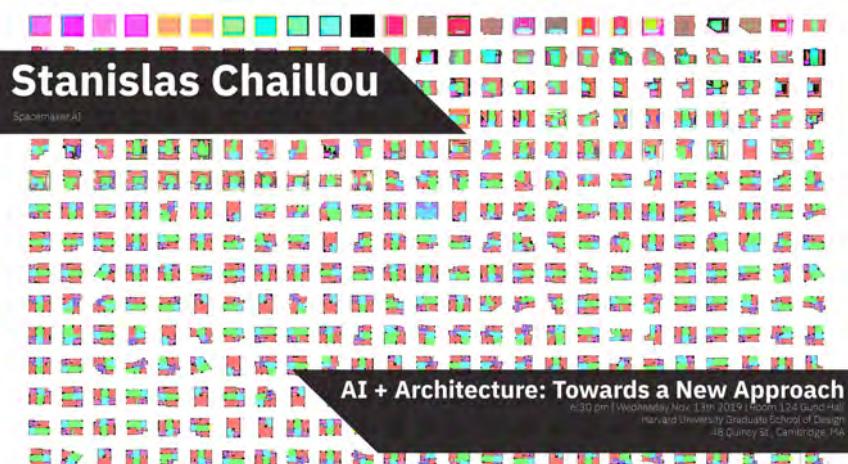
Unity

GSD SCI 6338
2019.11.21

LECTURES

The full set of course open-source lectures can be found on:

<http://bit.ly/GSD6388-Fall2019>



GUEST LECTURES

2019.09.18 | "Kintting for Architecture" by Dr. Mariana Popescu

In this guest lecture, Mariana Popescu shared her work on digital fabrication, knitting, textiles, and their potential impact in a more sustainable building future.

Dr. Mariana Popescu is an architect with a strong interest in innovative ways of approaching the fabrication process and use of materials. Her work as researcher at the Block Research Group in the NCCR Digital Fabrication, ETH Zürich, revolves around textiles as integral part of building processes, culminating the acclaimed Knit Candela sculpture, exhibited in the Museo Universitario de Arte Contemporáneo in Mexico City, and her PhD dissertation "KnitCrete: Stay-in-place knitted fabric formwork for complex concrete structures."

2019.10.30 | "Intuitive Interfaces" by Nono Martínez Alonso

In this guest lecture, Nono Martínez Alonso discusses his work on developing intuitive interfaces for creative communities, and how the collaboration between human and artificial intelligences can enhance the design process like, for example, with suggestive drawing.

Nono Martínez Alonso is an architect and computational designer with a penchant for simplicity. He holds an MDes Tech from the GSD and currently works as a Machine Learning Engineer and Designer for Autodesk Inc. He also runs the Getting Simple Podcast, where he interviews designers and thinkers about how to make less, better.

2019.11.13 | "AI + Architecture: Towards a New Approach" by Stanislas Chaillou

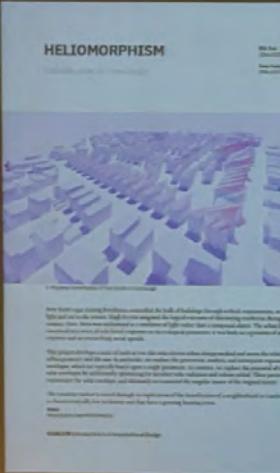
Artificial Intelligence is progressively bringing new means and methods to our industry. Beyond a mere technological shift, it is a radical evolution of our practices. Laying down a rigorous understanding of AI, and framing its inception in our field will define our ability to harvest its potential. In this guest lecture, Stanislas Chaillou discusses the new role of AI in architectural design practices, and illustrate it with some of his own work.

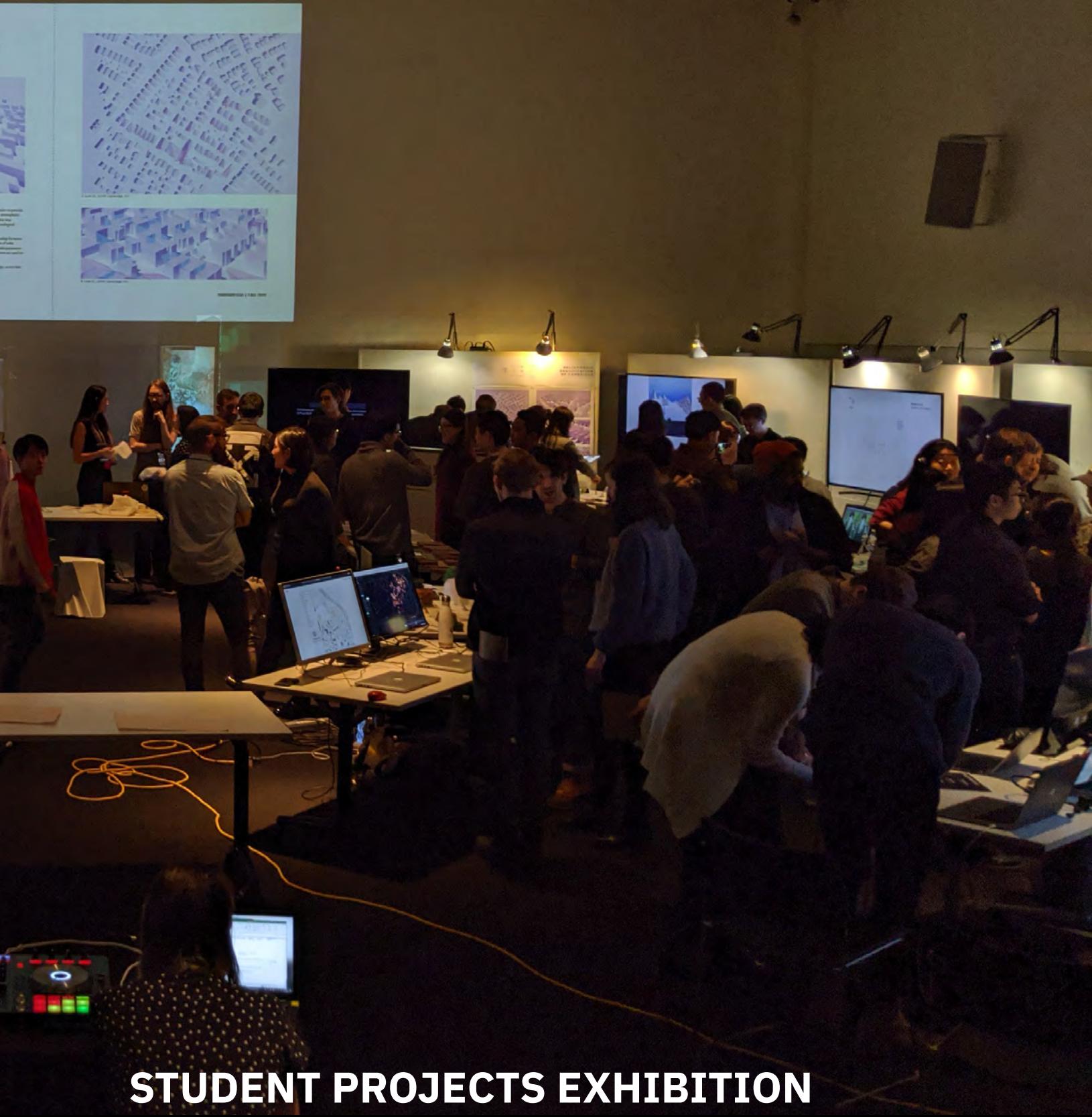
Stanislas received his undergraduate degree in Architecture at the Swiss Federal Institute of Technology of Lausanne. Focusing his practice around Architecture and Technology, he believes in the necessary integration of both disciplines to change our built environment. He has previously worked at internationally renowned firms including Adrian Smith & Gordon Gill in Chicago, Shigeru Ban Architects in Tokyo, Flux.io in San Francisco, and others, and works currently at Spacemaker.AI

2019.11.14 | "Generative Design in Architecture" by Nate Peters

In this guest master class, Nate Peters discusses generative design and its application in architectural design processes. The basic principles of generative design are introduced, illustrated through simple examples, and its relevance in design, analysis, simulation and optimization problems is discussed.

Nate Peters is a computational designer and software developer with experience in design optimization, digital fabrication, and machine learning. Nate received his Master of Design Studies in Technology from the Harvard Graduate School of Design, and his Bachelor of Architecture from Iowa State University. Currently he works in Boston as a software engineer in Autodesk's AEC Generative Design Group. At Autodesk he has assisted in the design and construction of multiple large scale research pavilions, and is currently focused on Project Refinery, a new generative design tool for architects and engineers in the building industry.





STUDENT PROJECTS EXHIBITION

Image credits: Seong Hyun Nam



The Student Projects Exhibition took place on Tuesday December 17th, 2019 in Piper Auditorium at the Harvard Graduate School of Design. It consisted of an open, public exhibition of their final projects.

A recap video of the event can be found on <https://youtu.be/qE3yaidoH54>

Guest reviewers:

Andrés Colubri
Spyros Ampanavos
Paloma González Rojas
Zach Seibold
Axel Kilian
Hyojin Kwon
Pavlos Protopapas
Martin Bechthold
Christopher Gumb
Olga Mesa
Almudena Ribot
Jonathan Grinham
Varvara Toulkeridou
Nate Peters

Student Project awards:

Most Playful/Fun:
Wei Wu for GHOSTLY SURVEILLANCE

Most Beautiful:
Hyemin Bae & Bryan Ortega-Welch for PRINTING ERROR

Most Technically Challenging:
Sana Sarma for CALL() AND RESPONSE()

Jury's Choice Award (ex aequo):
Koby Moreno for PETRI PLOT
Pengcheng Sun, Maoran Sun & Yuebin Dong for MASS PRODUCTION

Student's Choice Award:
Peilin Li, Haoyu Zhao & Beilei Ren for CLOCK HANDS







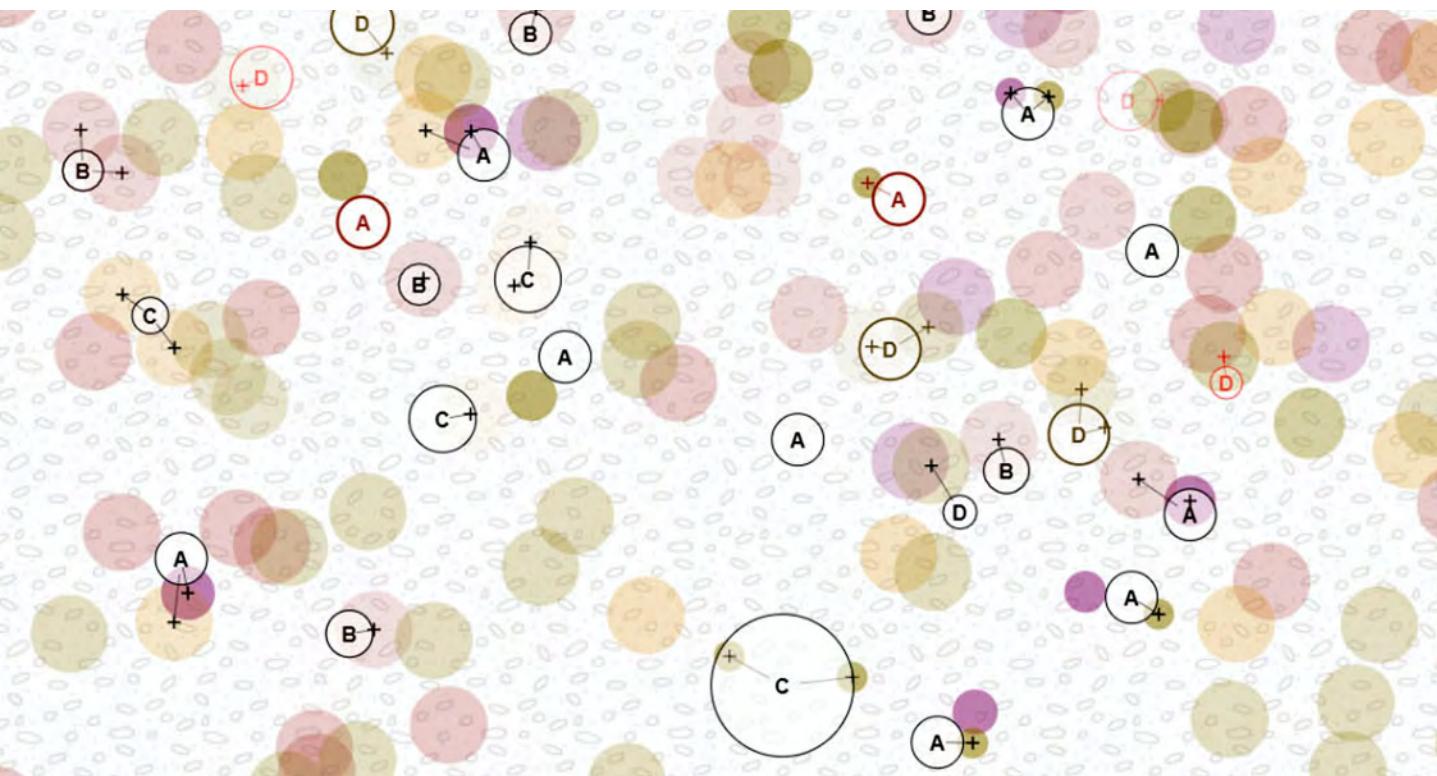


STUDENT PROJECTS CATALOG

PETRI PLOT

Koby Moreno
MLA I AP 2020

A Web Tool to Learn About Phytoremediation



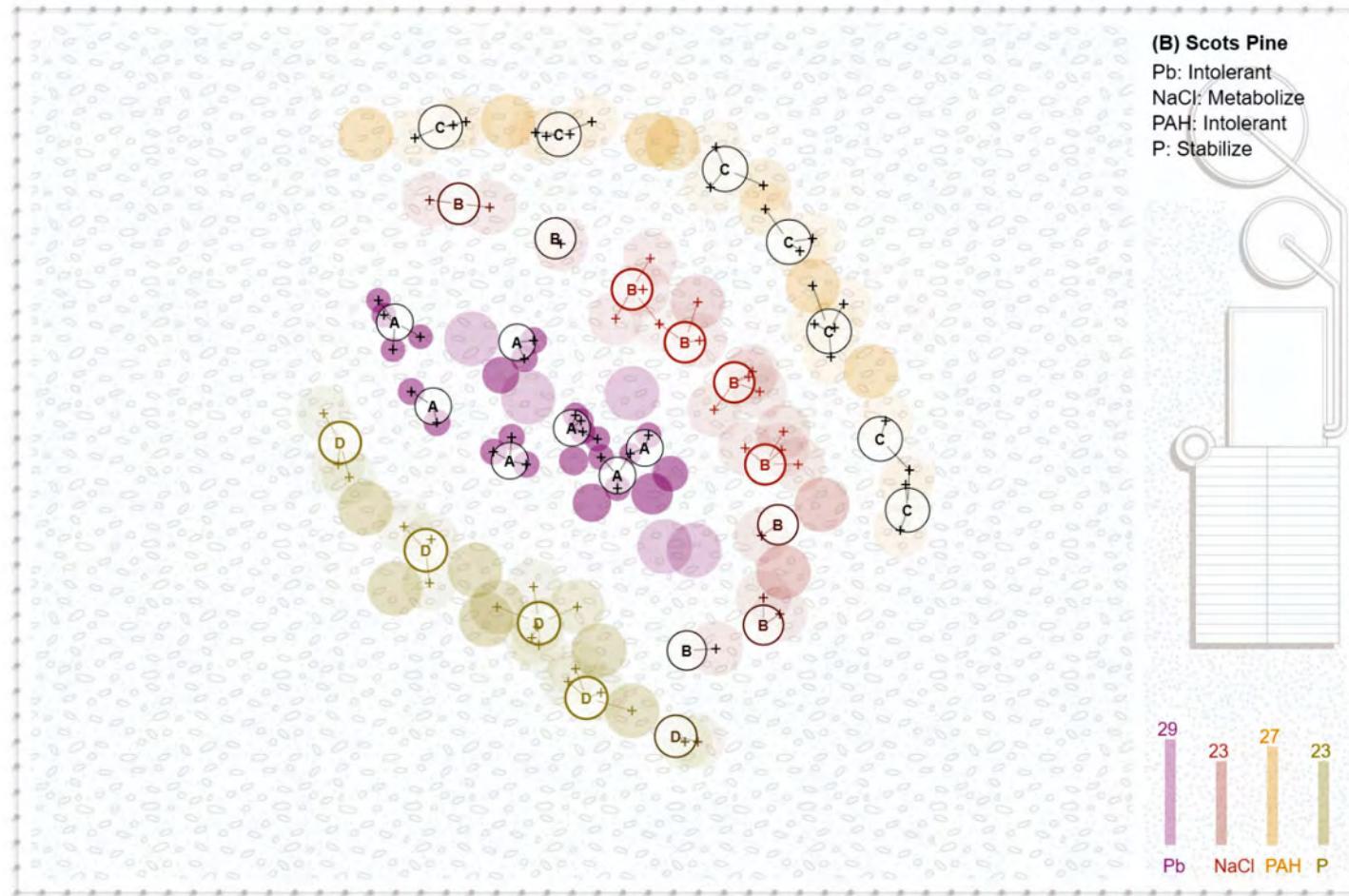
1 Planting results using the randomize functions

Phytoremediation is the process in which plants remove pollutants from soils and water bodies. Depending on the plant species, pollutant type, and concentration of said pollutant, this process could take anywhere from 5 to 50 or more years. Petri Plot provides students with a web-accessible tool to be able to visualize and experiment with phytoremediative processes in planting design. Inspired by the petri dish (a clear container used in scientific studies to populate and observe changing fungi and bacteria), Petri Plot utilizes user-observation and interactivity as its primary means of educating them about this topic. This program was built using JavaScript, HTML, and CSS so that it could be hosted on the web and become a publicly accessible resource.

Video

<https://www.youtube.com/watch?v=MrePPUqWeWE&feature=youtu.be>

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2 Strategic planting according to plant and pollutant type



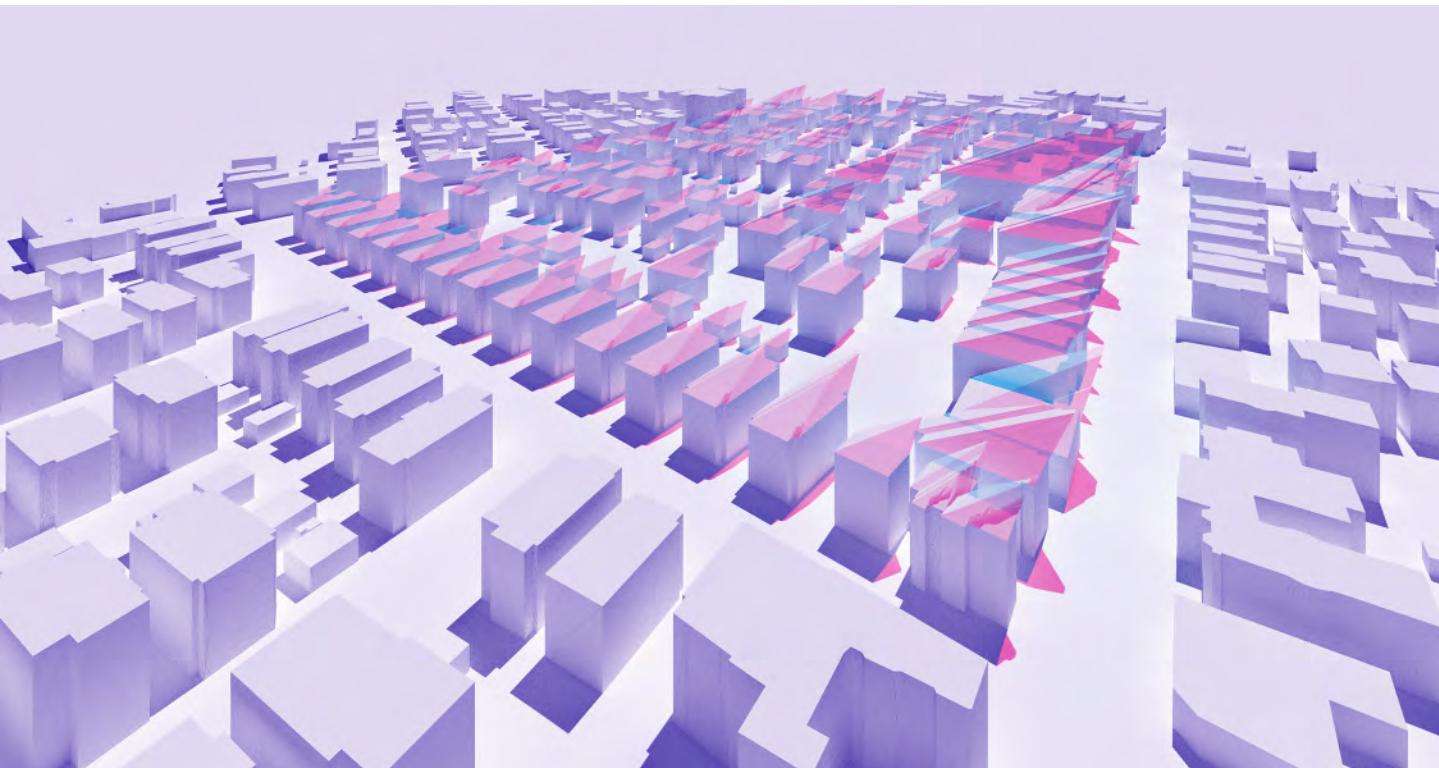
3 A petri dish, the inspiration for this project

HELIOMORPHISM

Densification of Cambridge

Min Yeo
DDes 2022

Sara Tepfer
DDes 2022



1 Proposed densification of four blocks in Cambridge

New York's 1916 Zoning Resolution controlled the bulk of buildings through setback requirements, in order to provide light and air to the streets. Hugh Ferriss imagined the logical extremes of this zoning resolution through atmospheric renders. Here, form was understood as a mediator of light rather than a composed object. The urban fabric was conceived as a series of rule-based responses to an ecological parameter; it was both an expression of an ecological response and an overarching social agenda.

This project develops a suite of tools to test this solar-driven urban design method and assess the relationship between urban geometry and the sun. In particular, we explore the generation, analysis, and subsequent expansion of solar envelopes, which are typically based upon a single parameter. In contrast, we explore the potential of multi-parameter solar envelopes by additionally optimizing for incident solar radiation and volume added. These parameters are used to reconstruct the solar envelope, and ultimately to transcend the singular nature of the original metric.

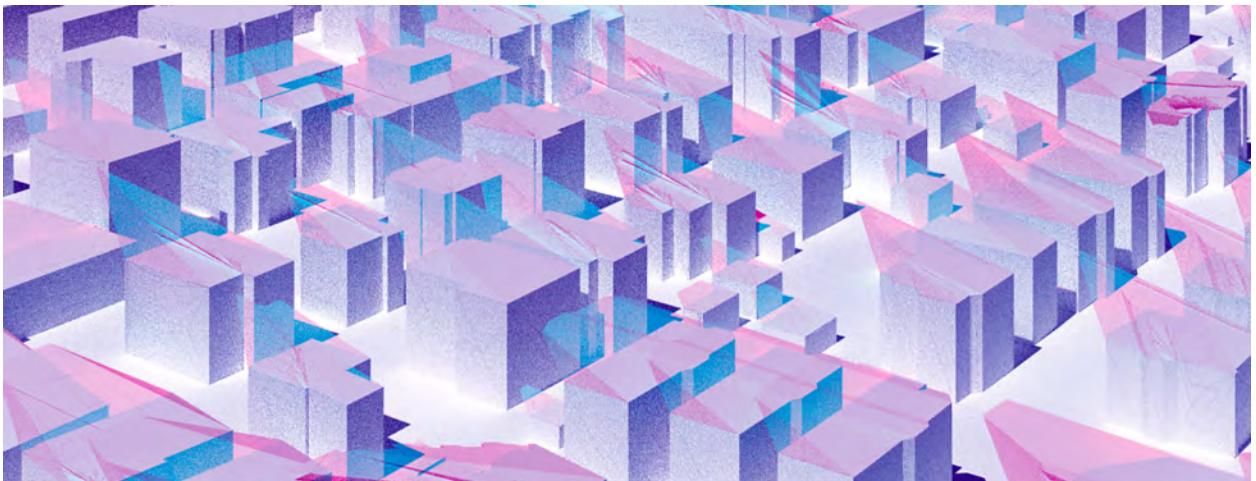
The resultant toolset is tested through an exploration of the densification of a neighborhood in Cambridge, a city that is characteristically low in density and that faces a growing housing crisis.

Video

<https://youtu.be/cAh1Sw9o61o>



2 June 21, 10AM. Cambridge, MA.

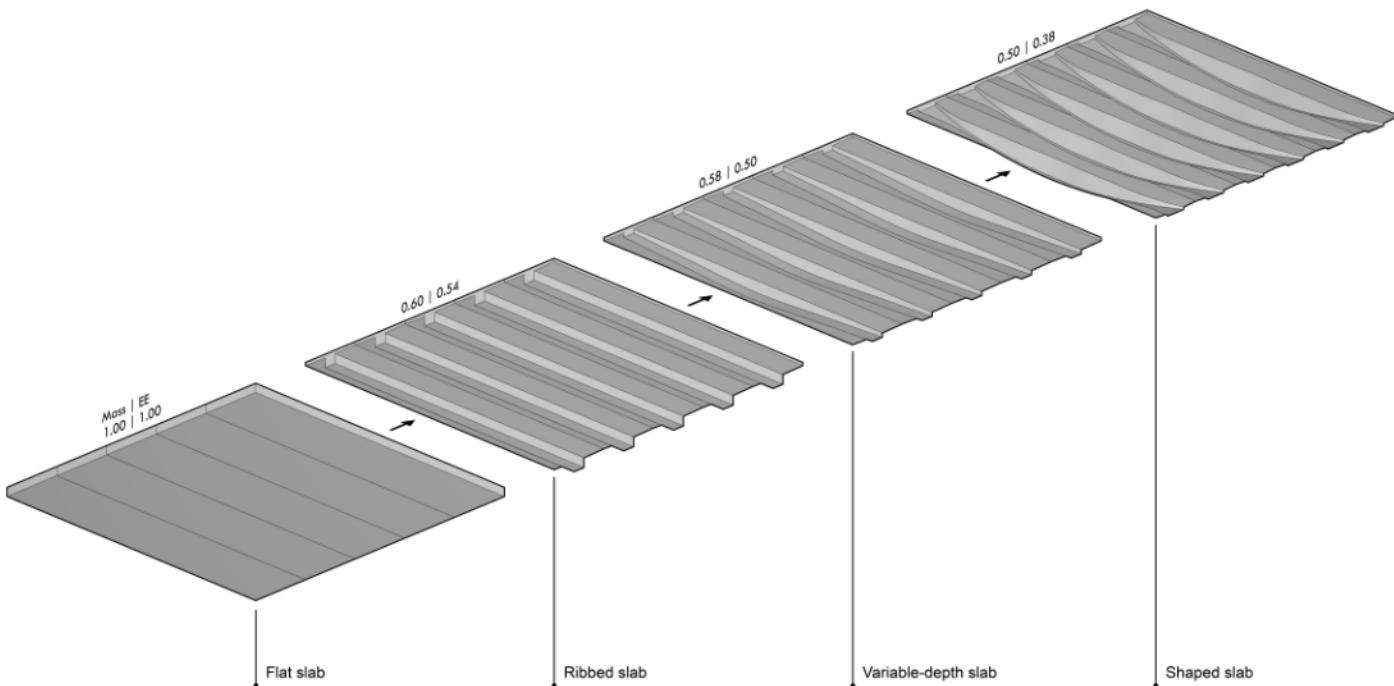


3 June 21, 10AM. Cambridge, MA.

CADDISFLY

Mohamed Ismail
MIT PhD 2023

Analytical Structural Analysis Tool



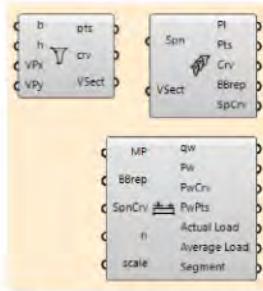
1 Caddisfly enables the performative design of concrete structures with geometric complexity and material efficiency.

The construction industry is resource intensive and unsustainable. As the construction industry continues to expand, so too do the economic and ecological costs of building. Depending on location, construction can account for 10-30 percent of carbon emissions. Construction also accounts for nearly half of the world's natural resource consumption. Today concrete is the most produced and utilized synthetic material in the world. Consequently, the mounting use of concrete structures in cities has led to a developing concern for the environmental costs of construction.

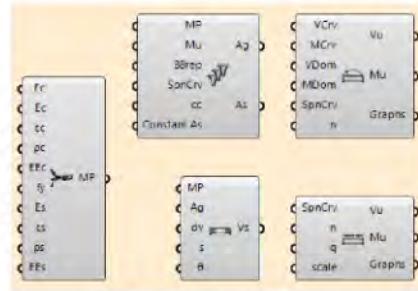
New tools have bolstered the design of material efficient structures with increased precision and predictability. Yet existing optimization techniques typically neglect the complexity of reinforced concrete as a configuration of various materials – aggregate, steel, cement, water – resulting in excessive material use and uncertain results. Caddisfly connects an understanding of concrete mechanics to new methods of analytical structural design and numerical optimization. Through computational structural design, there is an opportunity to build far more with far less, reducing the economic and environmental costs while meeting the demands of a growing population. Caddisfly makes the design of material efficient concrete design easier by providing real-time analysis of a concrete element along its length.

Video

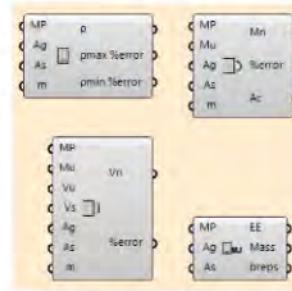
<https://youtu.be/P3wGjLDzPgw>



1 | GEOMETRY

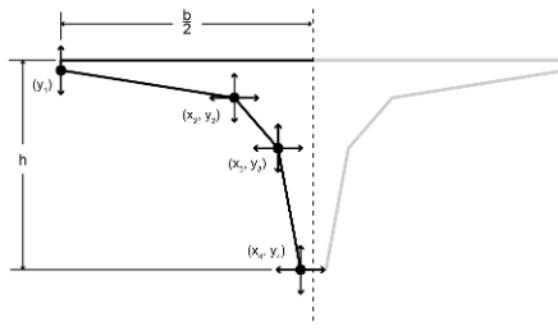


2 | ASSEMBLY

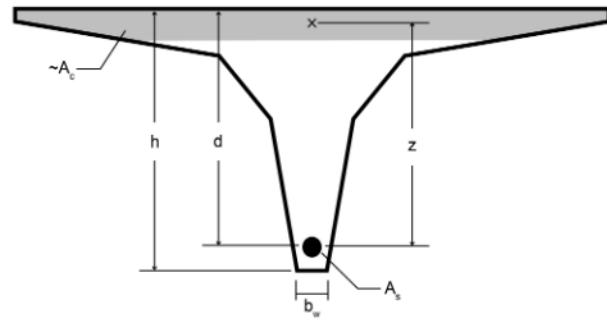


3 | ANALYSIS

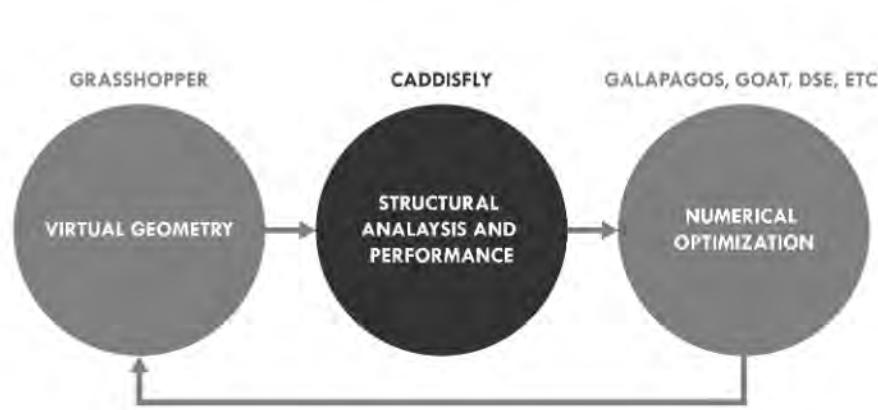
2 Caddisfly hosts a suite of components that define, analyse, and inform the design of free-form concrete elements.



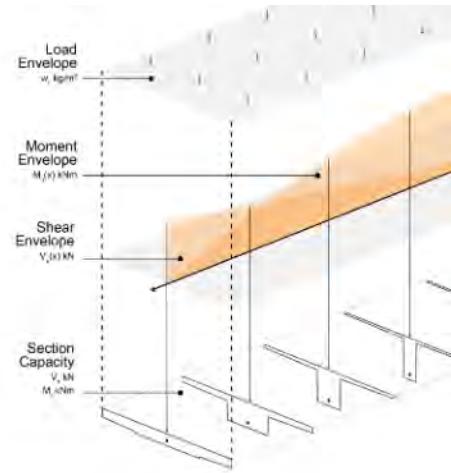
3 Designers have the freedom to generate new geometries.



4 Caddisfly automatically assesses variable geometry.



5 Caddisfly fills the existing gap between parametric geometry and numerical optimization with rapid structural analysis.



24 HOURS IN CAMBRIDGE

An Interactive Web + Unity Game Design

Chenlu Wang
MDes Tech 2021

Meichun Cai
MDes Tech 2021

Kaihong Gao
MDes Tech 2021

Peitong Chen
MDes Tech 2021



1 Unity game full size

Cambridge is the place we study, live in and spend time with each day. Out of your daily routine, have you ever wondered what your schoolmates do for their days? Are you curious about some hidden interesting spots in this city that you never knew before? Our project 24 Hours in Cambridge gives you this chance. Besides, living in Cambridge, although we are already so used to everything happening here, have you ever had different imaginations of this city when you walk in it, like in Alice Wonderland and the Monument? The Unity game could take you to explore a “hidden Cambridge”.

We made an interactive website for users to filter data and see what GSD students do/ where they go in a day. You could also filter data to see people's route animation in that day. For several special spots where people visit a lot / activities happen frequently including harvard yard, harvard square, science center and Gund Hall, we made Unity 3D interactive games in multiple scenes for people to play with. Interaction includes collectible, environment animation, ray tracing, building description UI and more. You could collect items along the way, see words popping up on interesting spots and interact with buildings.

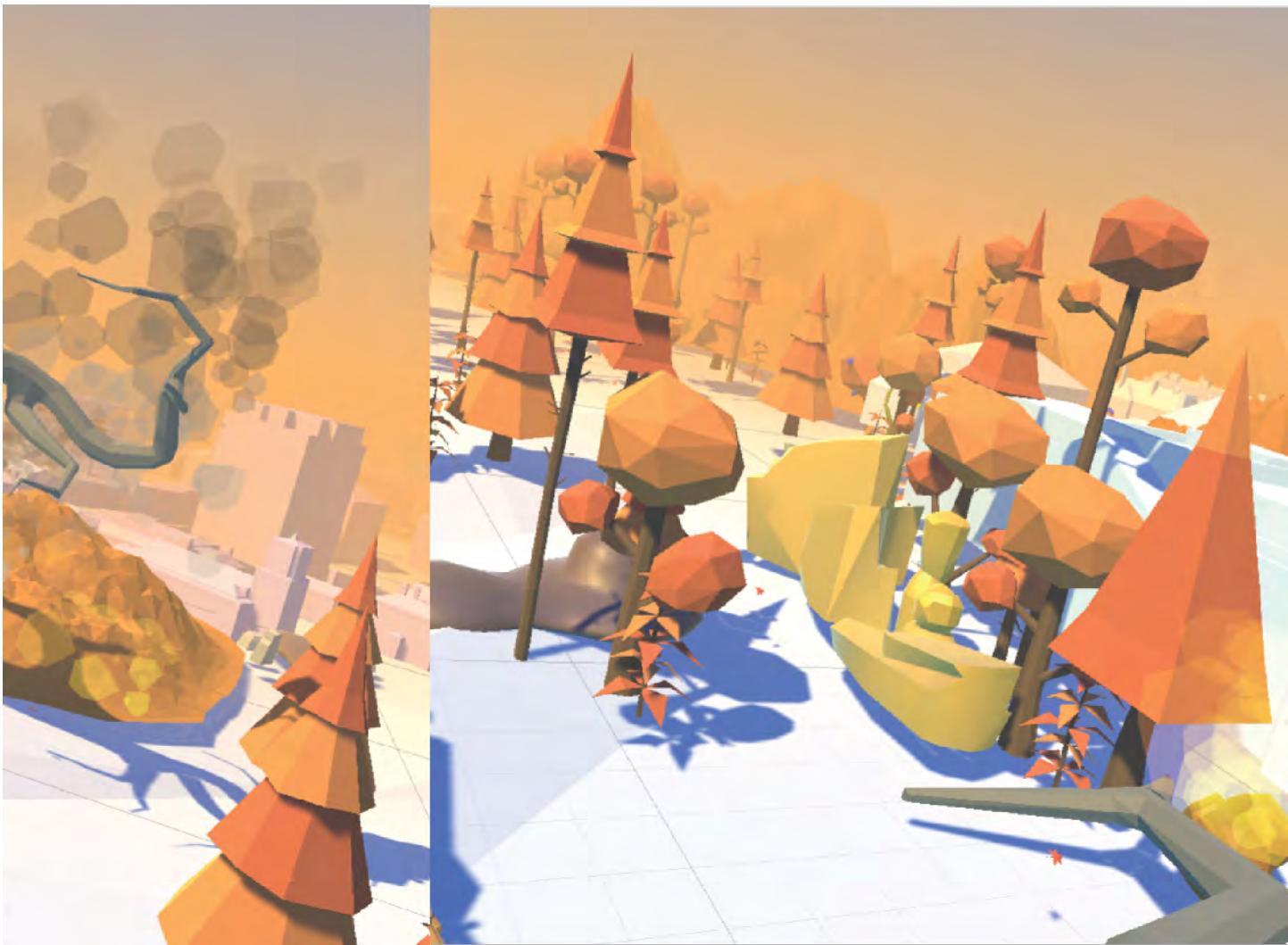
Video

<https://youtu.be/SY1Fr7fAXFM>

Learn More

https://drive.google.com/open?id=1oqc_N22BpQHSeTpJJQrFoQUzEMVaFFO

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2 Unity game details



3 Interactive website design

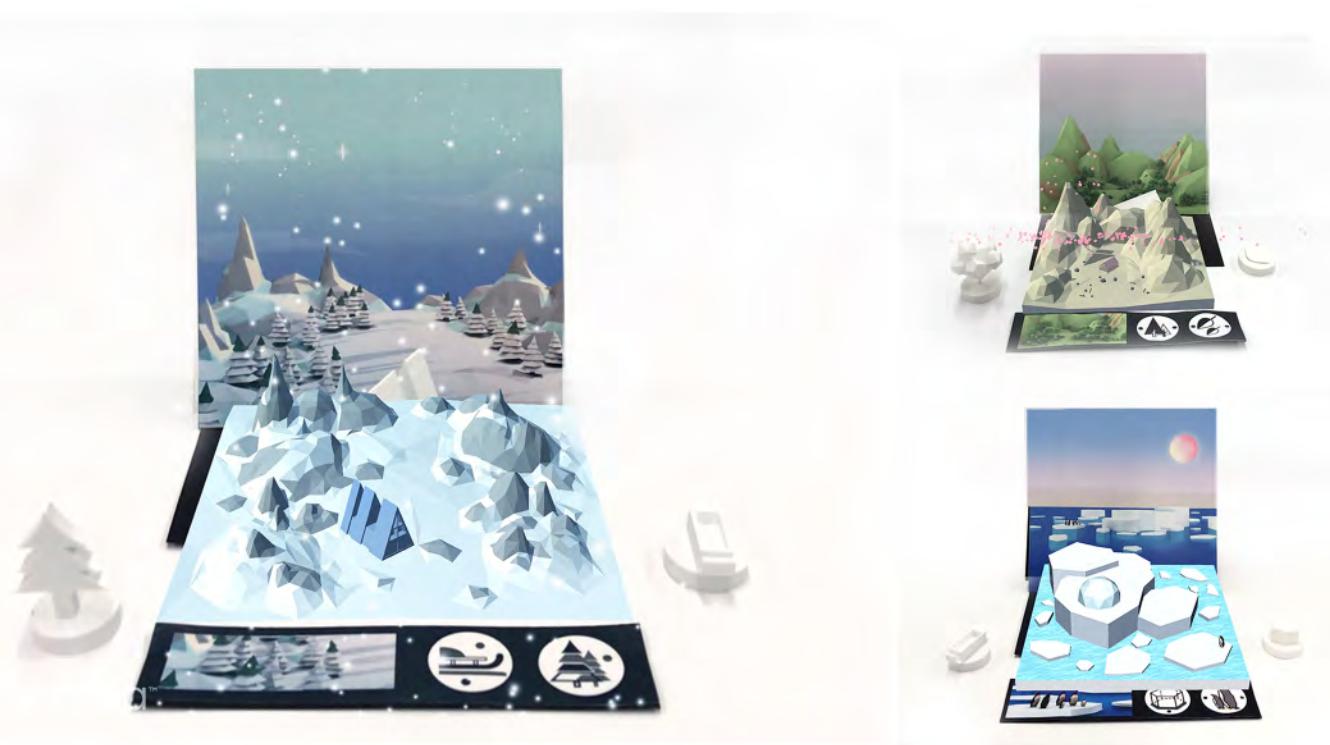
AR HOLIDAY CARD

Interactive Card Set for Your Architecture

Mingxuan Qin
MAUD 2020

Yamei Chen
MAUD 2020

Tongtong Zhou
MLAUD 2020



1 AR scene of 3 environment looking from an iPad screen

It's that time of year – Happy Holiday! We present a set of themed holiday cards that will transform your architecture pieces into the AR world, with the bonus -- interactive components that allow you to manipulate the environment.

3 themes include a Snow Mountain, with pine trees, flying Santa and reindeer; an Iceberg, with moving icebergs, and a penguin; a Forest, with deciduous trees, and flying flower petals. Within each folded card, the user will receive a main theme piece, a target piece with around buttons, and several 3D-printed objects functioning as the button handlers. The case of the card can be folded into a support for setting up the theme image and the buttons. A pre-installed App dedicated for this AR Holiday Card kit allows the user to manipulate the environment in an AR world.

Have fun!

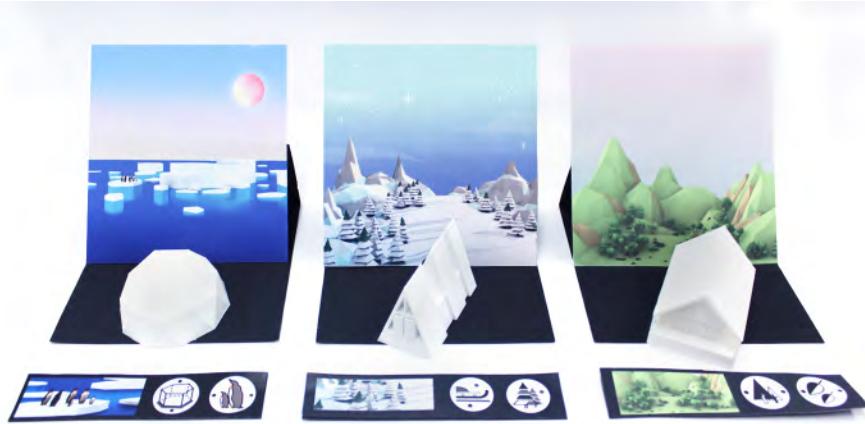
Video

<https://www.youtube.com/watch?v=SpHEh21WIEU>

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2 Real-time interaction with the AR and the environment



3 Themed holiday cards with target pieces

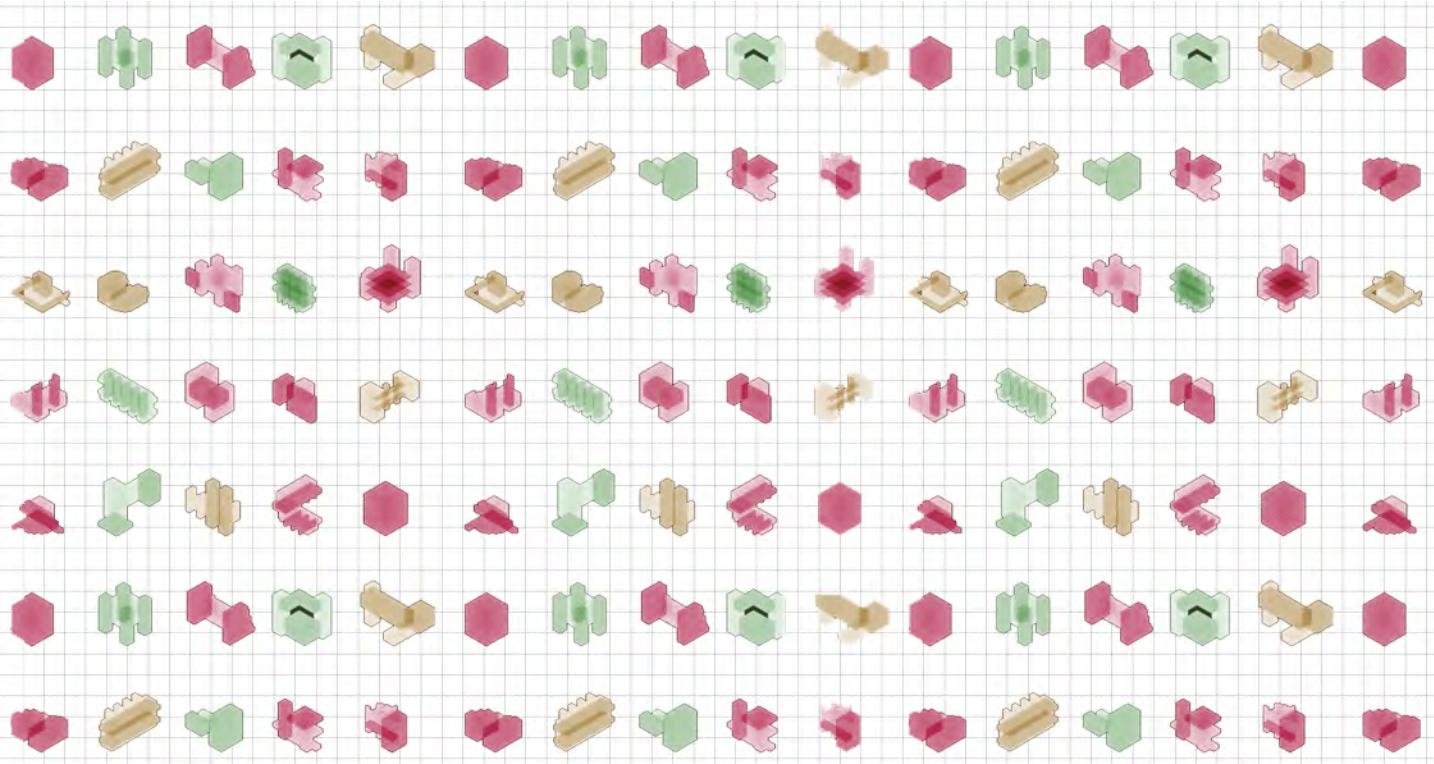
MASS PRODUCTION

Urban Massing 3D Sketchbook

Pengcheng Sun
MAUD 2020

Maoran Sun
MDes Tech 2020

Yuebin Dong
MAUD 2020



1 Mass production: conceptual urban massing sketchbook

This project reflects and explores how CAD “aid” early-phase urban design. Currently, urban design is mostly done with 3D software. After some sketches during early concept design phase, most time of design development is spent studying and manipulating building massing in 3D modeling software.

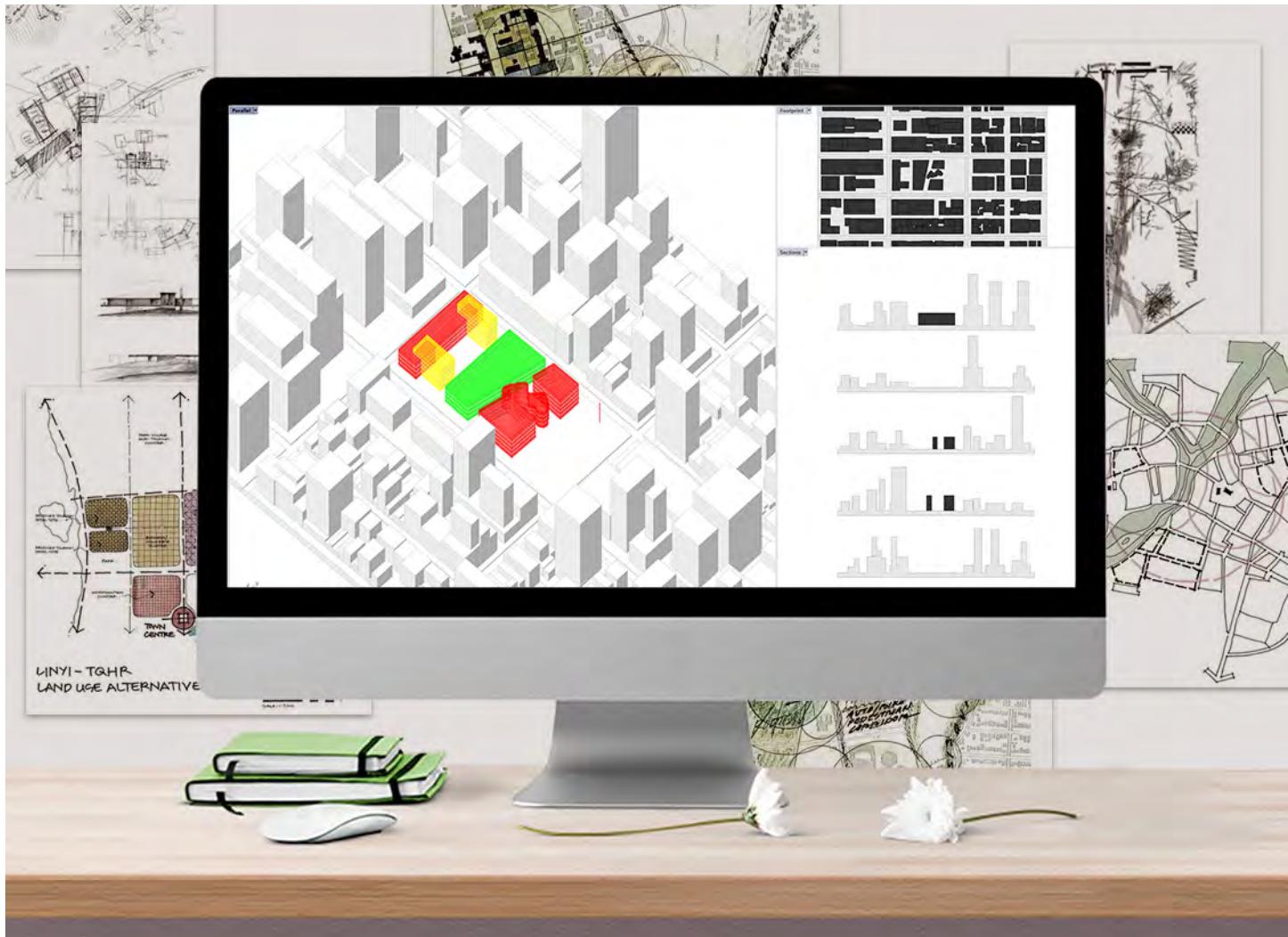
Our group is interested in providing an alternative workflow which emphasizes hand-on 2D sketches and quick 3D massing feedback from 3D software. This “old school hand and eye” design workflow makes early concept design phase more efficient and productive. The advantage of this workflow is quick design iteration, and the hands-on design manipulation. The limitation is that this prototype may only apply during the early design phases and lacks the ability to do detailed design.

Video

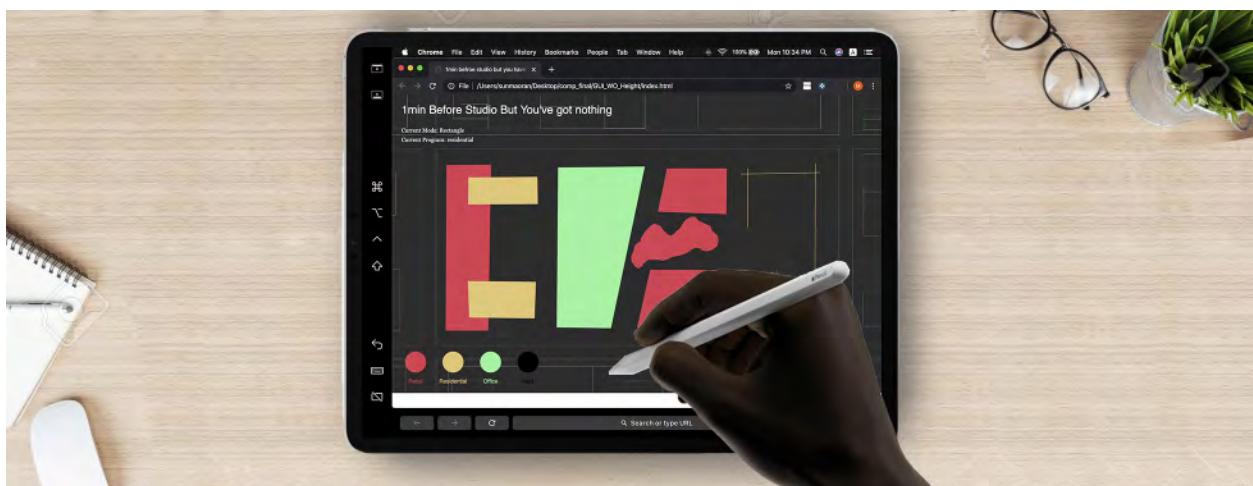
<https://vimeo.com/379930148>

Learn More

<https://github.com/MaoranSun/MassProduction>



2 3D massing on urban context provides quick design feedback



3 2D concept sketches study the relationship of solid and void massing

EYES SEE YOU!

See, and Be Seen

Xinru Liu
MDes CC 2021

Maria Roldan
MDes Tech 2021



1 Array of eyes in the canvas. Image taken from Processing.

Eyes see you! is a playful yet creepy installation that lures users with a vibrant array of eyes and stares at them. Conceptually, the project deals with objectification, social pressure, and eye geometry and movement. Design wise, it is split into three areas: the creation of eyes in a parametric manner, the arrangement of the eyes, and the sensors that control movement.

The eyes consist of two parametric Bezier curves. Just like regular eyes, they each contain an iris, which has a subtle gradient of colors to make it look more realistic, a pupil, eyelashes, which are the connection between corresponding points along scaled curves, and eyelids, with some fashionable eyeshadow that matches the eye color. Fills and line weights add other make up accents, like mascara and eyeliner. The eyes are arranged in a canvas that adjusts to the projector. Using nested classes, they are created in pairs, so they blink and move together, just like your eyes do! The movement is controlled by two UNO sensors. One sensor tracks side-to-side movement and controls the pupils and irises. The other sensor tracks depth, and controls blinking, jittering, and squeezing. Stop by and see the eyes see you!

Video

<https://youtu.be/JkpFvipH3HU>



2 Installation mock-up, using UNO sensors, Arduino, and calibrated projections



3 Eye architecture, including color palettes and basic movements

HEARTBEAT UNIVERSE

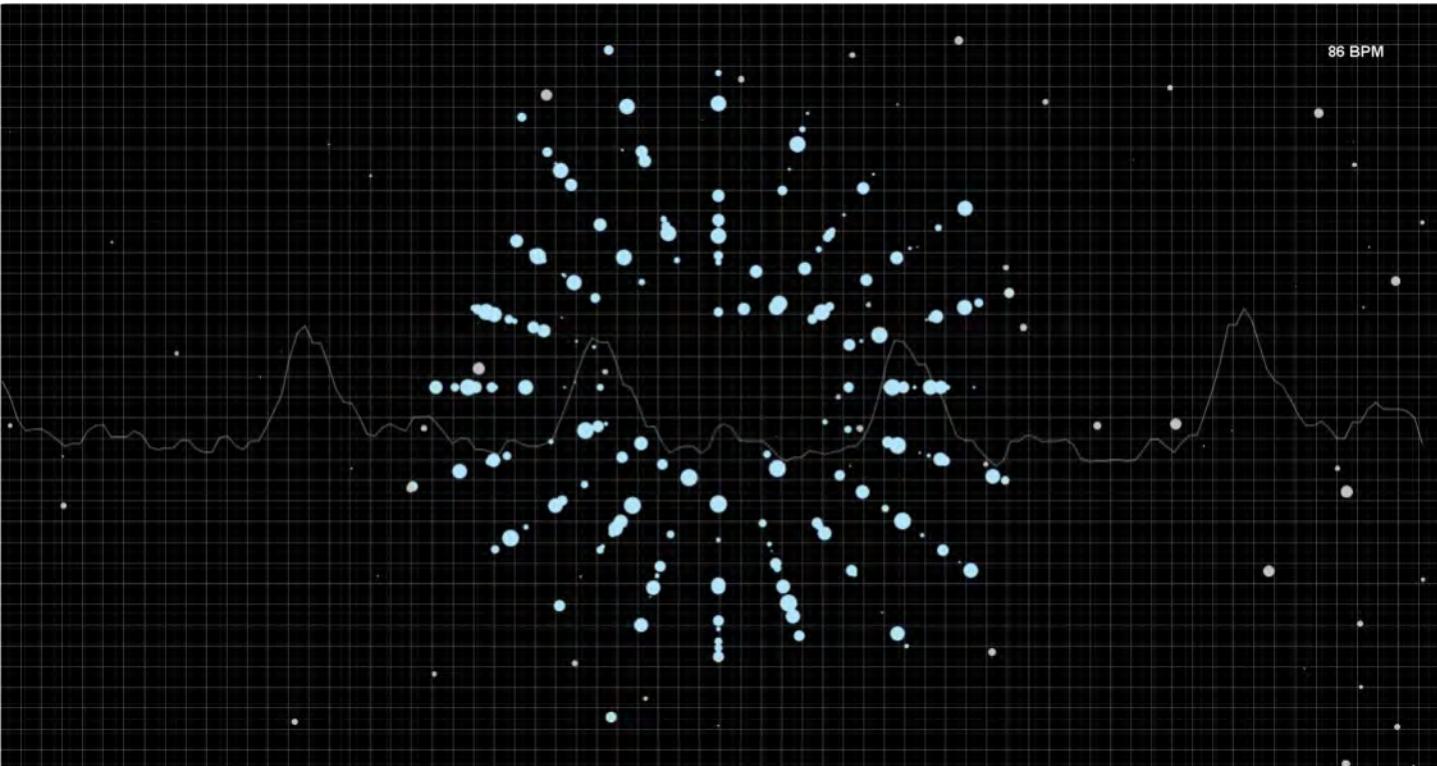
A Digital Heart Pulse Installation

XingJian Jiang
MAUD 2020

Cindy Xiao
MAUD 2020

Jiayi Wang
MAUD 2020

WeiHsiang Chao
MAUD 2020



1 Heartbeat BPM universe

It is a common phenomenon in our society today that young people generally pay less attention to their health condition. Their everyday lifestyle is composed of many unhealthy habits, including but not limited to long sitting hours, staying up late at night, drinking & smoking. The fast-paced modern life inevitably increases the risk of heart-related health issues, and sometimes it becomes too late to fix when a sudden heart fail strikes upon.

As architecture students, we are also subjects of heavy workload and high anxiety level; however, often times we don't give ourselves enough time to reflect upon our own health. Among the typical health measurements, the heartbeat is the most easily accessible data to be monitored on a daily basis. Currently, heart rate data is not completely understood by the users due to its uninventive display convention. The users pay little attention to the heart rate BPM values and find it difficult to relate to actual health information. Our group is proposing to generate a graphical representation of the traditional ECG as a way to raise awareness for cardiotonic health among young people like us.

From now on, slow down, take a deep breath, and feel your own heartbeat.

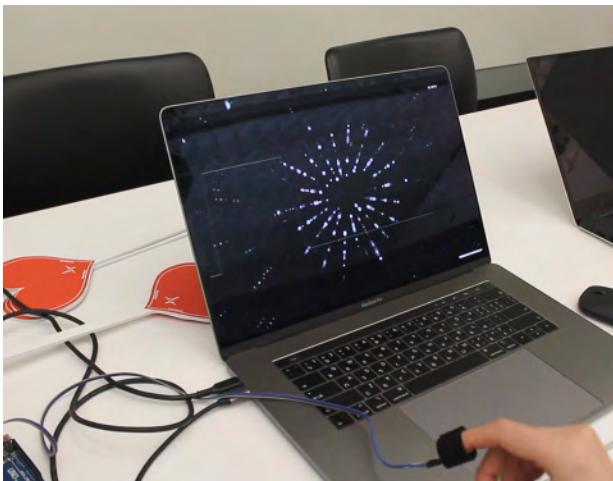
Video

<https://youtu.be/kA0DyI75WnU>

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2 Heartbeat universe multiple



3 Coding

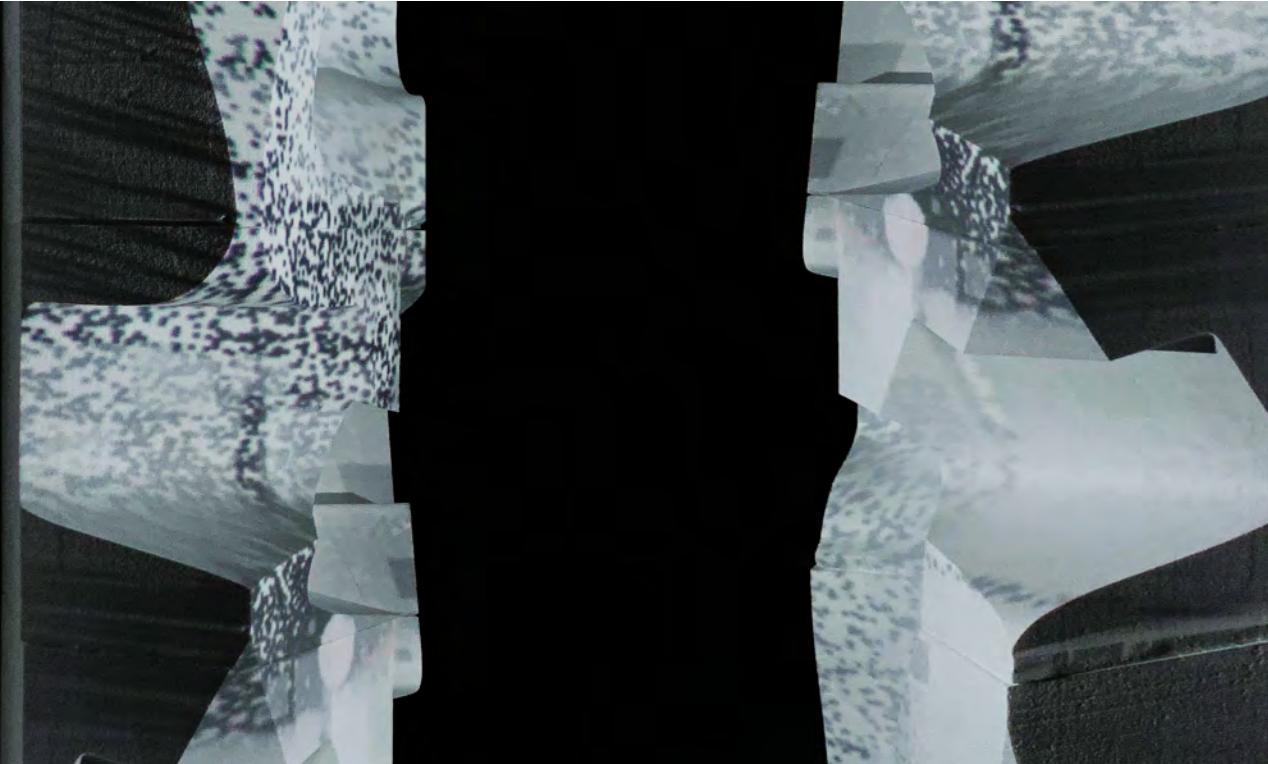


PHANTOM MONUMENT

Augmented Vision Through Sound & Motion

Zhenyu Yang
MDes Tech 2021

Lei Ye
MDes APDP 2021



1 Close shot of the projection

This project seeks to use projection as an associated digital description of geometry, to project alternative readings onto physical forms. Further develop a series of notation system to either enhance or obfuscate the formal logic of the geometry.

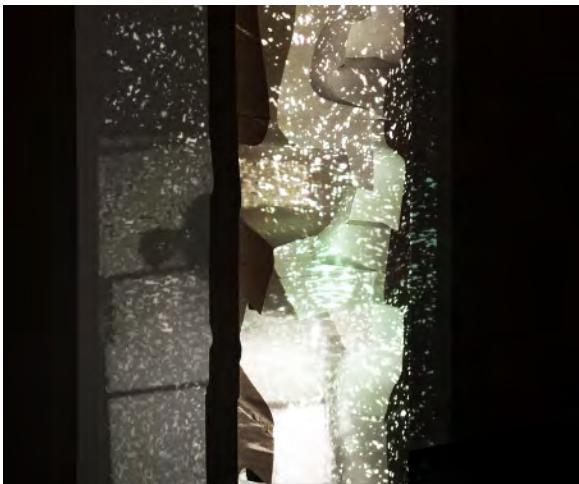
The project focuses on how to use light and shadow as a phenomenon to visually re-interpret the original attributes and boundaries of the geometric form, at the same time considers how to give this interpretation a new dimension and Narrative through sound and motion, as a factor with obvious temporal characteristics.

Light and shadow will be first re-interpreted to geometries as Points, Lines and Surface, by doing so reconstruct the reading of the geometry. Further, Timely sounds and actions on the field will be superimposed in geometric form, as an interactive feature to reveal the idea of coding phantom description onto the form.

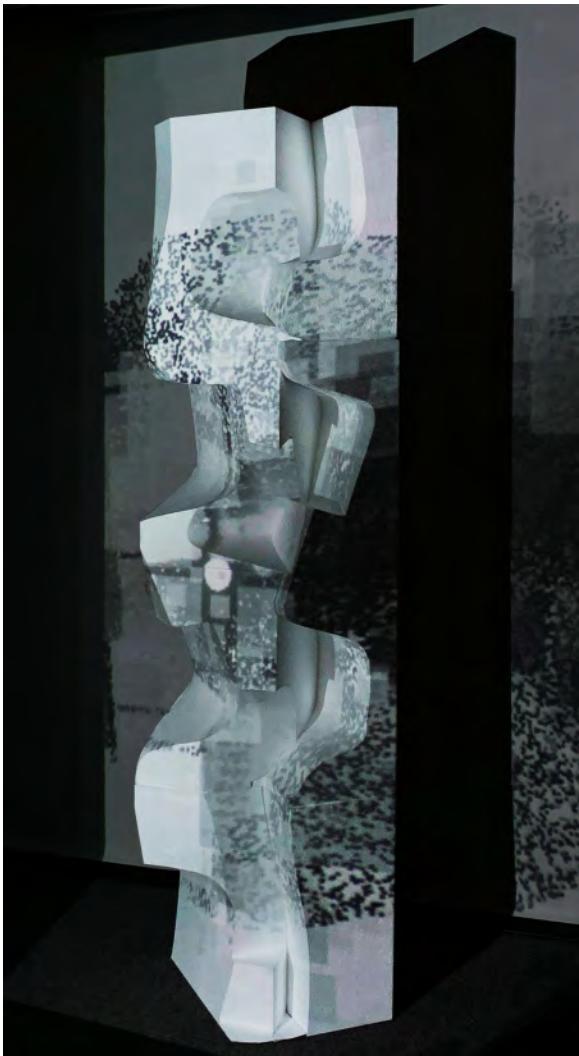
Video

<https://youtu.be/c0eMjnbaKDY>

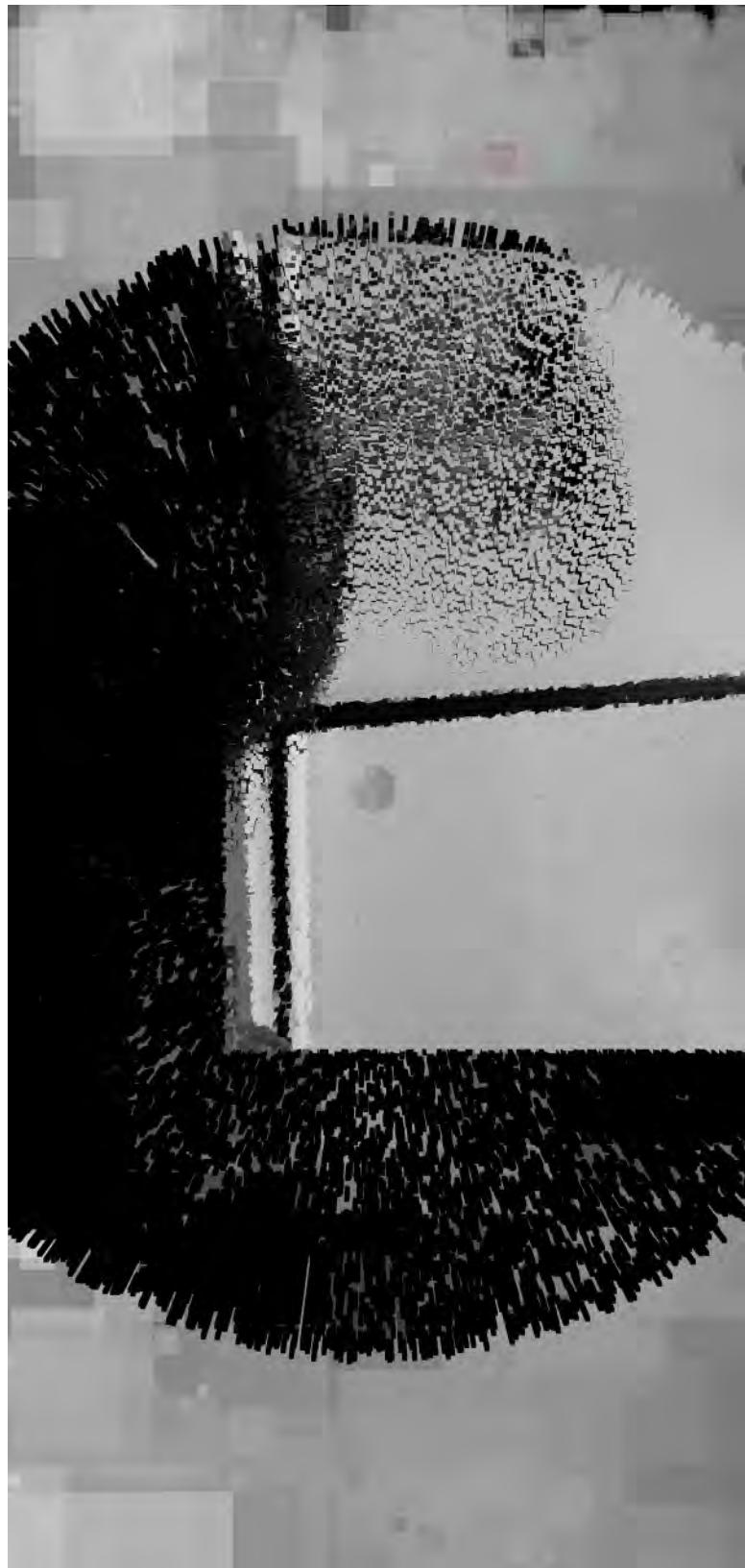
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2 Dot cloud



3 Overall shot



4 Sound & motion

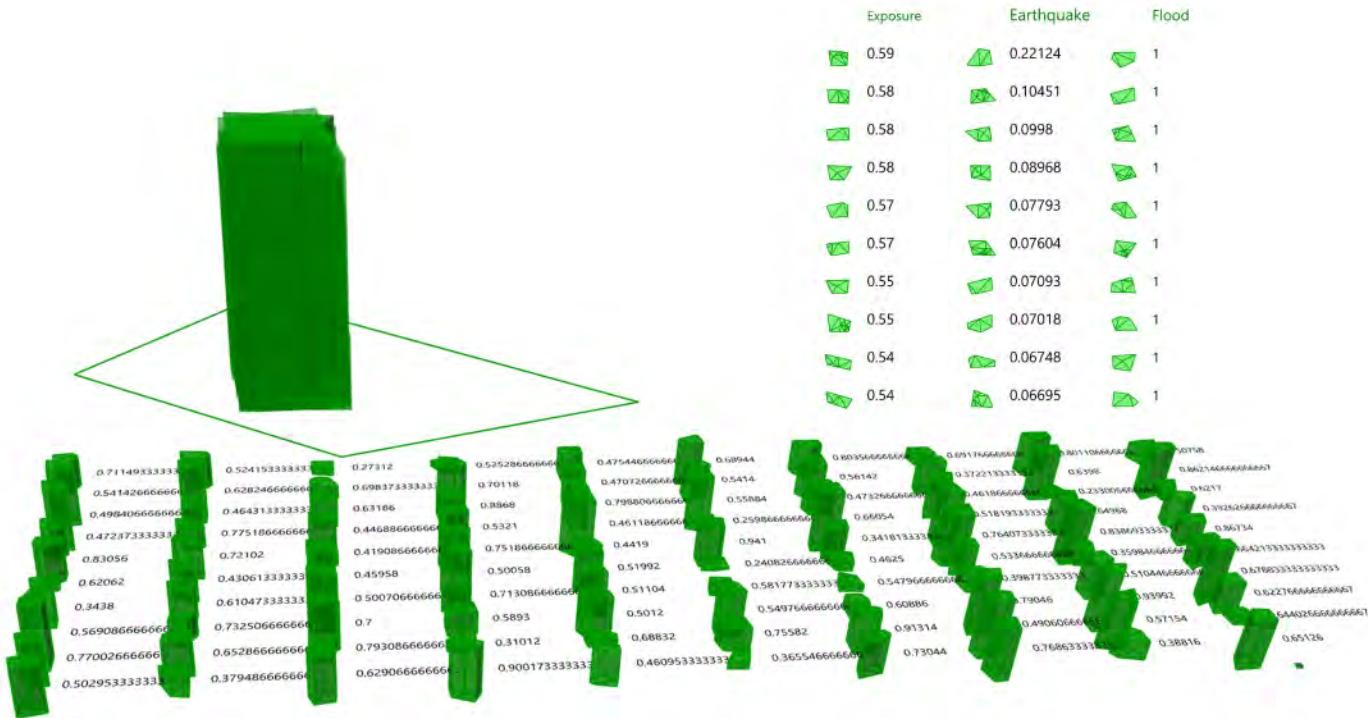
GREENFORM

Accelerated Massing for Sustainable Designs

Mirah Xu
MDes EE 2021

Moulshree Mittal
MDes CC 2021

Kezi Cheng
PhD 2021



1 Randomly generated massing with user ranked score factor and top scoring for each environmental factor

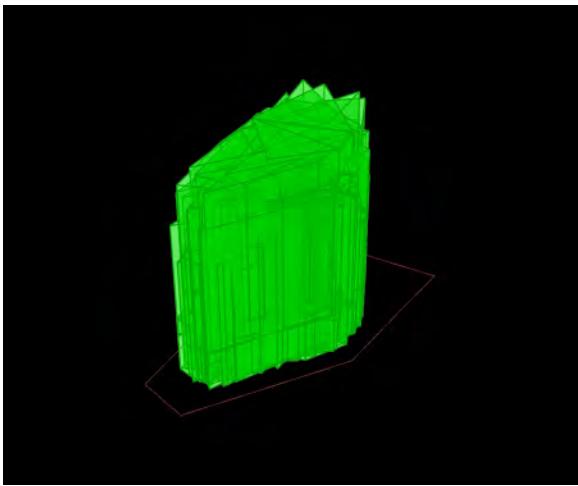
Architects and urban designers go through many tedious iterations of early design massings just to reach a potential design for the planning stage. Additionally, designers do not necessarily consider environmental impacts while running those initial re-iterations of massings. GreenForm incorporates environmental factors such as solar exposure per surface of the building as an essential factor of design concept, in a way that makes it easier and quicker for designers to get through the initial massing phase.

The program allows users to input site specific data – plot restrictions, bye laws, vulnerabilities to natural disasters -- and outputs many random iterations of potential massing arrangements that have optimal geometric volumes. The output is composed of primitive forms such as closed form structures that can represent any buildings ranging from small residential to large commercial. Each output is scored based on the priority of factors placed by users. The scoring tool is implemented to represent how well a geometric massing responds to those factors, and enables users to have the freedom and control to choose the optimal massing with aided designs. This prototype is a preliminary version, and additional features capturing other environmental factors will be implemented with more time and resources.

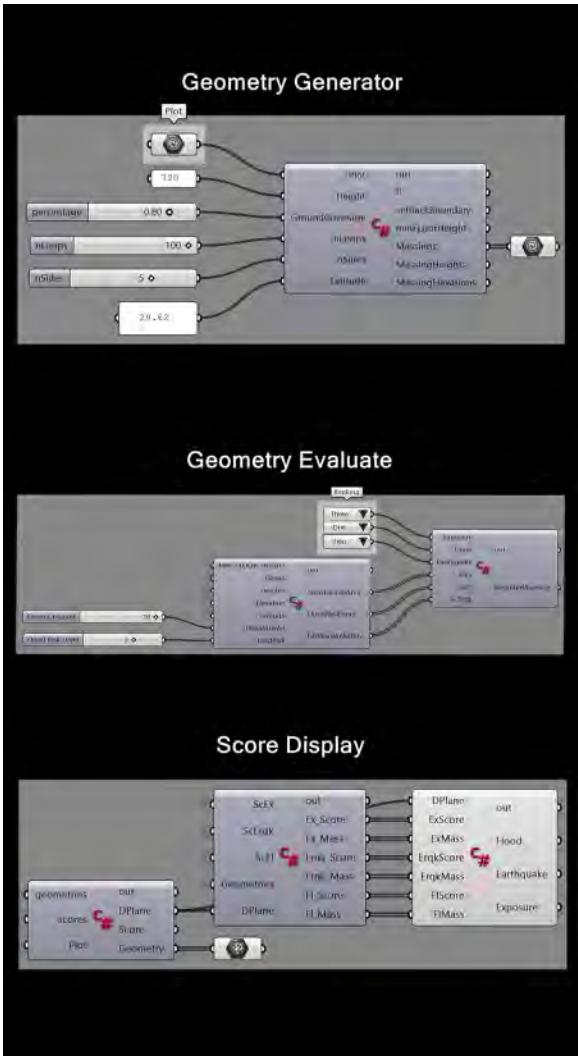
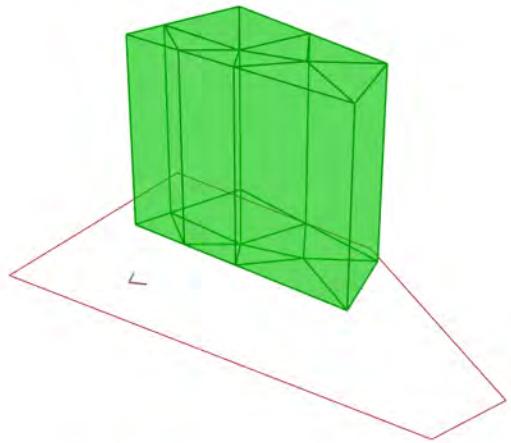
Video

<https://youtu.be/XlsqTIuK7tw>

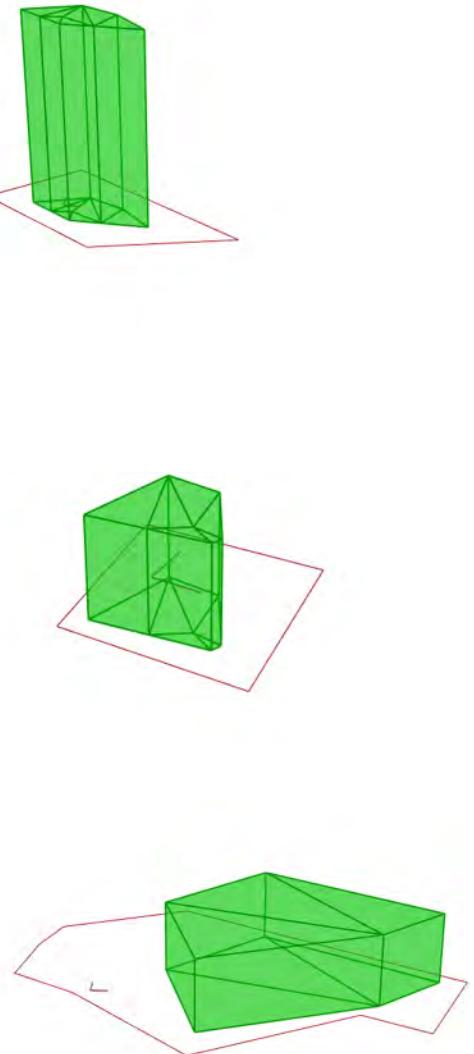
GSD6338 Introduction to Computational Design



2 Overlay of 100 massings using same plot restrictions



3 Grasshopper user interface



4 Randomly generated massing for different site-specific input data.

SCRAPING BY

Shun Yin Gabriel Lam
MArch I 2022

Adaptive Clay Carving for Performative Tiles



1 Adaptive carving system with Intel RealSense attached to ABB robot arm

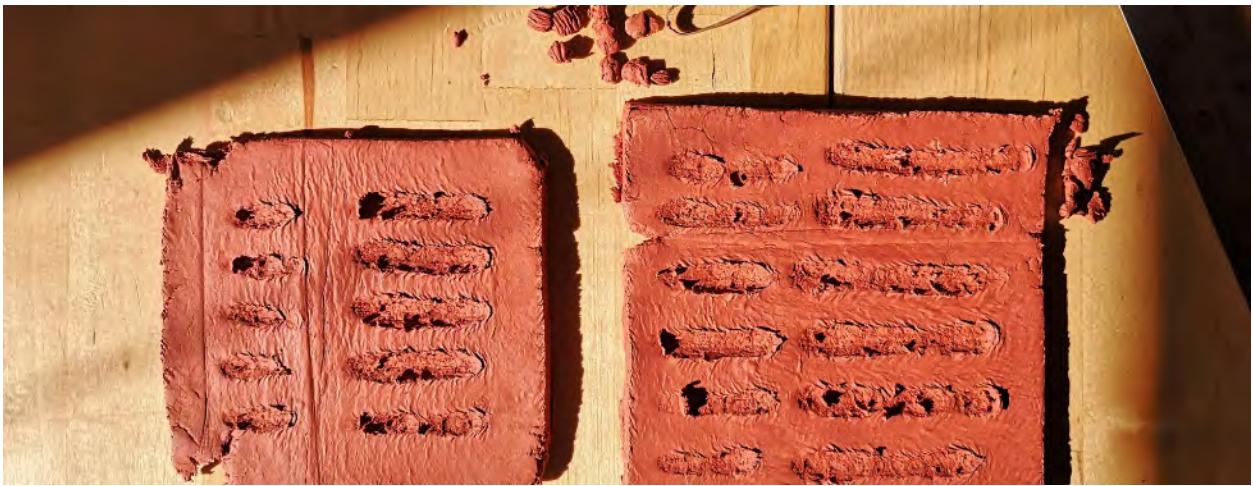
An interest began in the introduction of a feedback loop into digital fabrication that would allow for a production process to be made adaptive; as in, the machine would be able to receive information regarding the material it is operating on and make adjustments throughout the process. We wanted to explore carving because it has a type of humanness that is inherent in the act of carving, so there is this interesting dynamic of automating a very human process, but also humanizing a very digital process.

The main research alignment for this assignment is allowing the machine to generate its own tool-path with any input surface and target surface. As the clay is being carved, there is a difference between what the actual state of the clay is, versus the ideal state of the clay after the carving motion, with an upper limit to the step-down increment. The scanning cycle placed between carving cycles would allow for the machine to adjust its tool-path to adapt for the tolerances caused by its previous step, resulting in a more balanced carving pattern, and also ultimately reach its target surface.

Video

<https://youtu.be/Rxfp7czh37Q>

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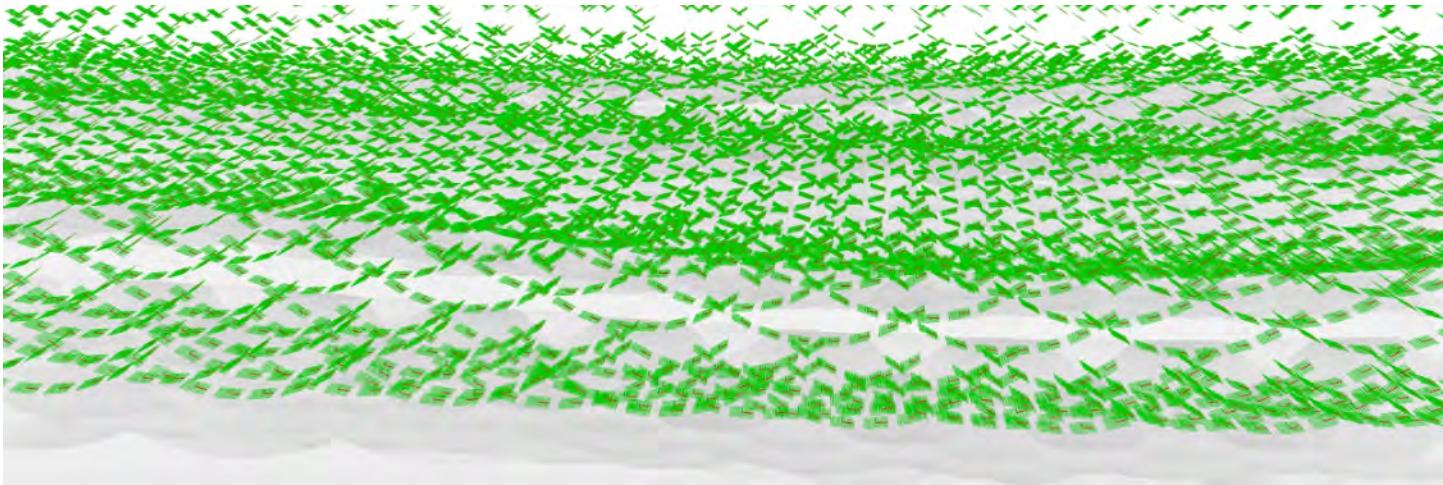
2 Carving clay is the most rudimentary form of sculpture



3 Carve tool attached to robot arm collet



4 Final geometry within 3D digital space



5 Toolpath planes in relation to carving simulation

UNBOUNDED DREAMS

Jiayin Lu

PhD Applied Mathematics in SEAS 2023

Perforated Lamp Generation



1 Lamps (left to right): Bedtime story; Goodbye to the past; Dancing into the night.

I have always liked light. Light is romantic; Light is imaginative; light is colorful; light is mysterious; light represents hope; light is a world of unbounded dreams. In this project, I developed a C++ program that generates perforated lamps based on pre-designed wall projection patterns.

The program takes in two kinds of inputs: a lamp shape STL model, and pre-designed light projection patterns on the 6 surrounding walls of the lamp. The program will then generate holes at the corresponding places on the lamp model and output a perforated lamp STL model. The perforated lamp, when put in a light source inside, will then project the desired patterns on the walls.

I made three demo pieces, where each of them is an artwork of a theme. I also made two large interactive demo for people to play around. The program is made available on my GitHub for anyone to use for their own design purposes. The example models are all free to download in my Thingiverse account.

Video

<https://youtu.be/5gCAXGaDBIM>

Learn More

https://github.com/jiayinlu19960224/perf_lamp_final



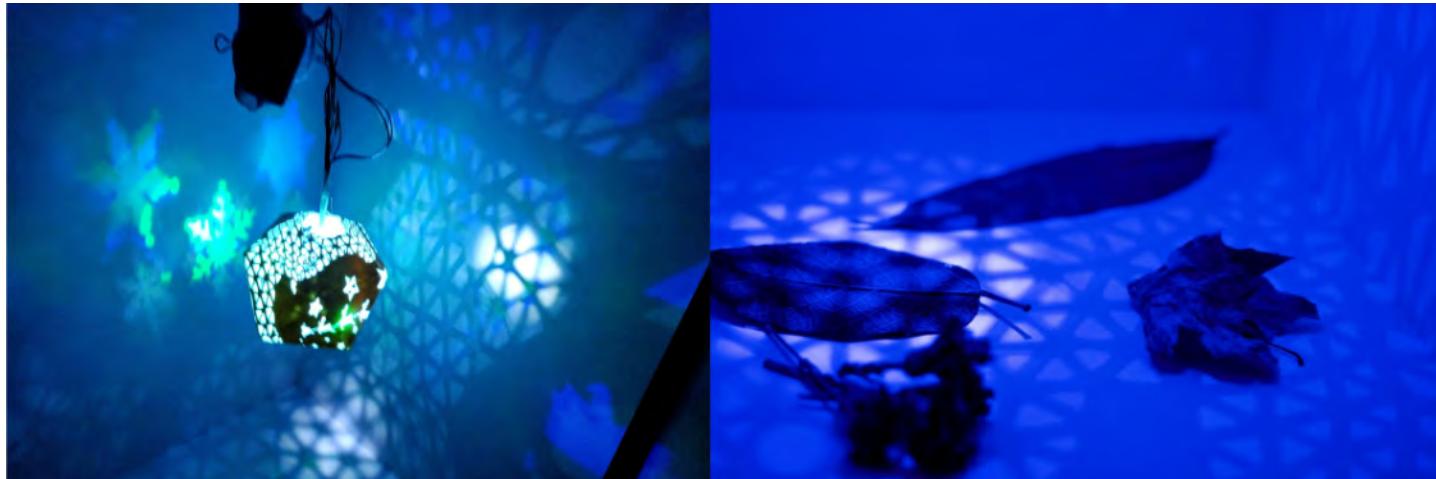
2 Projected wall patterns



3 Projected wall patterns



4 Interactive demo with 3 colors' lights to play around

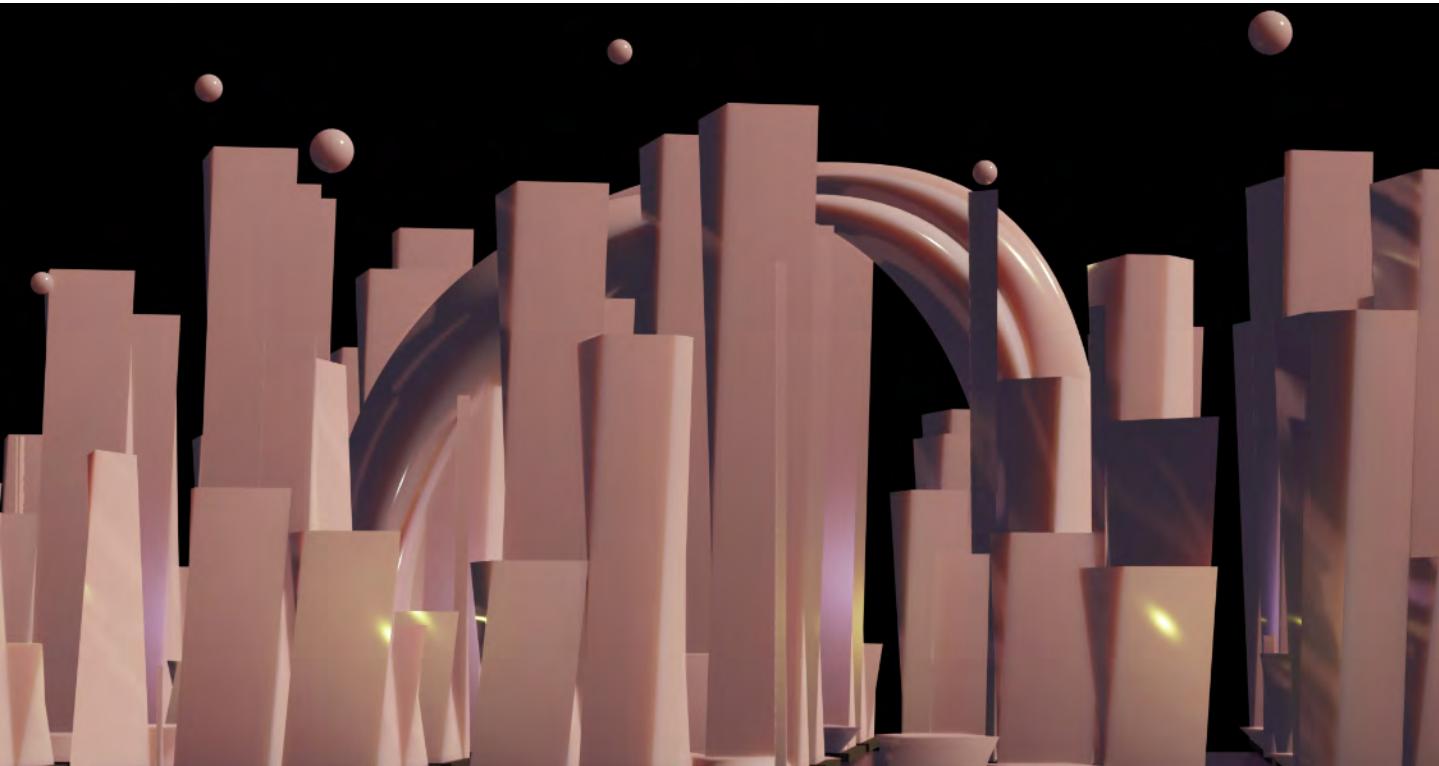


5 Dreamy lights

URBAN SPLASH

Erik Fichter
MArch I 2023

Urban Dreaming with Clear Orientation



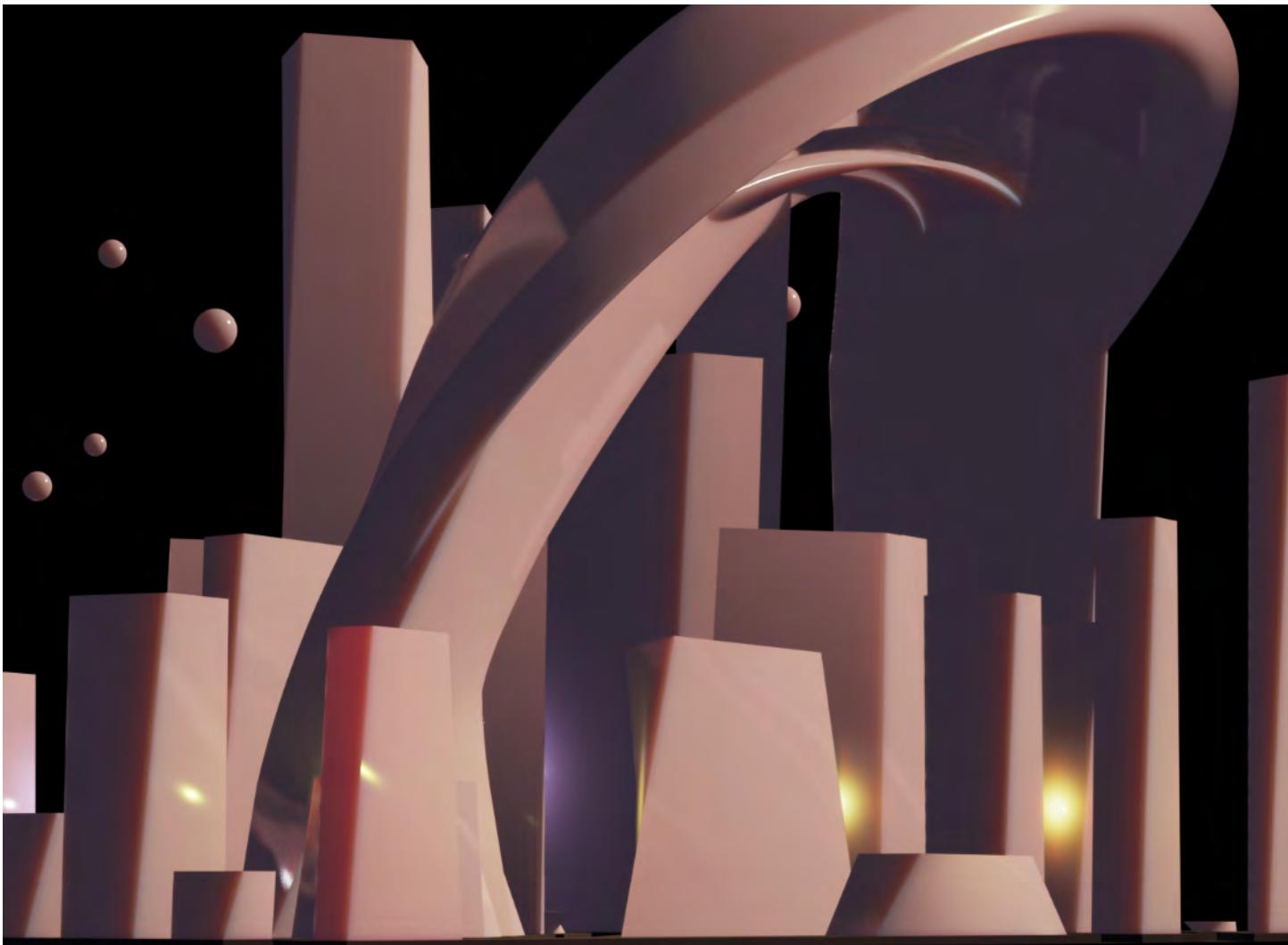
1 The Urban Splash based on the city grid of Paris

URBAN SPLASH is an urban design project linking an urban vision and computational design. The urban provocation grows out of the desire to make cities better readable through the urban notion of orientation. Orientation is important for navigating through the city and is often aggravated through the homogeneous and generic city-scape.

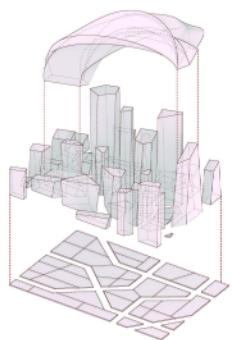
The proposed provocation enables urban readings for orientation on different scales. On one hand the sense of direction is strengthened through the rotation of the buildings to optimize the interior on the one hand and give a sense for the south when walking through the street. Further the plan envisions that the two plots with the greatest roof surface gets connected into an arch. The arch acts as a center point to gravitate around and at the same time offers a reading which parts of the city are similar plot sized which might correspond to a certain program. The coding of the project allows the user to feed a map with plot outlines which then automatically answers with an option. The options can be adjusted by providing further building code restrictions like the building perimeter and height limits. Those inputs in combination with the rotation of the roofs create varying roof areas which will be the seed for the urban bridge, the URBAN SPLASH.

Video

<https://youtu.be/33jWceuXHnk>



2 The Urban Splash based on the city grid of Las Vegas

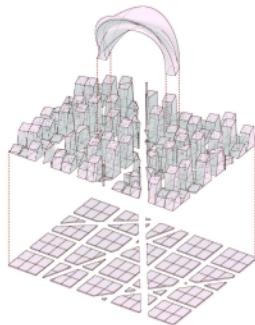


LAS VEGAS GRID

orientation is provided
through a central bridge
connecting the two largest
roof surfaces

orientation is provided
through the volumes
rotating to the south
direction

the program computes
based on given plot maps



PARIS GRID

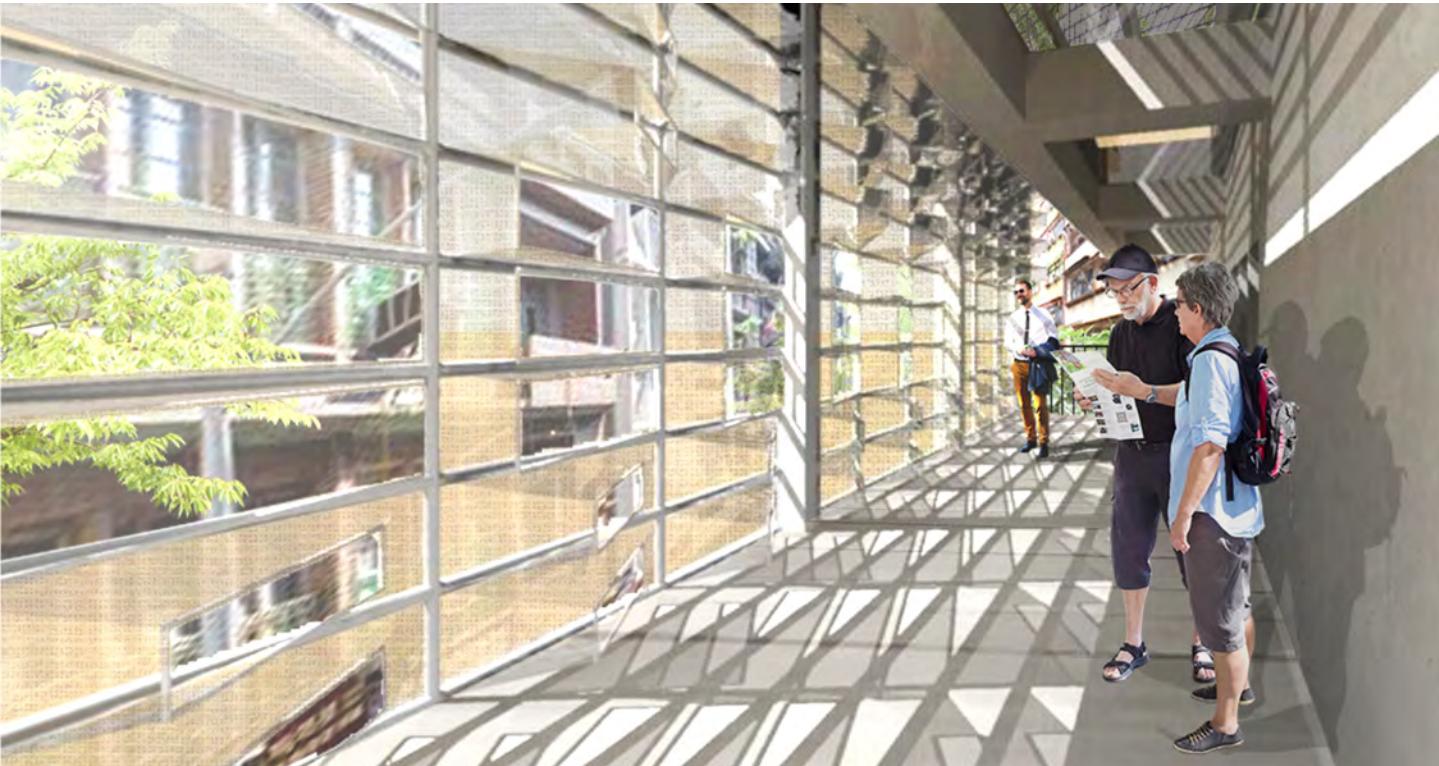
3 Diagrams

INTERACTIVE FAÇADE

Modular-Environmental Generated Geometry

Yun Ting Tsai
MLA I AP 2020

Kuan Ting Chen
MDes EE 2021



1 Public balcony perspective

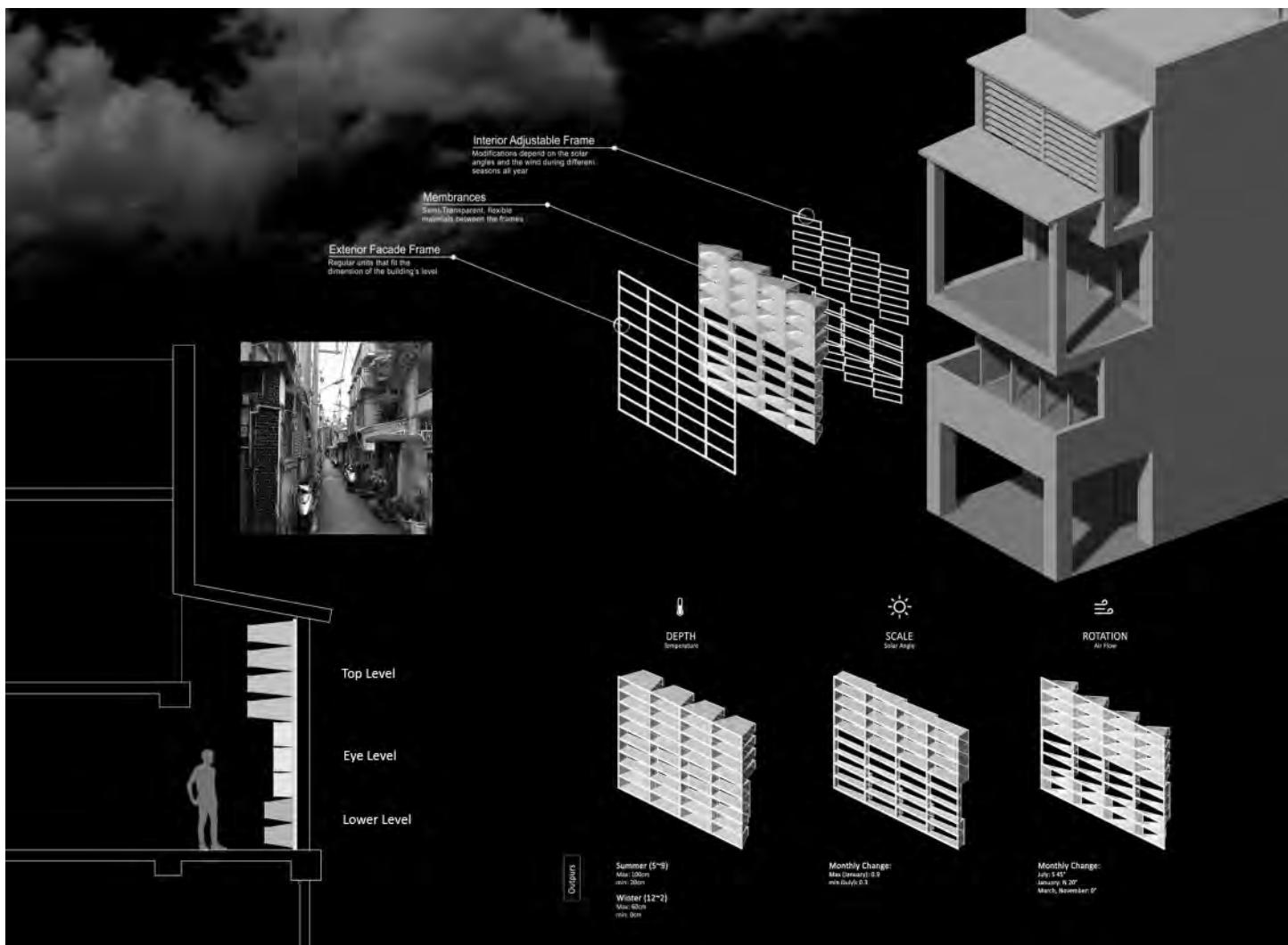
Our goal started by redesigning a past project that modified the original street house façade. We use C# in grasshopper to create a new transparent façade that could interact with the surrounding and create good interior condition for the user. We started analyzing the sun position, radiation, temperature and the average wind direction throughout the year.

We want to design a new grid system that is flexible and easy to adjust. Therefore, we decided to use fabric as the main material since it could block the sunlight and still have the flexibility for adjustment. The fabric skin is controlled by two layers of steel grid that also strengthen the façade system. The exterior is fixed to the concrete structure and the interior grid is controlled by the environmental conditions, and this is when the coding comes in handy. The transformation could be defined by three elements (scale, rotate and depth) that are adjusted based on the sun position, wind direction and temperature. Moreover, considering user experience, we decline the movement of eye-height units to avoid blocking the view from indoor spaces. Our goal is to find the right balance for various environmental circumstances.

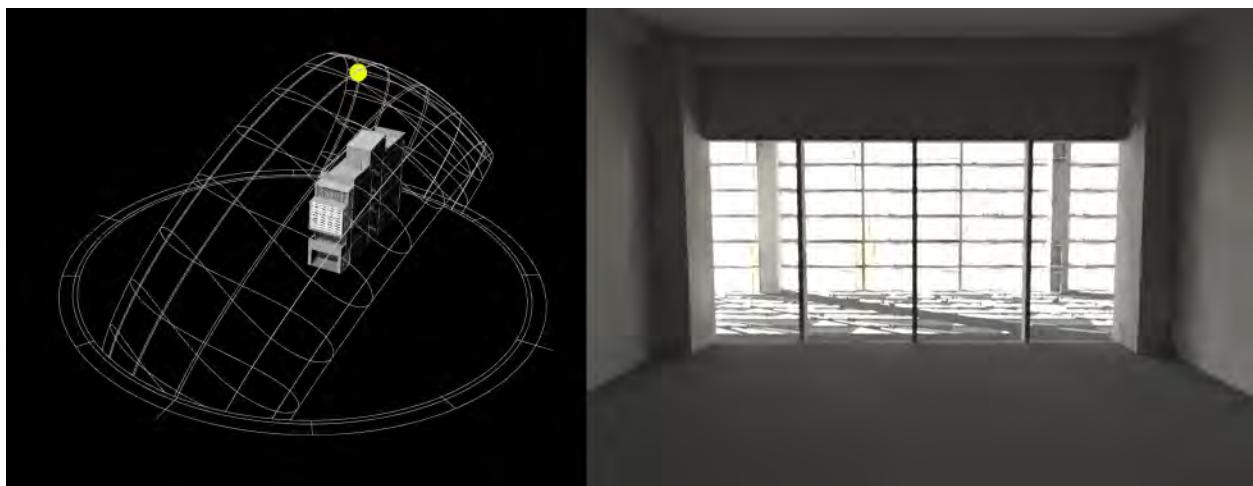
Video

<https://youtu.be/6rm1cjyBx5s>

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2 Design methods



3 Solar simulation outcome

THE SAIL

Digitalization of Classical Moods

Yiou Wang
MArch I 2022

Loren Li
MArch I 2022



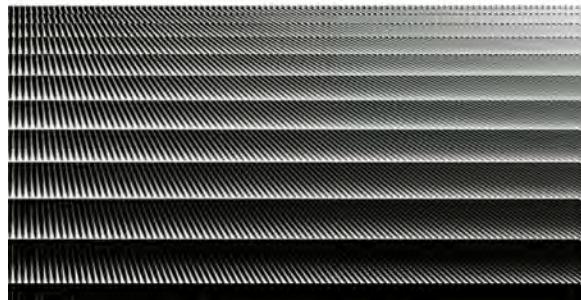
1 Drifting away with the waves

The 14th century Chinese painter Ma Yuan created some of the most expressive waves in Classical Chinese Art. His waves combined the best of realism and abstraction. Some create a calm ambiance by being nothing more than a multiplication of the same geometric shape; others capture frozen moments of violent, splashing waves ready to escape the picture frame. He eschewed a monotone, single-styled interpretation of waves and instead infused each of them with personality. These waves convey different moods to the viewer. We were very inspired by his approach and imagined what he would do if he had the digital tools we have today. Can we recreate waves that convey human moods through digital means? We approached it by combining the movement of waves to the tempo of music. Music evokes emotions from the listener the same way Ma Yuan's waves do visually. Henryk Wieniawski's "Kujawiak" provides the music to which an array of sine waves created in Processing 3 move in tandem with. The result is an ever changing, mesmerizing sea surface that allows one to mediate with. Come enjoy it!

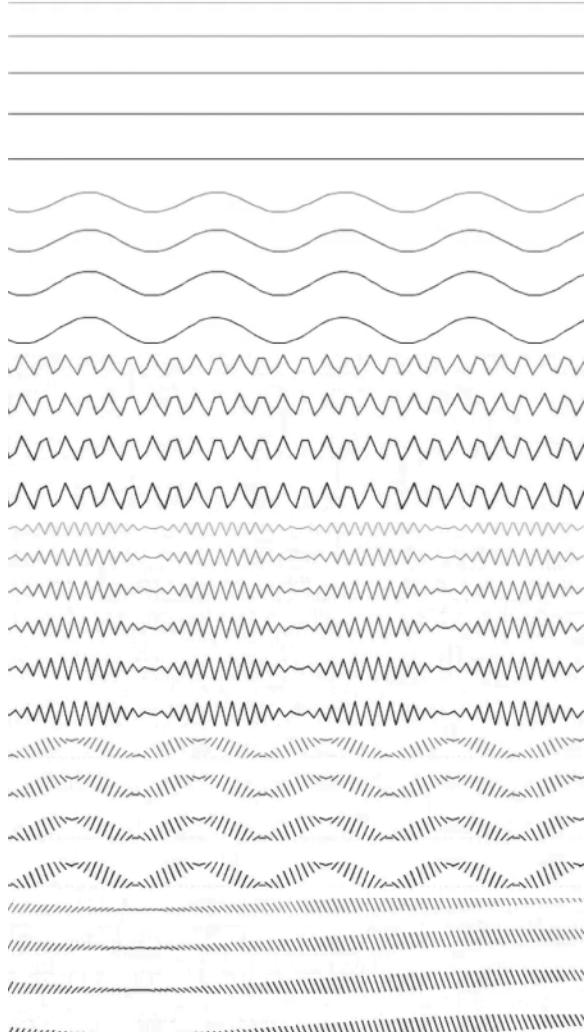
Video

<https://youtu.be/RG-WOCLAT2s>

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2 Early trials



3 Testing transformations



4 Ma Yuan's waves with moods and personalities

PIXEL VARIATIONS

Vibrating Pixelated Portrait Filter

Tiange Wang
MArch I 2022

Wei Wu
MArch II 2020



1 Captured image display options

Instead of still pixelated portrait, we take a step further to create images of vibrating pixels. These vibrating pixelated images made up of individual pixels of flexible shapes and sizes further adapt the form of digital art to the prevalent usage of contemporary media such as computer and phone screens, which incorporate numerous motions and animations - nothing stays still.

The vibrating pixels, as an interpretation of digital photography and film, destabilize the relationship between what is in the image and what is reality. At certain parameters or alternating milli-seconds, the pixels represent nothing like the original image. The pixelated image alienates itself from the original and shows new relationships within the itself by the composite effect of the pixels (the effect as a function of user-determined pixel shapes and sizes). During other seconds, the pixelated image intensifies certain relationships in the image while muting the others.

This is when our current photography and filming tools start to interpret reality for us, rather than faithfully recording as is.

Video

<https://youtu.be/fi6DjgBQTk4>

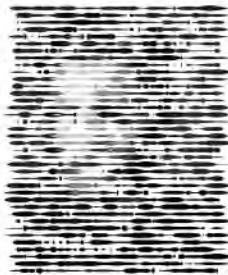
```
1.ellipse(x + x_offset, y + y_offset, random(1,width/a), random(2,height/b));
```



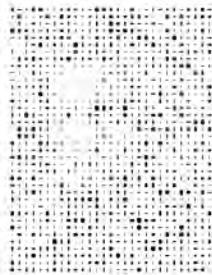
a = 30; b = 40



a = 10; b = 20



a = 10; b = 50

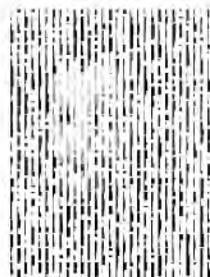


a = 60; b = 50



a = 5; b = 5

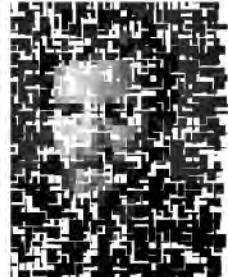
```
1.rect(x + x_offset, y + y_offset, random(1,width/a), random(2,height/b));
```



a = 80; b = 20



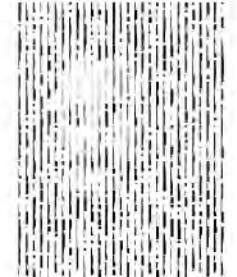
a = 2; b = 2



a = 20; b = 20



a = 60; b = 5



a = 100; b = 20

2 Relevant variables testing



3 Multiple images test

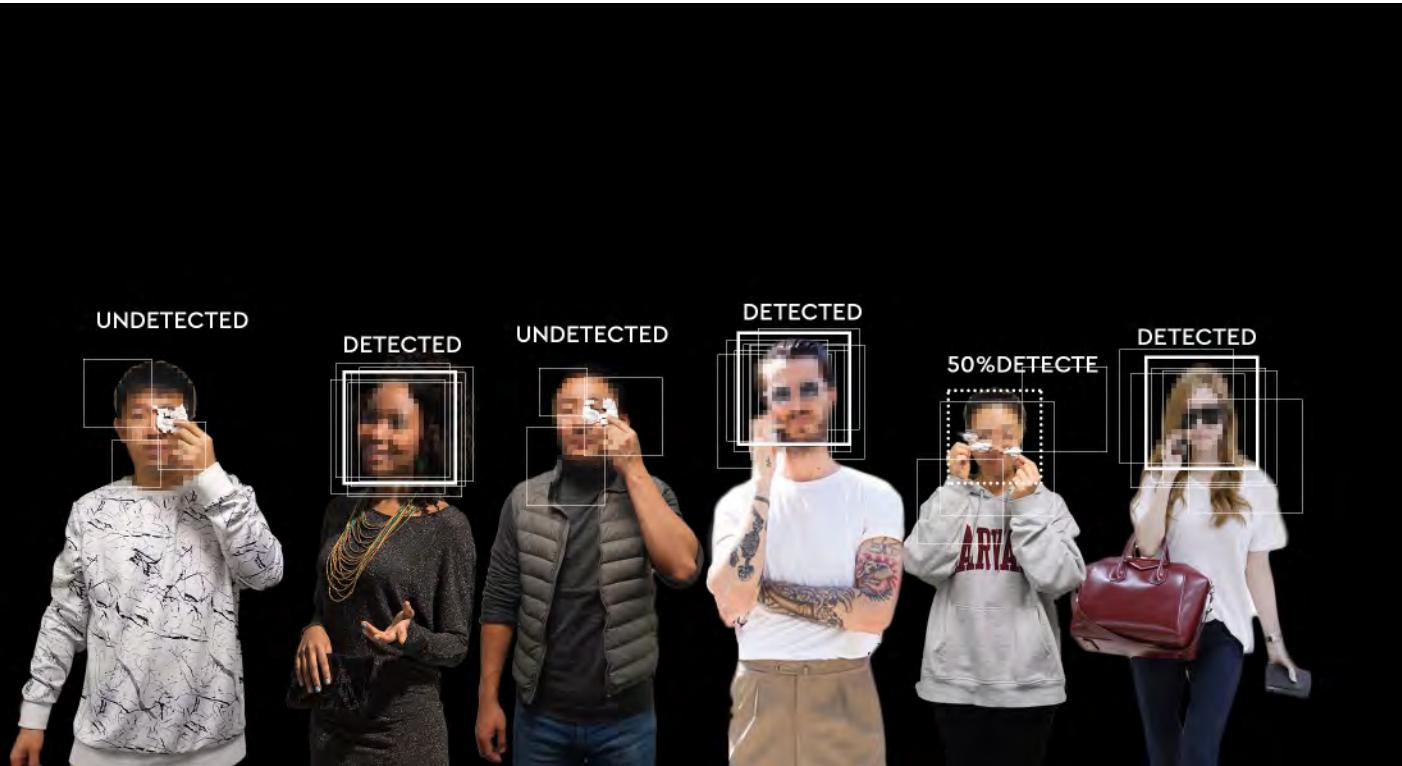
PHANTOM GAN

AI Undermining AI with Fashion

Runjia Tian
MLA I + MDes ADPD 2022

Huopu Zhang
MArch I + MDes Tech 2020

Ruijun Liu
MDes Tech 2021



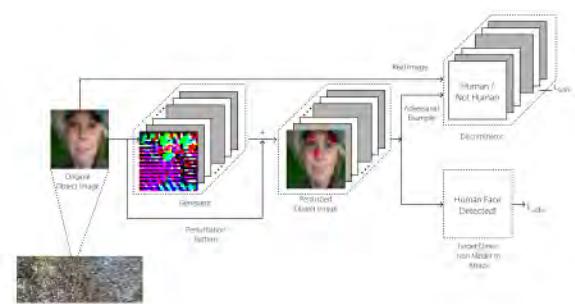
1 OpenCV facial detection interface foored by phantom fashion

Today with the advance of deep learning algorithms, biometric detection technologies are ubiquitous. However, as the lack of public awareness and legislations, our biometric data is aggregated usually without personal awareness, and abused in legal and illegal ways. Under such context, the creative technologists at Harvard GSD propose a tool that protects personal biometric privacy from unwanted and unconscious facial detections and recognitions.

To achieve this, the team designed a pipeline for generating wearable fashion that undermines unwanted biometric detections, using AdvGAN, a Generative Adversarial Network algorithm that generates adversarial examples that can fails facial detection algorithms. Trained with object detection dataset such as CIFAR 100 and ImageNET, our Phantom GAN generates fashionable masks that people can make users 'invisible' from biometric detections. More than any other common fashion shopping experiences of try-on and purchase, the user experience pattern fitting, model generation and can buy the . When wearing our fashion, not only will you stay cool, you will also becomes the Phantom of Machine Visions.

Video
<https://youtu.be/McXp6J8TT30>

Learn More
<https://github.com/runjitian/SCI-6338>



2 AdvGAN neural network structure



3 Fashion mask fabrication



4 Perturbation pattern through training progress

PLAYHOUSE

Dylan Bachar
MArch II 2020

A Playful and Interactive House Design



1 Elevation interface

Robert Venturi's Vanna Venturi House embodies postmodern architecture by manipulating common architectural elements through scale and positioning. Similar to Venturi's project, the playfulness of scale and position allow the user to create their own iconic house design using a video game controller. The project aims to achieve a playful design approach through an artistic point of view, breaking away from habitual design processes among 3D softwares.

Using the controllers joysticks, triggers and buttons, one can alter many of the fundamental elements that characterize the house, creating a unique project every play. These manipulable elements provide quick and fun characteristics while being able to rotate the house 360 degrees. Visually, the representation approach evokes the postmodern graphic language through a simple flat appearance of color and line weights.

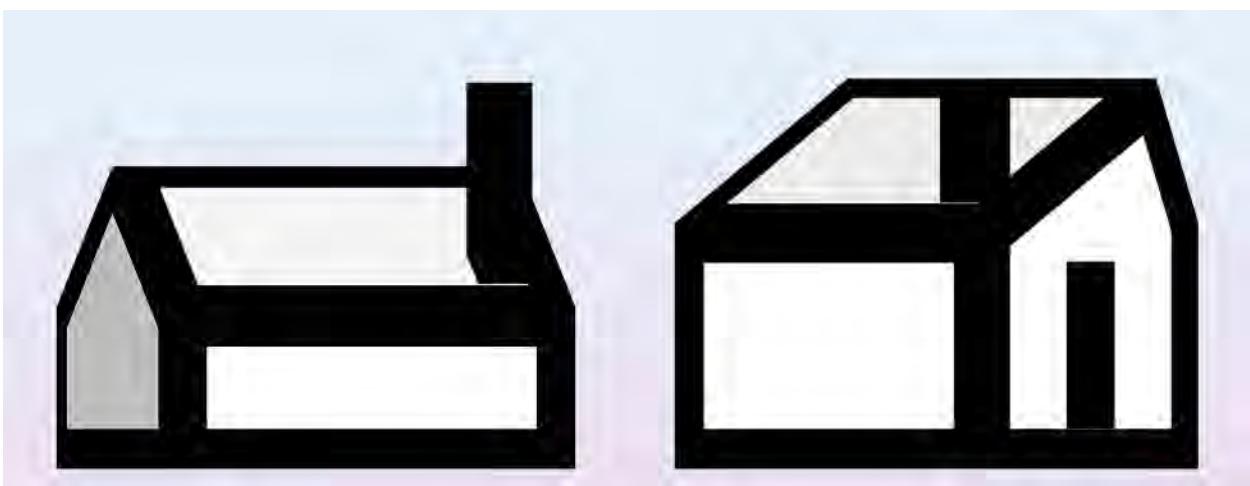
Video
<https://youtu.be/3cMu-XF7pXs>

Learn More
<https://www.thinkdylan.com/object-no2>

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2 Video game controller manipulation for design



3 House iterations and rotations

BECOMING IMAGE

Caleb Hawkins
MDes Tech 2021

An Exploration within Imaging Itself



1 The input image is no longer legible

As an artist I investigate the tensions, and synchronicities between technologies of display, interaction, sensing, and surveillance. Situated between a virtual self comprised of data, and the physical world that I perceive with my body, I perform artistic acts to interject myself into the digital feedback loop of imaging technology. I use various technological mediums to move between virtual and physical realms of making in order to conceptualize new embodied perceptions of technology. It provides a method of learning more about their relationships to, and effects on public and private space.

Becoming Image, is part of an artistic process of conceptually understanding the digital image. I designed an interactive, virtual image transcoder that responds to bodily movements and audio frequencies to explore the relationships between image, pixels, sound, and body. It is used to virtually explode the image, and explore the virtual space between its pixels. By deconstructing the data in the transcoder and looking at pieces from within, we can gain new insight into what it means to see images in the digital age.

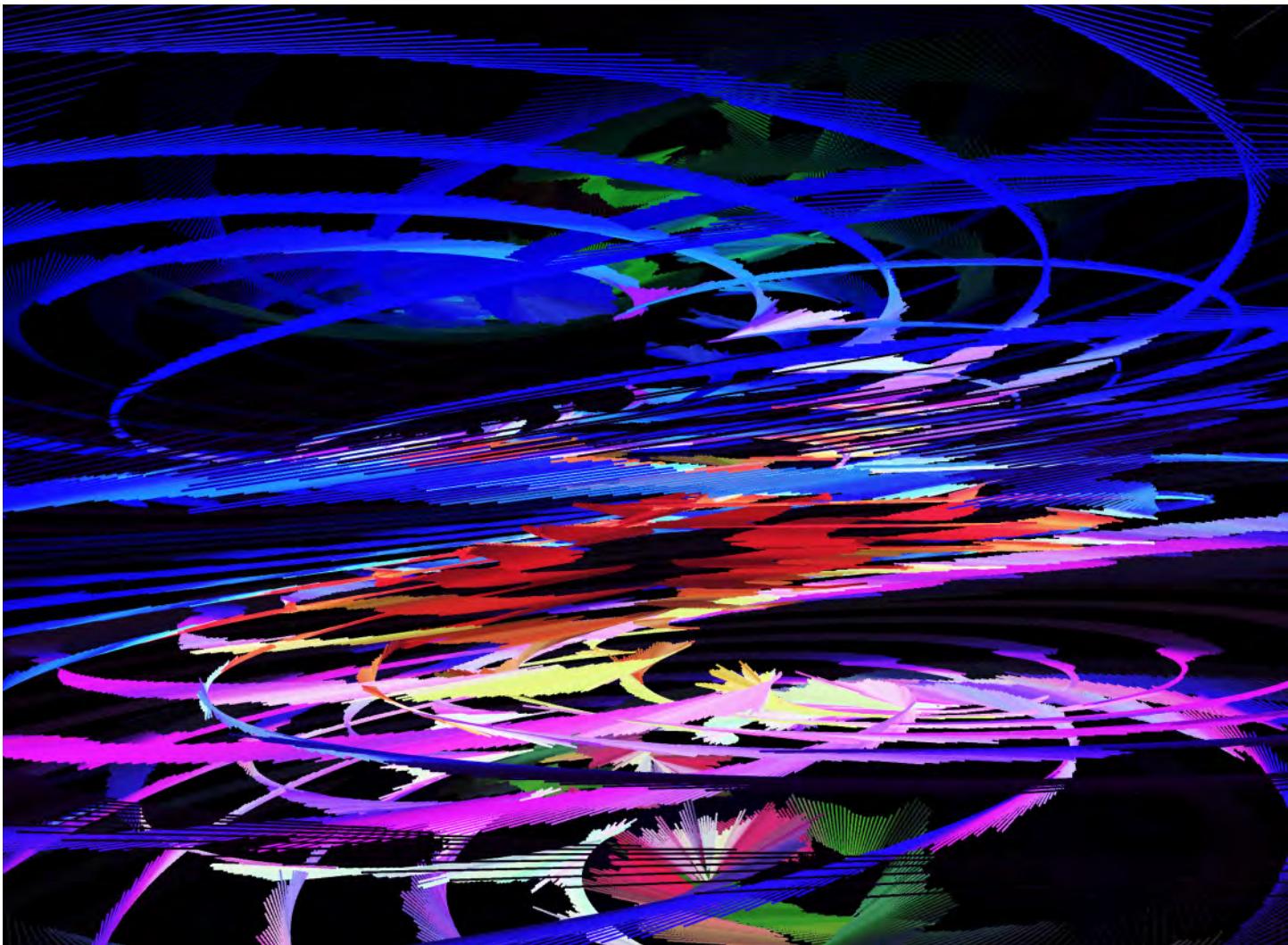
Video

<https://youtu.be/LEAJ95-nAHM>

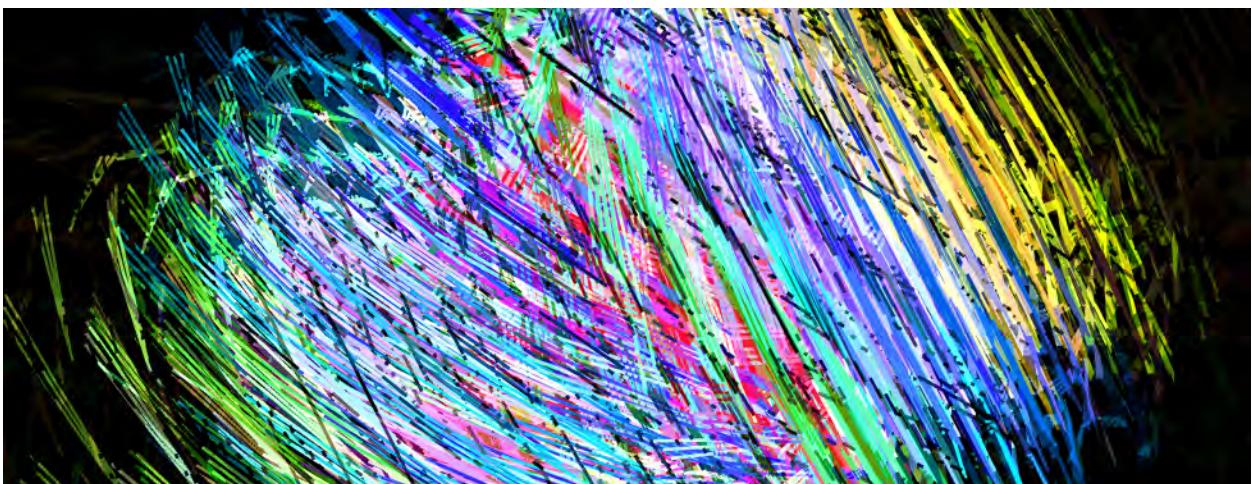
Learn More

<https://www.calebhawkins.design/>

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2 You can get lost in the vortex of pixels

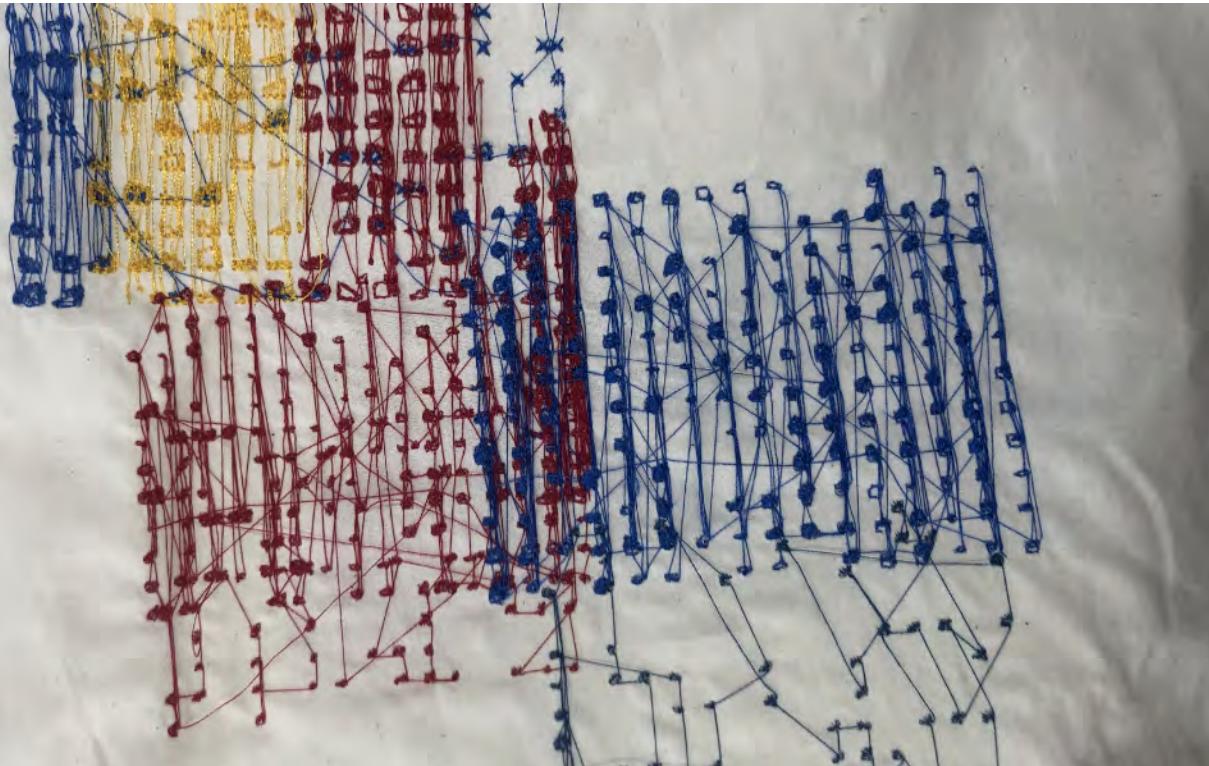


3 An intricate and organized chaos

POETIC ENTWINE

Delara Rahim
MDes APDP 2020

Mathematics of Stitching and Coding



1 Poetry of the material vs. poetry of the code

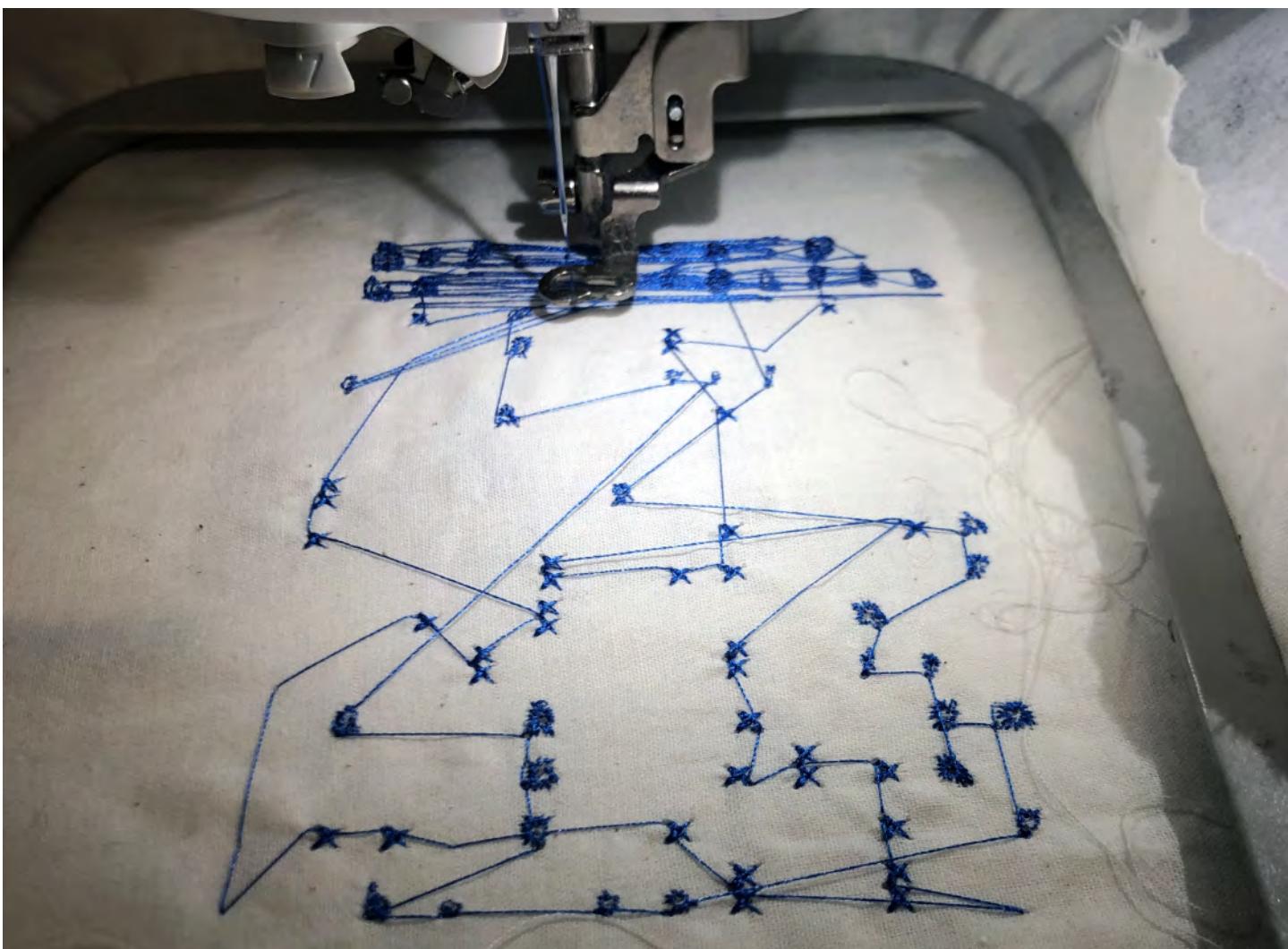
This project is exploring the ideas in textile and coding, inspired by history of generative computer art and the history of the connection of the mathematics of weaving and technology. Through exploring this materiality, material affect and weaving patterns , a series of generative designs and patterns are created with the technique of digital embroidery.

These drawings are inspired by the works of Vera Molnar, Beryl Korot and Manfred Mohr, by introducing the medium of fabric to experiment the poetic translation of the algorithm of the code into the poetry of the materiality. As the simple geometric designs generated by Processing get translated to embroidery, the machine creates the algorithm for the stitches which create new patterns and lines on top of the original shapes, weaving the material that is in the intersect of craft and computation. The translation of the machine gives the 'woven material' a handmade and gestural element that is drawn by the machine representing the element of time.

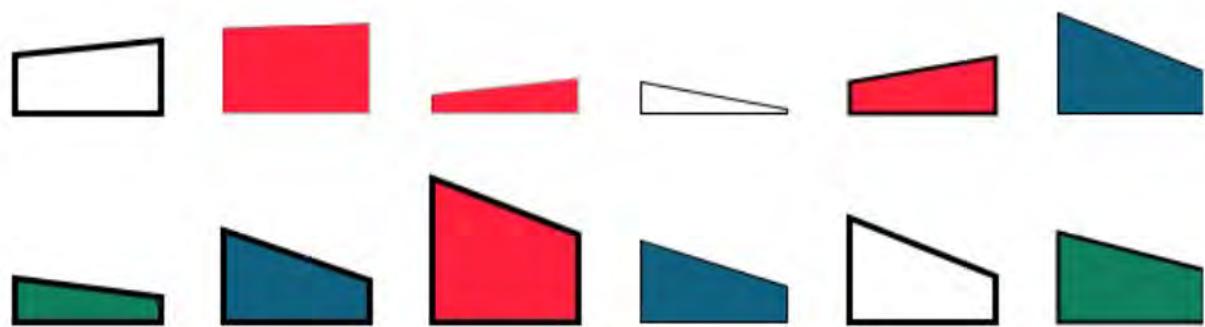
Video

<https://youtu.be/wzFZLtHoyAQ>

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2 Algorithm of embroidery with coded pattern



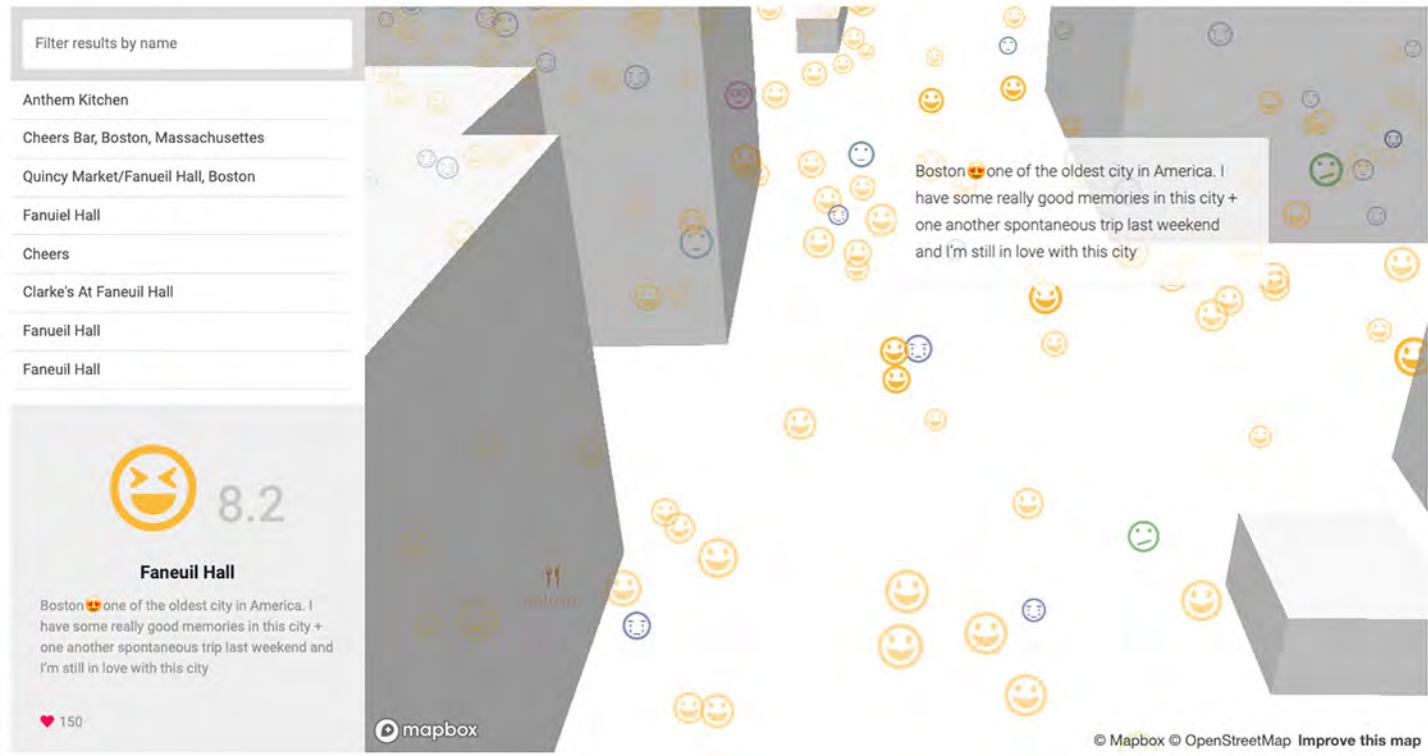
3 Generative pattern design

EMOJISCAPE

Tangible Emotive Data for Cities

Sue Kim
MDes Tech + MLA I AP 2020

David Rossenwasser
MDes Tech 2021



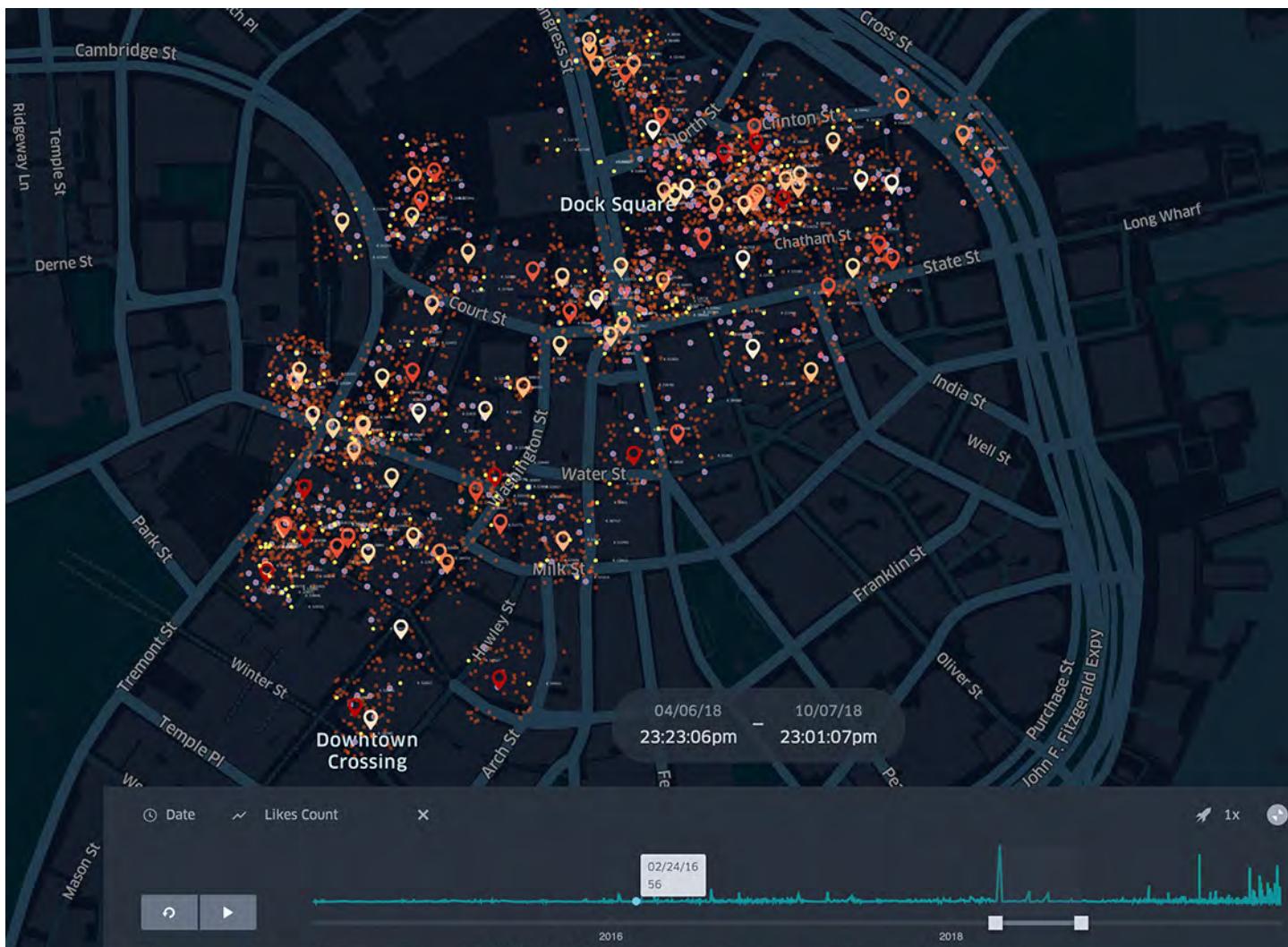
1 Emojiscape

A cityscape is difficult to digest. In the context of architectural engagement or interaction with our built environment, big data has the potential to hugely impact the way we rationalize urban-scale and architectural-scale decision making. When considering human-centric qualities such as perception or behavior, however, this is not nearly as explicitly quantifiable or straightforward to evaluate.

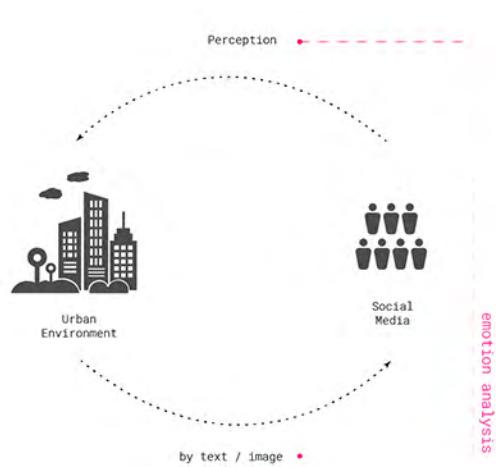
Emojiscape suggests that social media may help to transform civic policy making, alongside architectural needs and successes by dissecting and evaluating human perception. Using emotion analysis with data gathered from social media platform—Instagram, Emojiscape develops experiments with the intention of bringing new value to architectural and civic narratives.

Video
https://youtu.be/_WMK3jh_Pu0

Learn More
<https://suekim37.github.io/>



2 Likes count over time



3 Emotion analysis by social media data



COHABITATION BUFFER

Customized Furniture for Both Kid and Adult

Pu Yu
MLAUD 2020

Xin Wen
MAUD 2020

Yao Gu
MAUD 2020

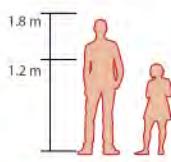
Concept Input

3 Parameters

1.Flexibility



2.Height



3.Weight



1 Concept

Comparison Analysis

Adult's Customization

Child's Customization

Soft Part

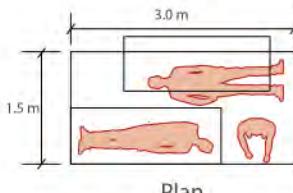
Sit

Lie on one's side

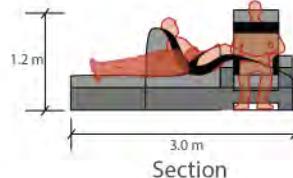
Lie on one's back

Output

Customized Multifunctional Sofa



Plan



Section

Adult and Child have different niches in a house due to the differences between their bodies. There is always some conflicts between them when the furniture in the house cannot meet the needs of both of them so that one has to compromise. Even so, people are unwilling to buy two sets of furniture due to its high price. To release the conflicts in a home, we are thinking that Is there any customized furniture that can satisfy both child and adult and also be cost-effective? With a comparison analysis, we found that assembling is a cheap way to achieve this goal. Our furniture would be fit together by two parts, including the harden base customized for the adult and the soft part for the child to put on the harden base.

According to the analysis of ergonomics, we know that customized furniture is changed with the user's body. And, three basic parameters are influencing the shape of the body involving weight, height, and flexibility. When we change these data input, we can get different shapes of furniture of the target adult and child. Then we can get the soft movable part by trimming the customized furniture of the child from the adult's.

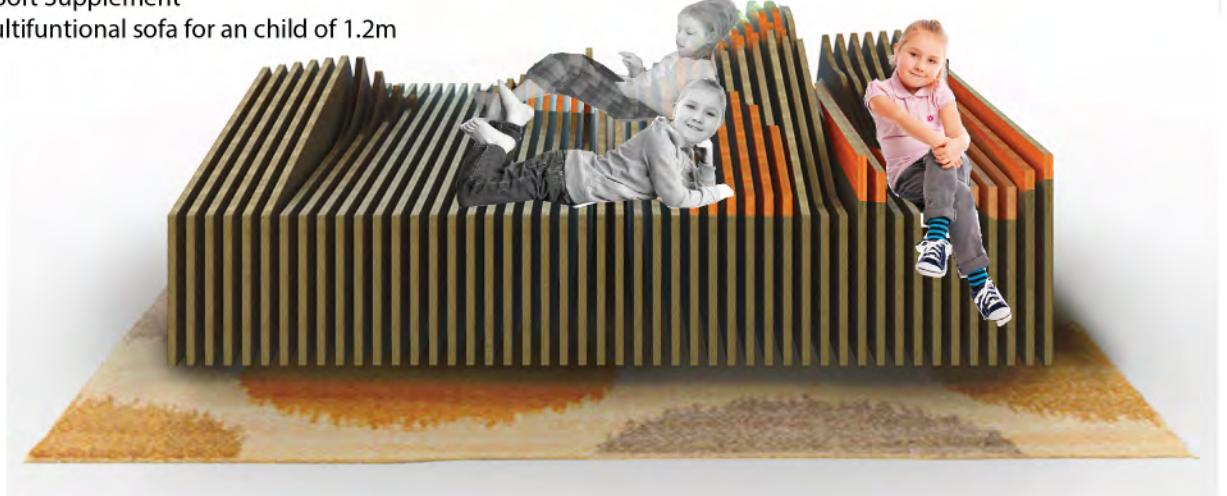
Video

<https://docs.google.com/presentation/d/13GdO1Ub7iWPhtXl-X7UzO6RQnemaKrMDf5DGChAG1GY/edit?folder=11p1-XCbNzz6uBCsjWG95RuItbH4vSXh>

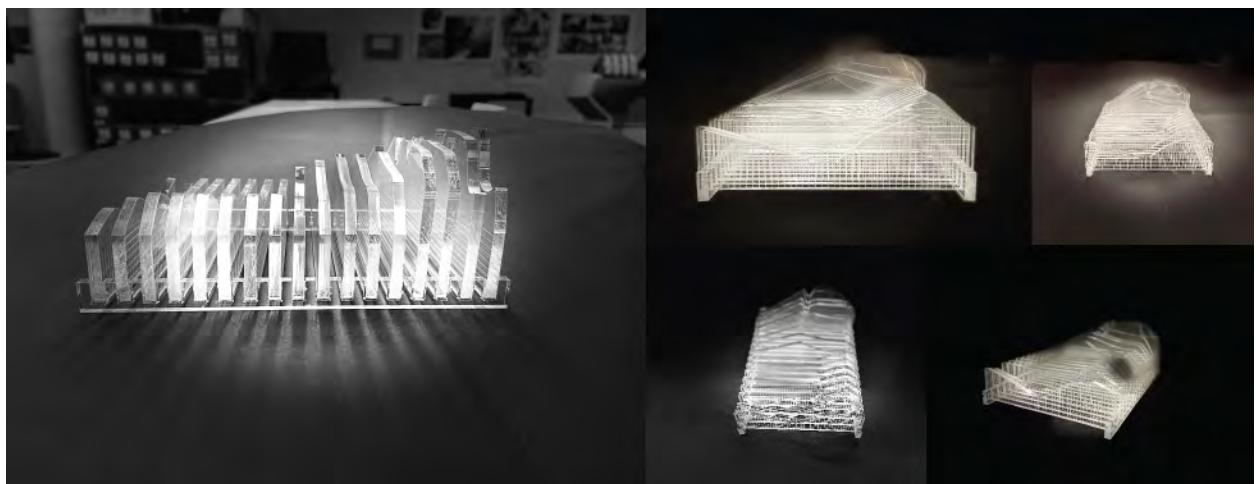
1. Hard Base
Multifunctional sofa for an adult of 1.8m



2. Soft Supplement
Multifunctional sofa for an child of 1.2m



2 Rendering

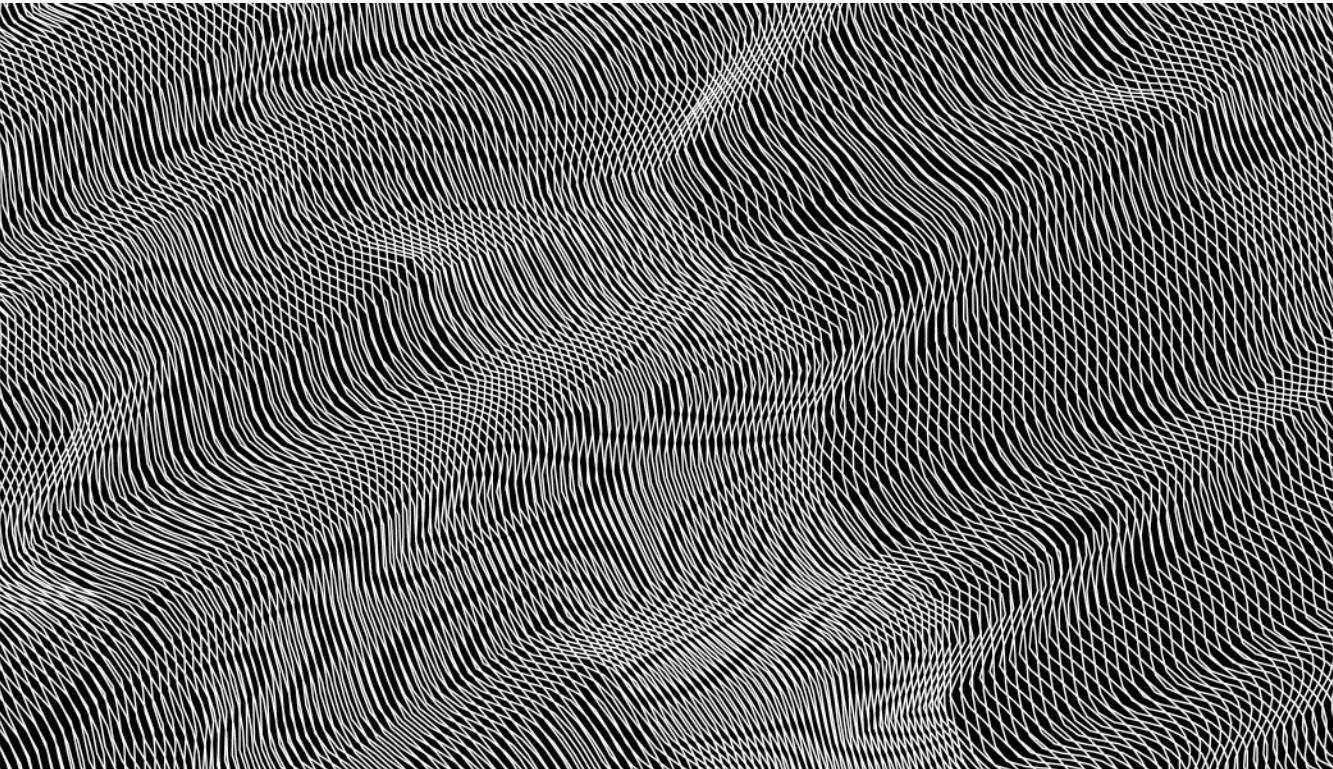


3 Photoes

3D PRINTING WITH SOUND

Erin Hunt
MDes Tech 2021

Un-Paralleled Layers with Sound Amplitude



1 Detail of a toolpath using amplitudes from Adele's song Rolling in the Deep

This group's work (including Sana Sharma and Katarina Richter-Lunn) was motivated by the study of sound. Each member researched a different facet. In addition to working with sound, each group member found ways to manipulate the inputted sound. For this portion amplitude was used as a means to analysis un-paralleled layers in Fused Deposition Modeling. The original sound was printed by a LulzBot Mini 2 3D printer. The sounds it made while printing were then recorded. This information was processed into an additional 3D print to create the printer's response to the inputted sound. A function was developed in C# that allowed for the extrusion multiplier to be varied depending on the distance of the next layer relative to each printed coordinate. As the layers are more compressed the extrusion multiplier is lowered, the inverse is true for those layers that are less compressed. This is relative to the approximate height of each layer. The rate was iteratively determined to find the most successful rate for the 3D printer. The process began in P5.js where the amplitude values of a MP3 file were recorded to a Tab Separated Value (TSV) file to manipulate in Grasshopper3D.

Video
<https://youtu.be/MbB9hFCjD9w>

Learn More
<https://erinlhunt.com/>

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TITLE	TOOLPATH	AMPLITUDE	PRINT	ARTIST
Let it Be				The Beatles
				LulzBot Mini 2
				Nirvana
Smells Like Teen Spirit				LulzBot Mini 2
				Adele
Rolling in the Deep				LulzBot Mini 2

2 Matrix of results of the three songs used to document the process

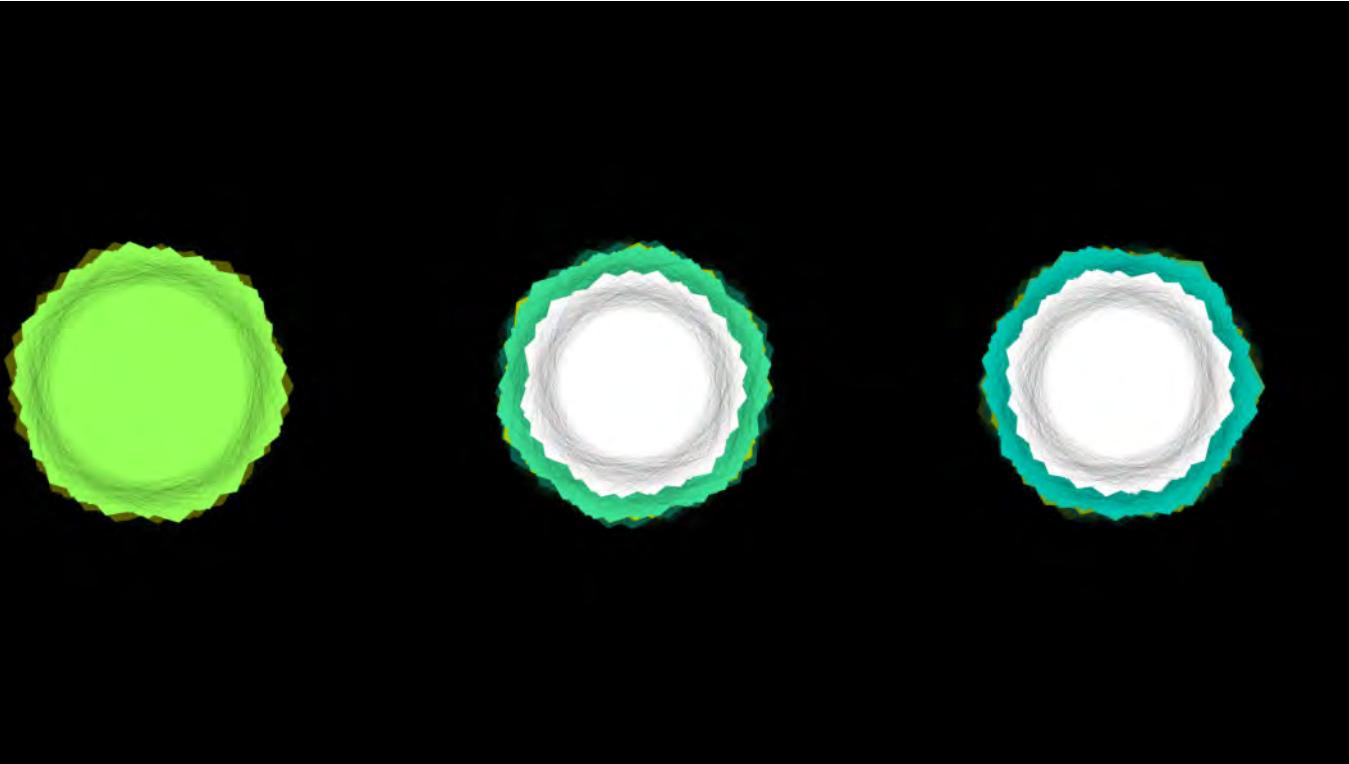


3 The resulting 3D prints from the original songs; "Let it Be," "Smells Like Teen Spirit," and "Rolling in the Deep."

CALL() AND RESPONSE()

Sana Sharma
MDes Tech 2021

A Collaborative Composition Experience



1 Entities as they ‘perform’ their own composition with sound, color, and movement.

Inspired by the famous musical interaction in “Close Encounters of the Third Kind,” “Call() and Response()” allows a human to perform a duet with a collection of digital entities that can respond and compose their own melodies. Driven by both machine-learning pitch detection and randomized, fractal-based pattern creation, this digital experience is part of a larger collection of SCI 6338 final projects that focus on the interpretation of melody to produce creative ‘translations’ and ‘transformations’.

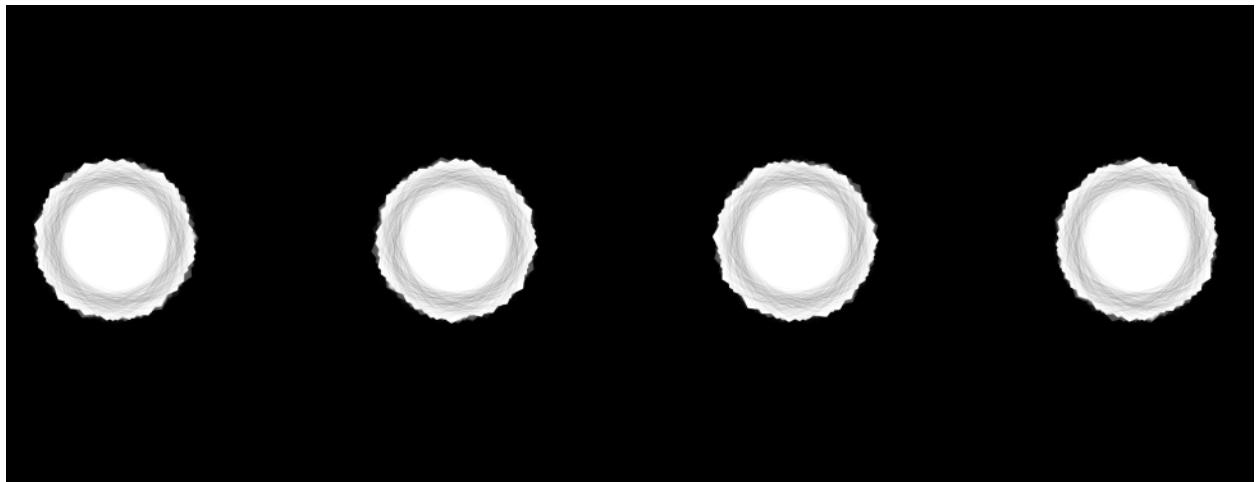
During the experience, the human participant sings or speaks into a microphone, and in real time, the digital entities respond with a new melody of similar length based on the participant’s original input. It is possible for the participant to allow the digital entities ‘to take the lead,’ building a back and forth where both the human and digital composing parties riff off of one another. However, it is just as interesting to push the experience to its limits by providing unexpected or difficult to interpret inputs. By allowing human participants to glean more about how the digital entities listen, learn, and compose through interaction and collaboration, this experience showcases how collaborative auditory-visual experiences can provide unique perspectives into complex systems that underlie them.

Video

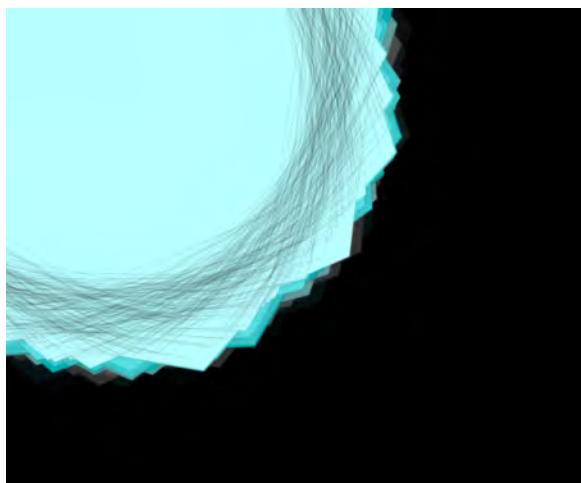
<https://youtu.be/XINKWLxZgDw>

Learn More

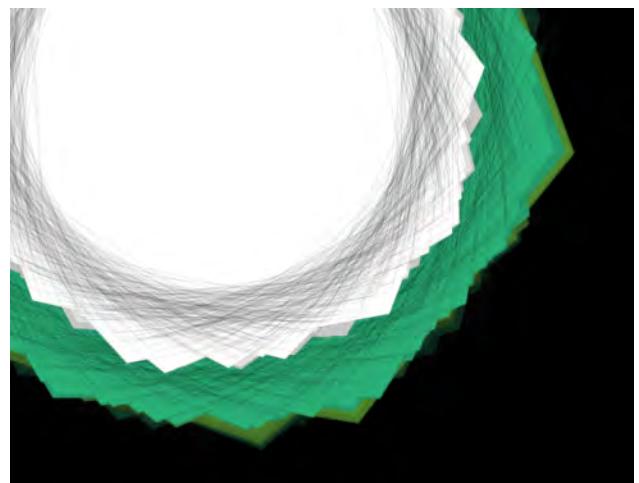
<https://www.sanasharma.com/callandresponse>



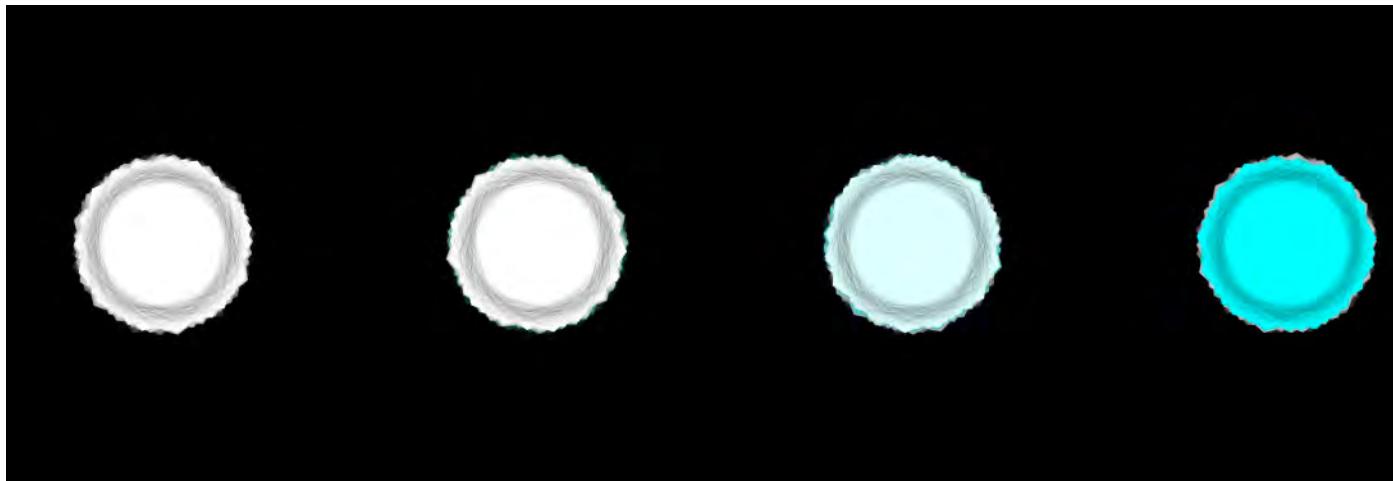
2 Entities in their 'resting' state, with fluctuations generated by Perlin noise.



3 Detail of appearance when 'listening'.



4 Detail of appearance when 'performing'.

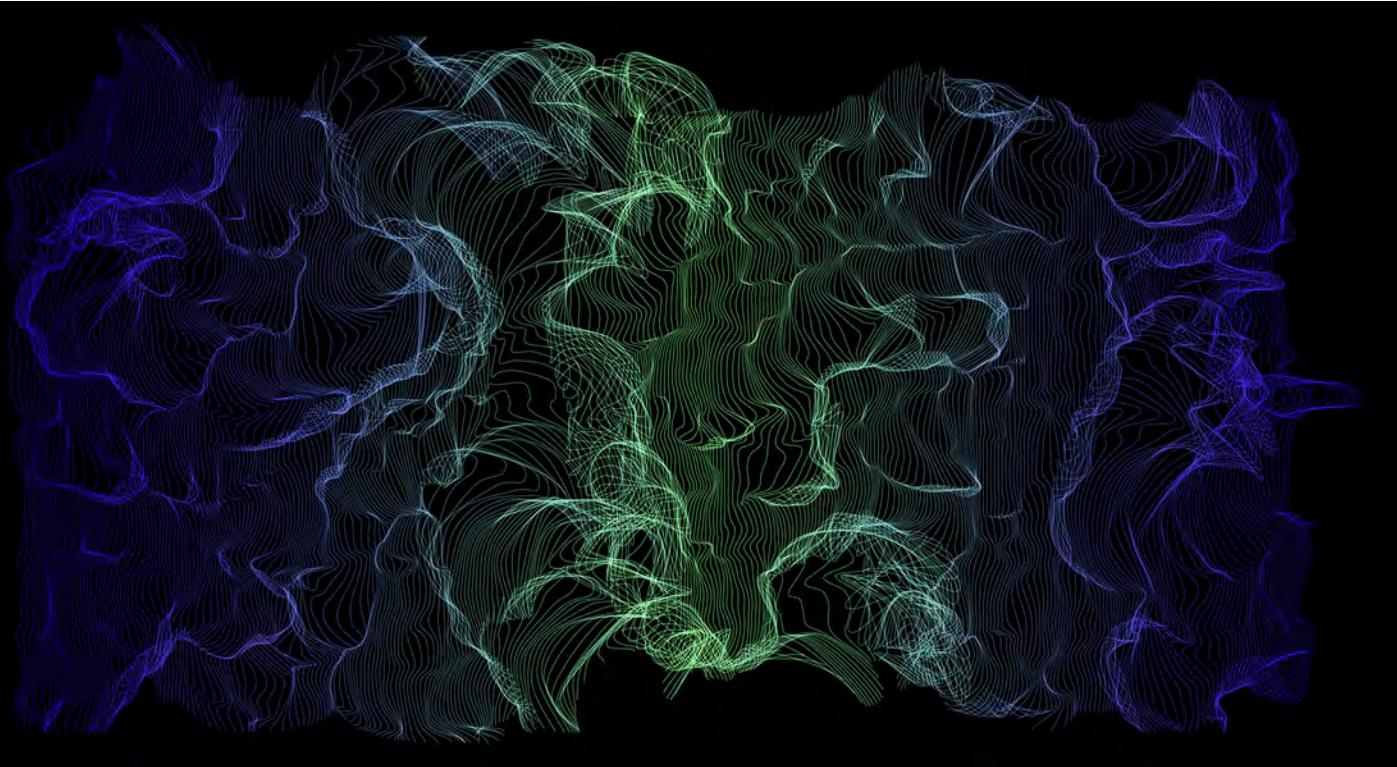


5 Entities as they 'listen' to a human performer, representing pitch with saturation.

MUSIC AND THE MIND

Katarina Richter-Lunn
MDes Tech 2021

Influencing The Dialogue



1 Caught in Action - Gamma Waves & Butterfly, Bassnectar

Working with sound as our foundational medium our team looked at three different ways in which to interpret the input and return a “translated” version. These translations include; audio user interaction which intuitively responds (Sana Sharma), the interpolation of a song through your brain wave data (Katarina Richter), and the formal adaptation of music through 3D printing (Erin Hunt).

In this part of the investigation sound was analyzed along side of the current brain waves activity from the listener, with use of the Muse device. This activity is then analyzed in real time to effects different characteristics of sound, such as; amplitude, rate, and pan. This allows users to have a certain amount of control over the music they are listening to and give live feed back of your current state of mind. All unique in their approach and output these projects seek to explore the power of auditory information processing by providing fun, relatable interpretations of complex systems.

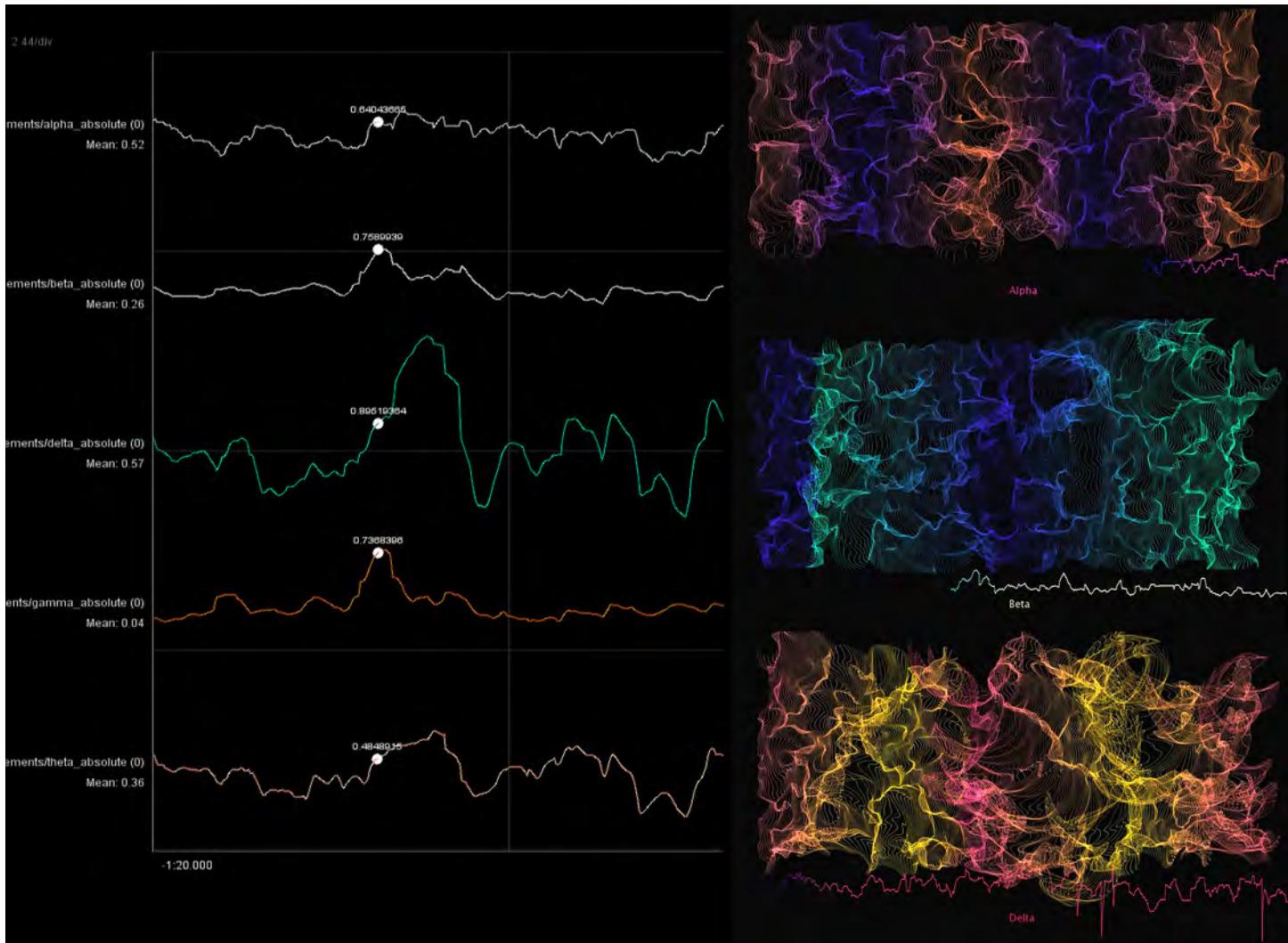
The hope being that this not only changes the way music is conceived, created and experienced but also can give participants a new medium through which they can start understanding these technologies, and even themselves, better.

Video

<https://youtu.be/7y08rOCOLO0>

Learn More

<http://www.katarinarichter.com/>



2 Parallel of brain wave activity and sound interpolation

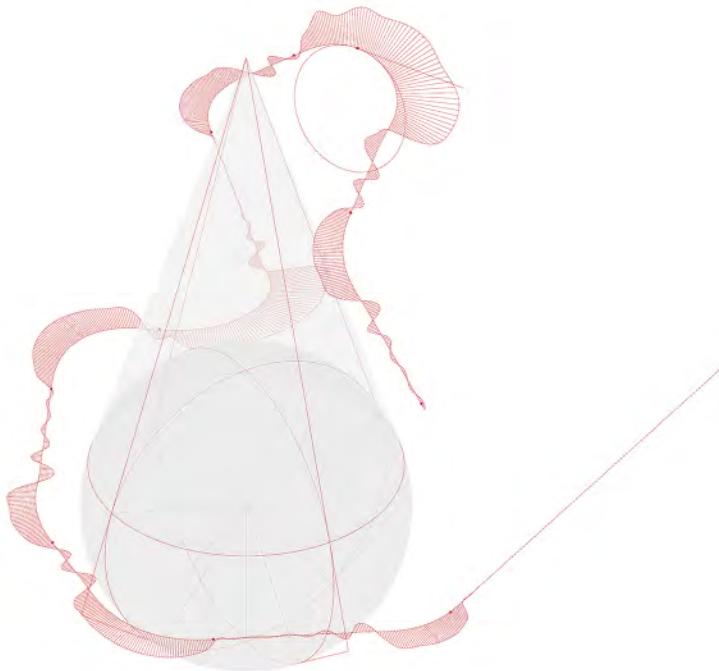


3 Muse headband used to query and stream data

DYMAXION CURVE

Yungi Jung
MArch I 2020

Drone Racing Track with Geodesicon on Conic



1 Steer behaving path with curvature analysis (cone-sphere stitch)

The goal of this project is inventing a new type of drone racing track and a track analyzing methodology. Current drone racing tracks are made of several ring-shaped check points on a ground. The reason they use a series of rings rather than a linear track is because of the wide range of drone's turning rate (they can usually turn 180 degrees in a second or fly in a perpendicular direction). Although the current drone racing tracks are made of ring-shaped check points, the overall geometry is pretty much like the conventional car racing track.

Let's imagine that there is a base curved surface such as a conic surface, a sphere, or a doubly curved surface which have mostly positive Gaussian curvature. If the surface is convex enough they could act as a constraint to drone's movement, which means drivers cannot fly straight to the next point and they should find the shortest path between the check points pushing their ways through the base surface. The shortest path on the curved surface is the same as the definition of the geodesic on non-Euclidean geometry. A simulating code considering a set of physical laws (location, velocity, acceleration, etc.) will help defining the geometry of the track, especially the corner condition and testifying which geometry is better or more effective for the racing.

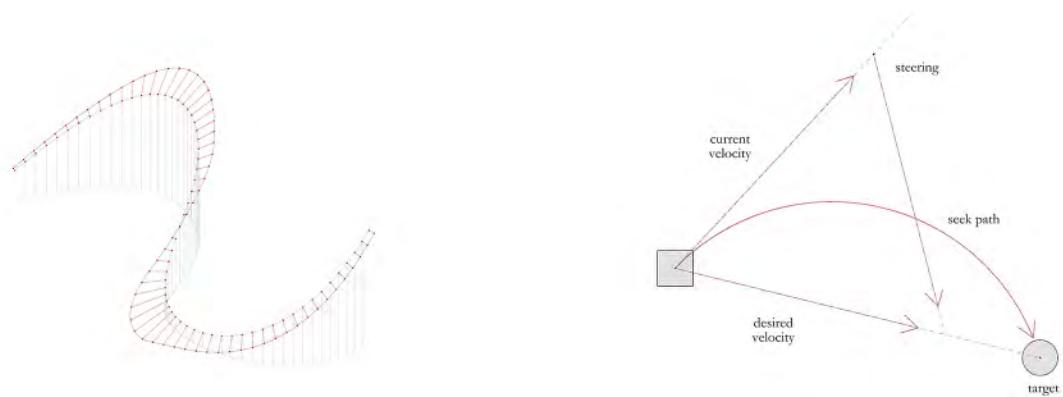
Video

<https://youtu.be/WQFtNtrgXl8>

GSD6338 Introduction to Computational Design



2 Steer behaving path with curvature analysis (doubly curved surface)



3 Curvature Analysis(left), Steering Behavior(right)

OSCILLATING FIREFLIES

Tamilyn Chen
College 2019

An Educational Tool for Synchronization



1 Night view of fireflies flashing

This project serves as an educational tool that models the fascinating self organizing and collective behavior of fireflies, namely the natural phenomenon of firefly synchronization. It recognizes and visualizes the flashing of these oscillators as pulsatic and episodic, fireflies that start out flashing randomly and only gradually synchronize with each other throughout the night. In other words, when a firefly is aware of the flash of another, it either slows or speeds up its flashes in order to become more in phase with the other during the next cycle. Fireflies become entrained by each other, meaning that fireflies have the ability to match its frequency to that of another firefly, thus synchronizing.

This project also analyzes the study based on Bard Ermentrout and John Rinzel's model (1984) of introducing an artificial stimuli in order to analyze the firefly's flashing rhythm. The flashlight essentially interrupts the firefly's natural behavior of going through a flashing cycle by introducing a periodic stimulus. Similarly, when the firefly is behind the stimulus' cycle, the firefly will speed up in an attempt to synchronize, and when behind, it will slow down.

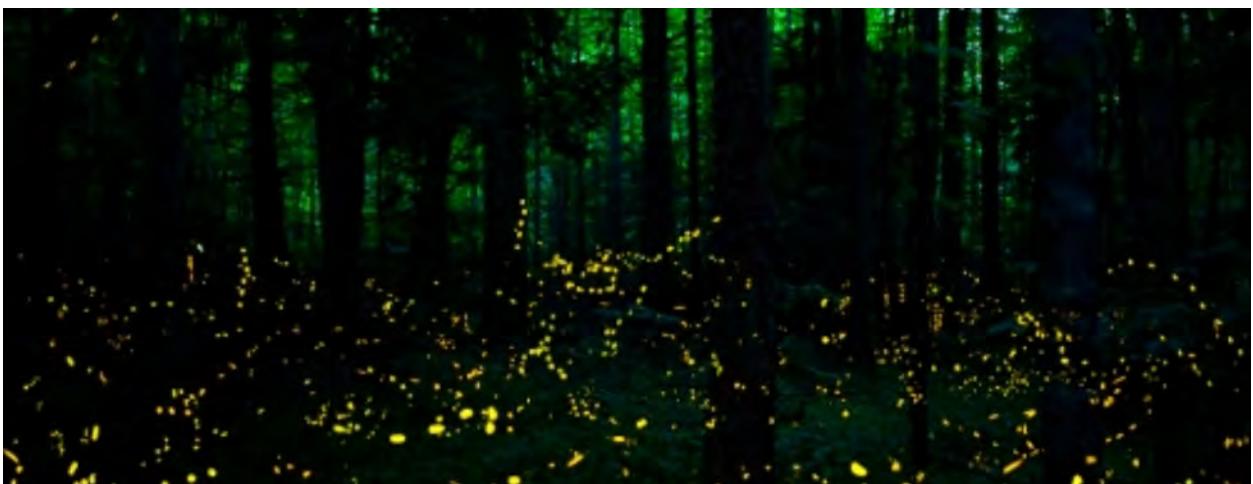
Video

<https://youtu.be/Yni-5xpaaZk>

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2 Simulated fireflies for this project



3 Forest night view of fireflies flashing

GHOSTLY SURVEILLANCE

Wei Wu
MDes APPD 2021

Interact With Your Web Camera



1 Wei is always watching you

Surveillance in the digital age could be dangerous, yet it could also be unharful or even benefit people in their daily life. With a series of interactive actions, I would like to playfully raise awareness of web camera surveillance.

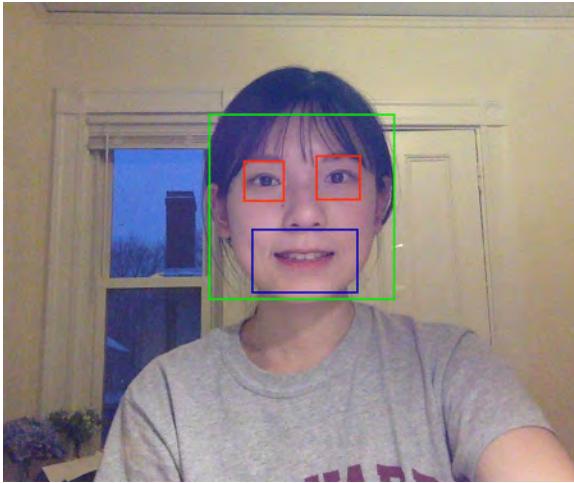
My first action is called “Wei is always watching you.” Using the basic processing index, I simulated a stranger who is observing your life through web cameras. However you move your mouse, I would always keep an eye on your movement.

Using processing and an application called Tramontana, I managed to build a face detection program that could detect your motion of the face, eyes, and mouth. Based on the face detection program, it would be easy to know the number of people in your room. Thus, I built a “Stranger Detector” software that can remind you of the people standing behind you. When another person shows up, your phone would vibrate and change the wallpaper to warn you.

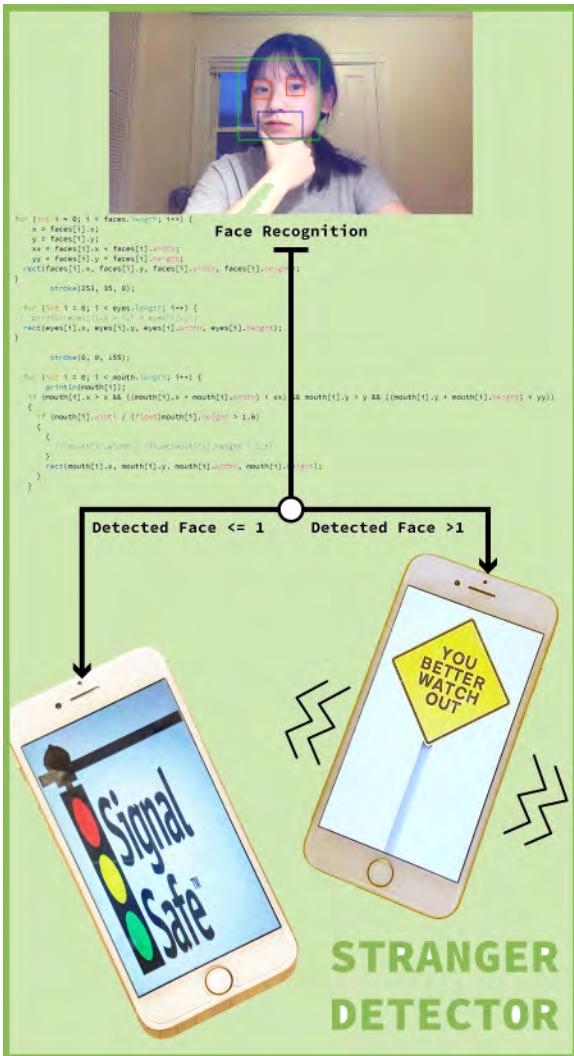
With the same strategy, I made the “Nap Detector” that would notify you when you close your eyes or head down while working with your laptop. Another program is the “Smile Detector” that would change a warmhearted wallpaper with

Video

<https://youtu.be/X1CpKNqDHJ8>

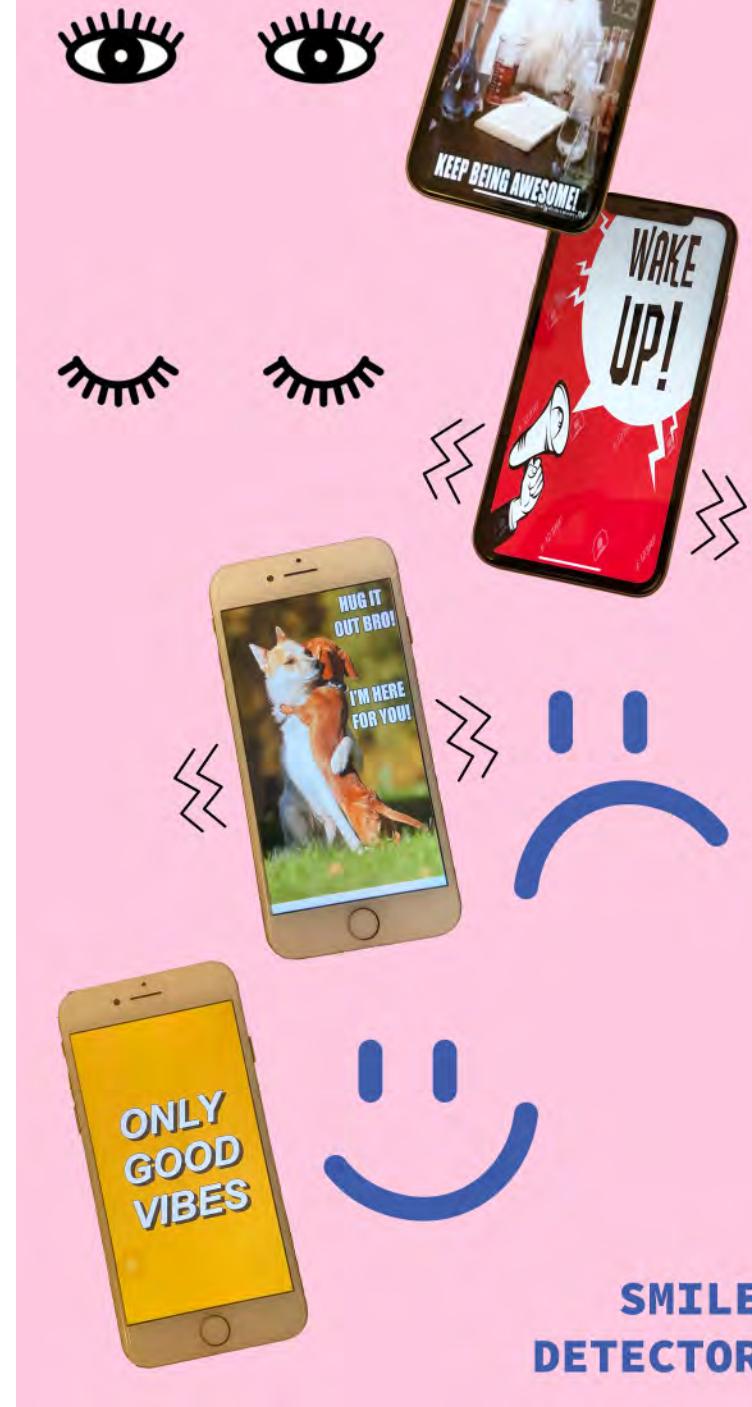


2 Face, eyes and smile recognition



3 Stranger detector

WAKE UP! NAP DETECTOR WHILE WORKING

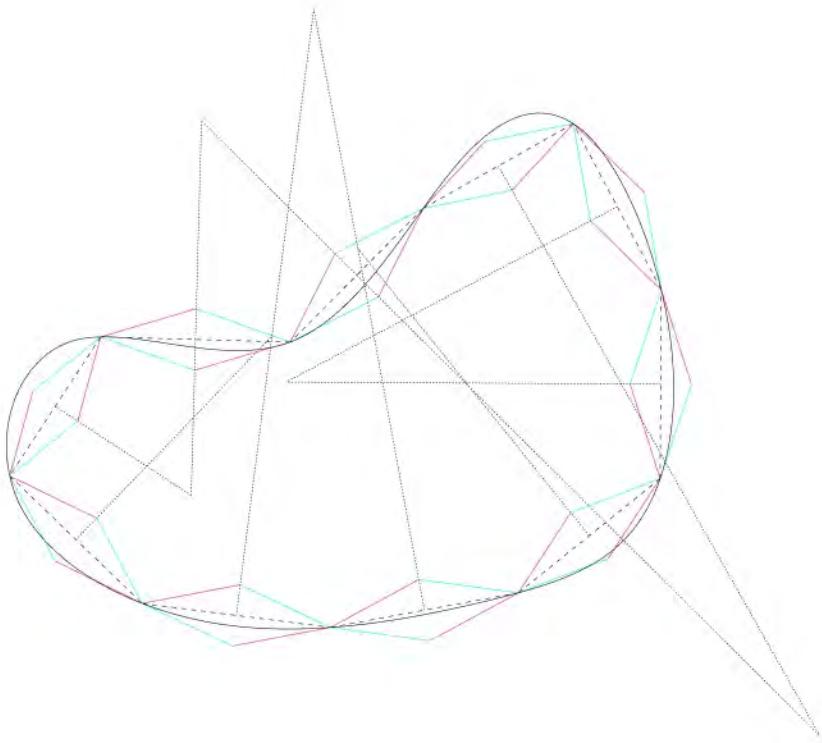


4 Nap detector and smile detector

CURVE2LINKAGE

Joonhaeng Lee
MDes Tech 2021

Generates Linkages on any 2D Curves



1 Analysis of freefrom curve and rhombus linkage generation

Curve2Linkage is a Grasshopper script that generates rhombus type scissor linkages on any 2D curves by calculating points, vectors, and planes on the curve. The initial concept of the rhombus scissor linkages was from Chuck Hoberman's 'Transformable Design Method' lectures 2019.

Understanding linkage mechanism is essential to design transformable design. However, mathematical logic behind linkages often behaves as a barrier for some design major student. The Curve2Linkage documents mathematical reasoning behind the linkages and provides fabrication data that students in GSD or all over the world help them to understand linkages.

Video

<https://youtu.be/RBCZW3hPK9A>

Learn More

<https://github.com/joonhaeng-code/Curve2Linkage>

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2 Application on alphabet curve



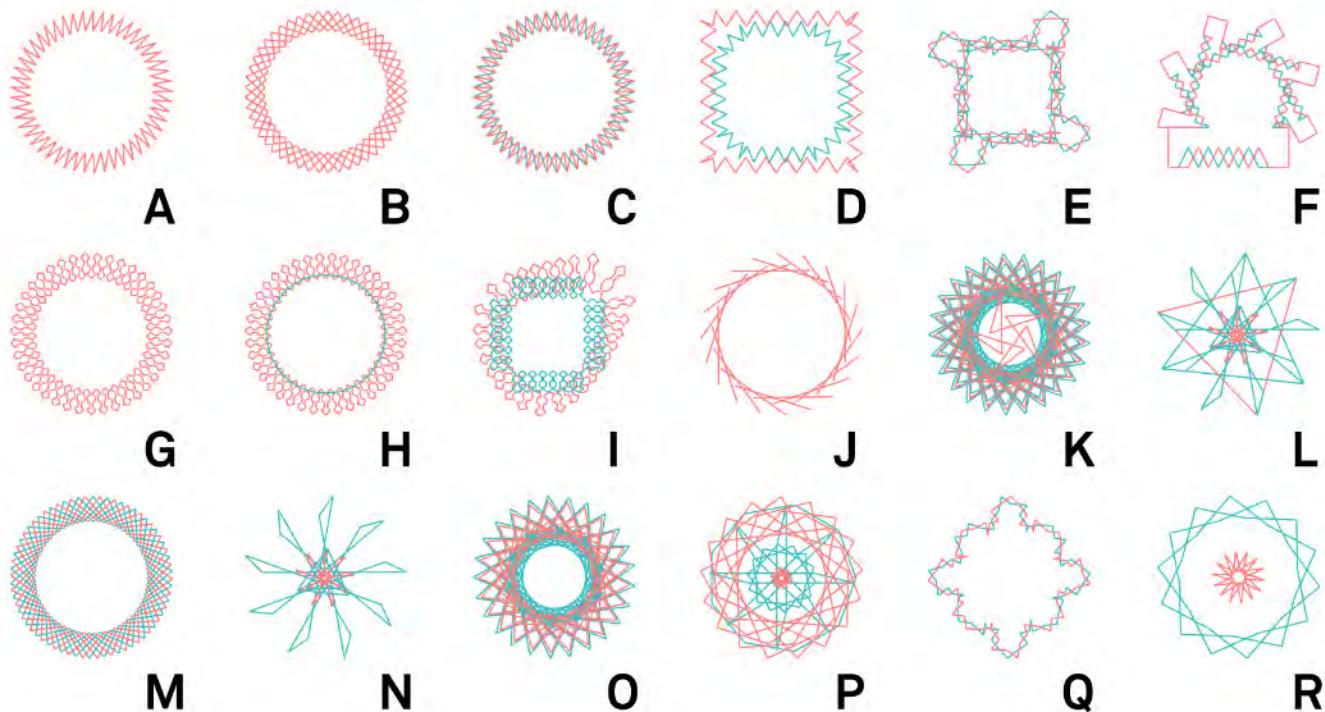
3 Expanded and compressed linkages

PRINTING ERROR

A Slightly Uncertain Slicer

Hyemin Bae
MDE 2021

Bryan Ortega-Welch
MArch I 2021



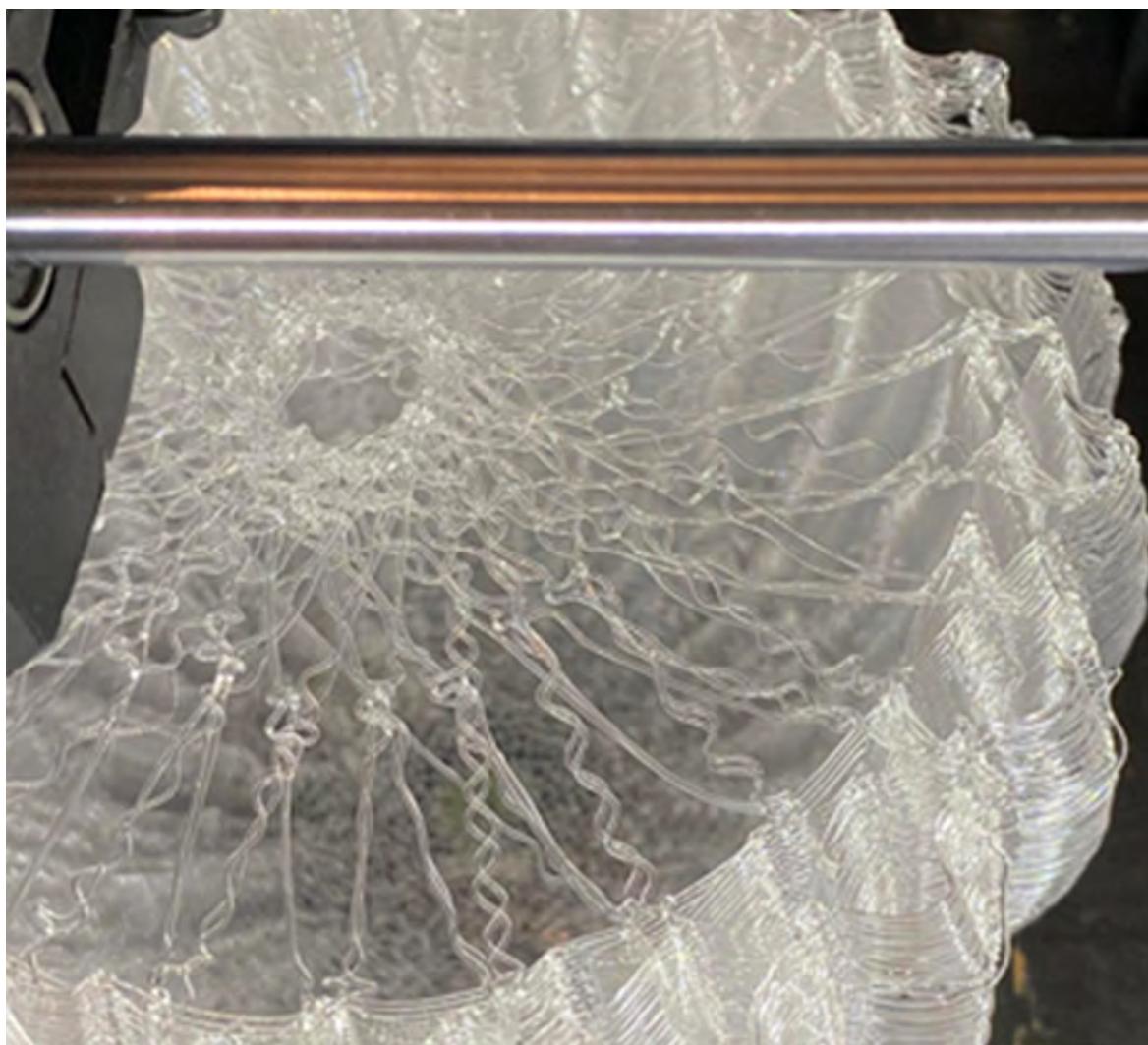
1 A menu of preset "stitch patterns" that can be modified parametrically

We were drawn together by our common interest in fragility and porosity. Conventional 3D printing "best practices" encourage the designer to generate "watertight solids" for error-free slicing and durable fabrication. Inspired by stitch patterns found on sewing and embroidery machines, we hoped to explore how far we could coax the printers to stray from solidity, opacity, and durability, while still retaining structural integrity.

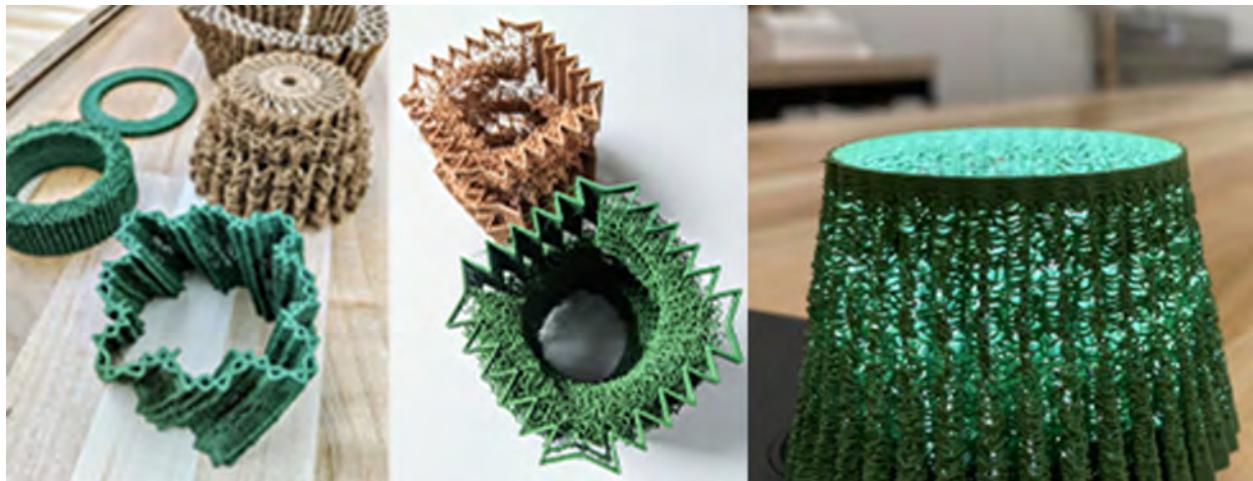
PRINTING ERROR helps the user generate "stitch patterns" and translate them into 3D forms. The user can experiment with the distance between layers, introducing an element of chaos - the filament begins to curl if the distance is too great. The slicer familiarizes the user with a new set of practices, such as beginning and ending an experimental print with a "lock stitch" to prevent it from unraveling. While playing with our slicer, decay was on our mind: we printed a series of objects using wood and algae-based PLA, pursuing forms that would be strong enough to retain soil or serve as scaffolding for growing mycelium, but fragile enough to succumb to biodegradation over time. We were drawn to the transparency of these prints, and began a second series using semi-clear and clear PLA, investigating translucent effects.

Video

<https://vimeo.com/380039966>



2 Translucent structures



3 Biodegradable forms

PRIZM

Capture the Essence of the Presence

Seonghyun Nam
MDes APDP 2021

Zidong Huang
MDes CC 2021



1 PRIZM is an interactive column that captures the presence of people

Column, is a part of am artificial structure that is invisible to the users. While its main function is to structurally distribute the weight of the structure, people mostly recognize the columns as visual interference inside space. Project PRIZM is to give meaning to the column and let people to notice its existence and interact with users in the space.

In designing the PRIZM, our team use python together with Rhino and Grasshopper to make the physical object. Machina and ABB robot was used to 3d hot wire cut the white foam which is 50cm x 50cm x 200cm big. Webcam is used, linked with processing – syphon – madmapper in real time to show the interaction design.

People who are wondering around the space will be captured and recorded in the PRIZM. This digital ‘archive’ of people in space can be a representation of a single space, but can be further expanded to visualize a collective memories and presence of people, such as holocaust memorials spread whole around the world, or veteran memorial parks.

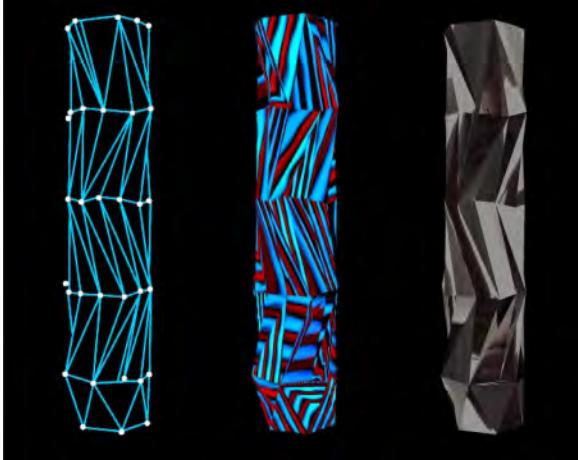
Video

<https://youtu.be/rjrw99bShnY>

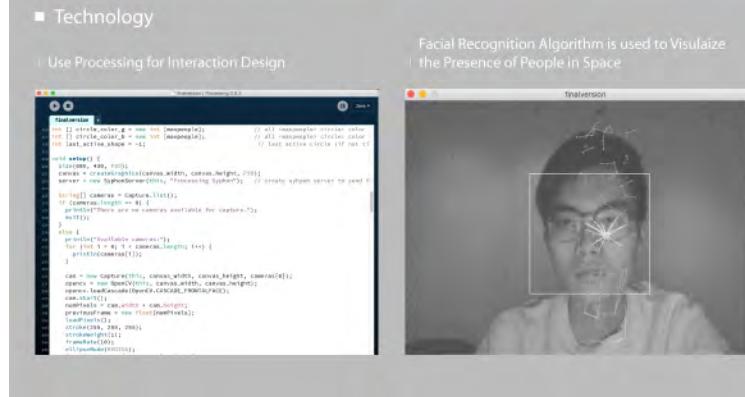
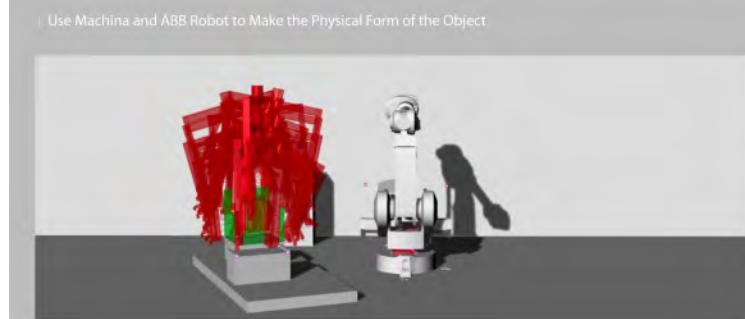
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2 Real-time interaction



3 Projection Mapping Design Variations

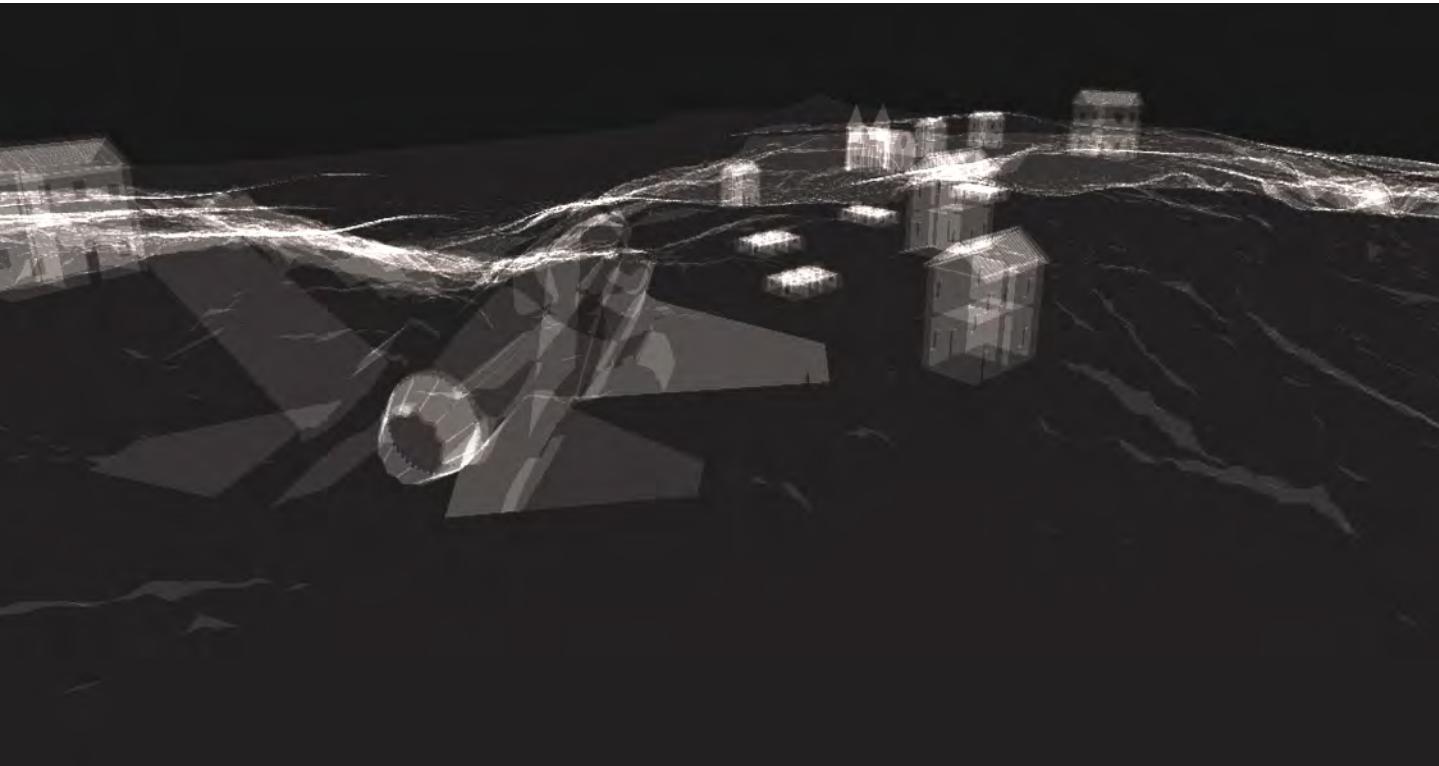


4 Design process

MOCK MOCK CITY

Ryan Thomas
MDes ULE 2020

A Caricature of Synthetic Training Environments



1 Stylized representation of the mock city flight simulator, made in Unity Engine.

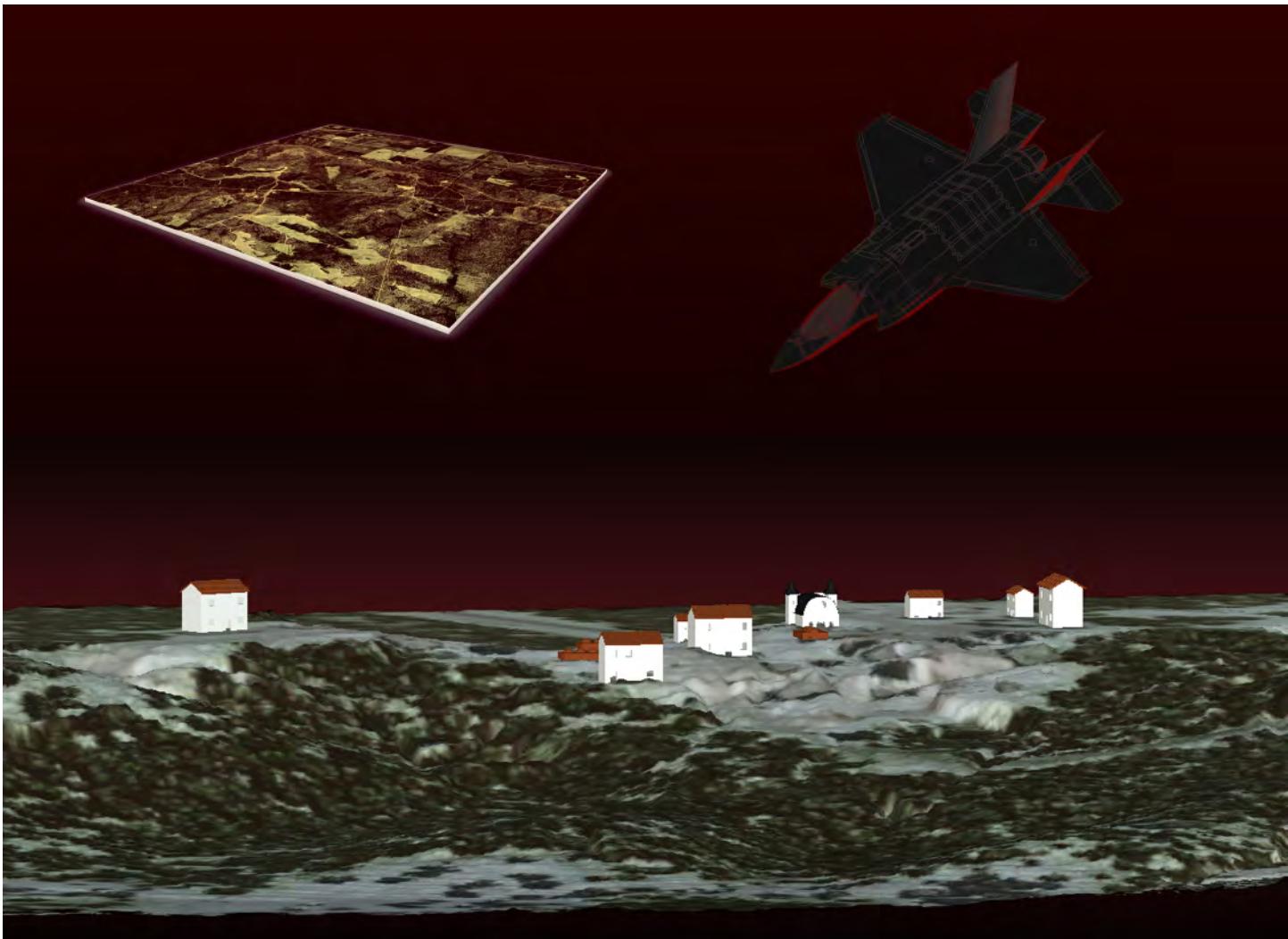
At present, across the United States exist hundreds of artificial cities devoted to simulating warfare in urban areas. These proving grounds have been designed and purpose-built to reify an image of cities as austere environments, one that justifies a preparedness for urban warfare. The result of this assumption has permeated everywhere from the creation of new doctrine and tactical handbooks on ways to fight in dense urban terrain, to massive investments in virtual and augmented reality gaming industries, to the makeshift and widespread construction of mock-cities and villages across the country and its greater territories.

The intent of this project is to turn these heavily invested tactics on their head, through a satirical gaming simulation. The outcome is a flight simulator, showcasing an example of the villages built for tactical exercises, crafted using aerial imagery, typological examples of typical urban terrain for tactical training, and the most expensive aircraft the U.S. government has procured. The project is meant to be intentionally cartoon-ish, to further showcase the absurdity of government expenditure through its own medium.

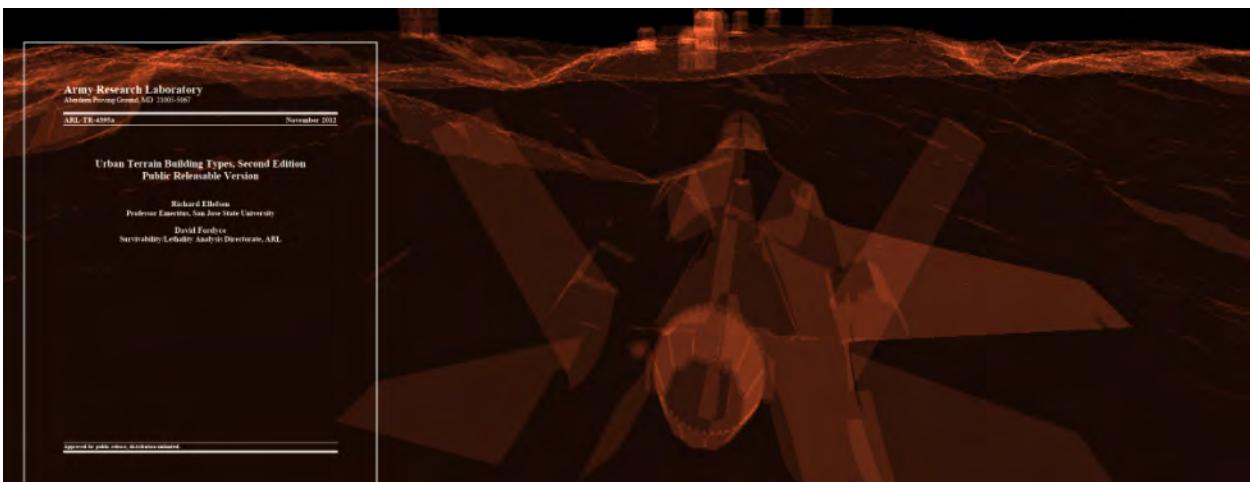
Video
<https://youtu.be/PbHn76MiIsc>

Learn More
<https://MOUT.Site>

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2 The components of the flight simulator involved a digital elevation model derived from LiDAR, and architectural objects



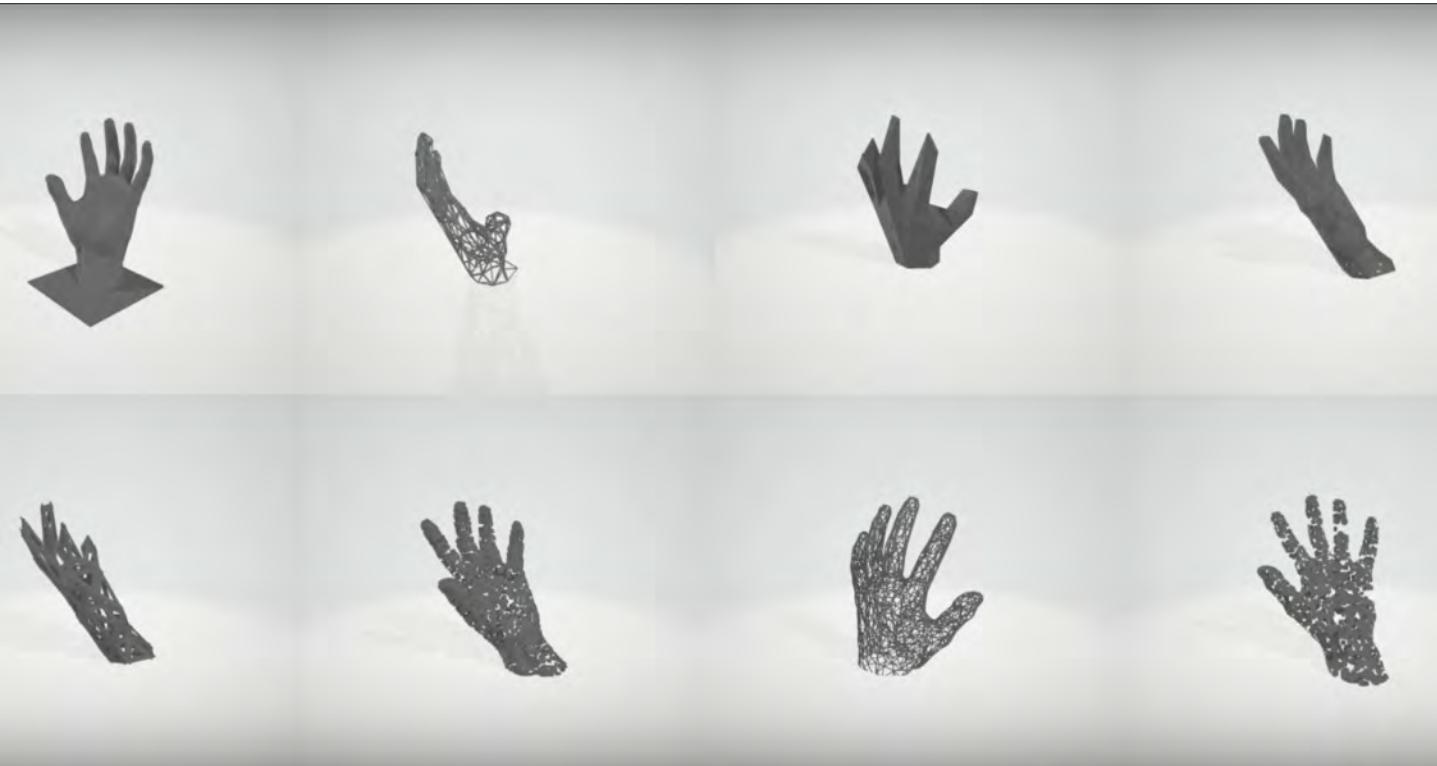
3 Left: Army Research Lab publication on urban terrain. Right: F35 view engaging with such terrain in the simulator.

PROJECT RUNWAY 2.0

Fits You Like a Glove

Vanessa Wu
MArch I 2022

Angela Blume
MArch I 2022



1 Iterations of 3D printed geometries

This project explores the possibilities of 3D scanning and 3D printing to create customized garments. Using the meshes of the 3D scans of our hands, we were able to manipulate them in order to create different iterations of 3D printable gloves.

Video

<https://www.youtube.com/watch?v=tqgzpkkDZNg&feature=youtu.be>

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2 Original hand to be 3D scanned



3 Geometry created by manipulating mesh of 3D scan

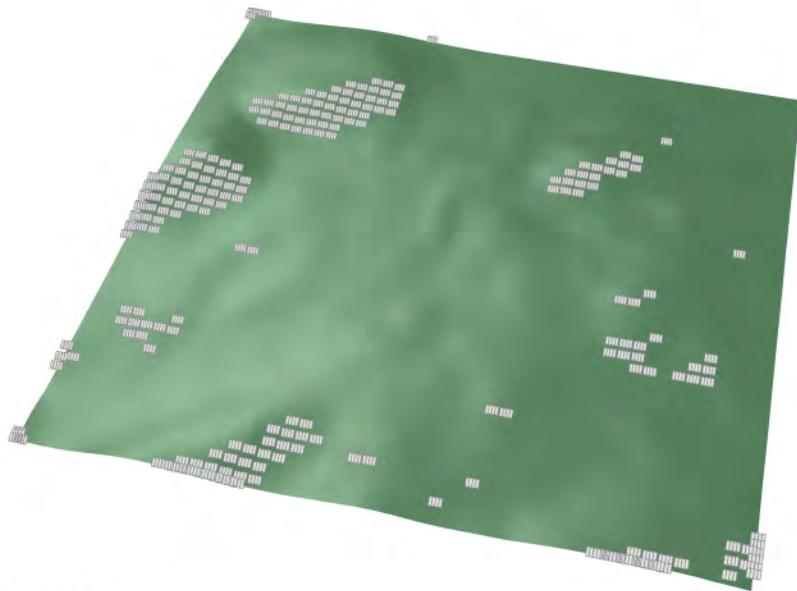


4 3D printed prototype

SOLAR TRACKER

Sunghwan Lim
MDes EE 2021

The Best Way to Utilize Solar Energy



The top 15% spot for solar generation
on the hillside near Boston, MA

1 Annual analysis for solar panel

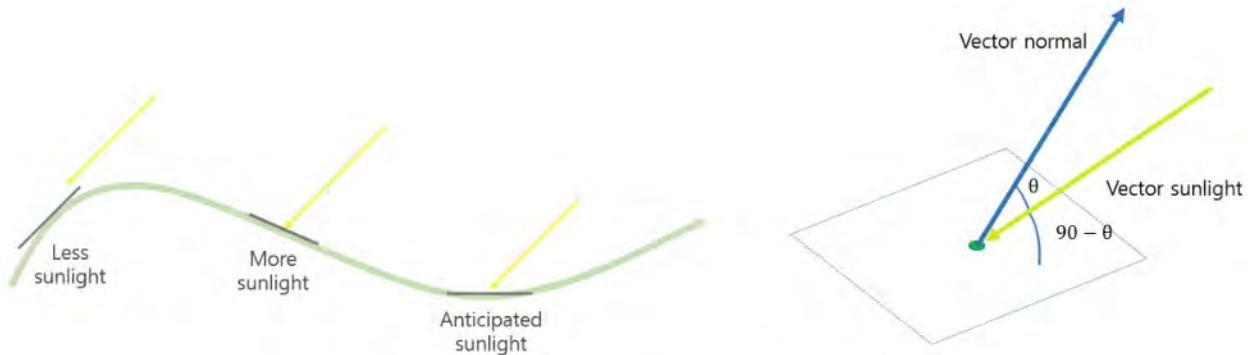
Have you ever thought which spot we can get the most sunlight? The spot that is perpendicular to the solar radiation is the place we can get more sunlight than the flat surface. What if we can find that specific spot and go for sunbath or place the solar panel and make the most profit? The Solar Tracker use the Google Map topography data that you choose and analyze the best spot at the certain time or annually.

The Solar Tracker not only find the best spot for the solar generation, but also help to save the cost of the supporting structure, maximize the land use by minimizing the interference of shadow between the panels, and visually integrate the solar panels to the topography. The last function of the Solar Tracker is related to the rising popularity of the solar panel on the roof. It assists the architects in the early design stage to know what the most efficient angle of the roof is when the location and orientation of the house or building are considered.

Video

<https://youtu.be/8HFeQVEokrw>

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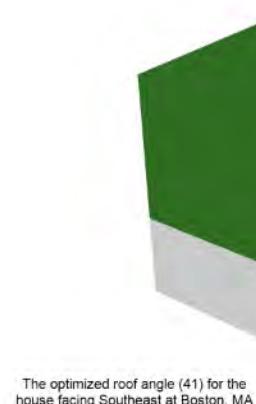


At the same location, the sun angle varies by the terrain condition

θ = Angle between Vectors

$90 - \theta$ = Angle of sun at the particular spot

2 Project concept

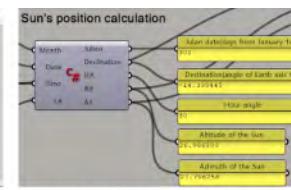


The optimized roof angle (41) for the house facing Southeast at Boston, MA

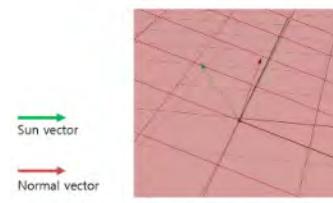
3 Roof angle analysis



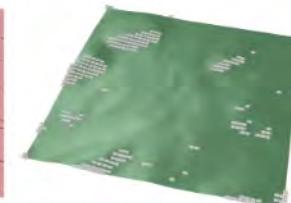
Step 1: Retrieve topography data



Step 2: Calculate the sun's position

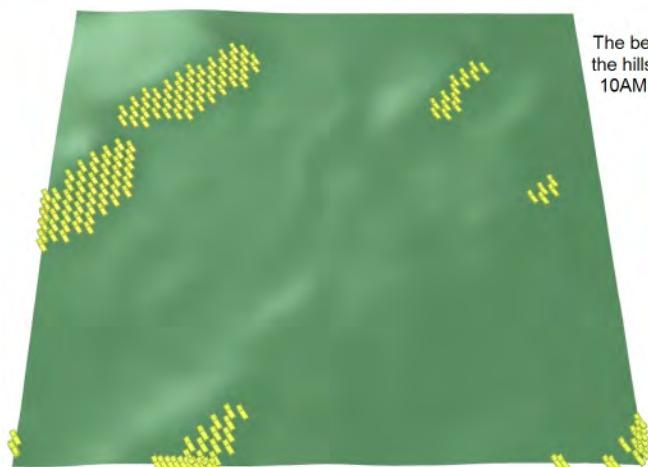


Step 3: Calculate the solar angle at each spot



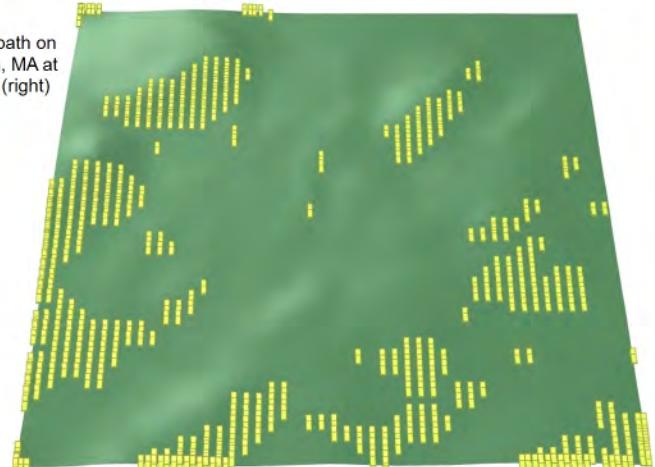
Step 4: Visualizing the result

4 The steps



The best spots for sunbath on the hillside near Boston, MA at 10AM (left) and 12PM (right)

5 Solar analysis at specific time



CLOCK HANDS

VR Experience of Controlling Time

Peilin Li
MDes Tech 2020

Haoyu Zhao
MLA I 2020

Beilei Ren
MDes RR 2020



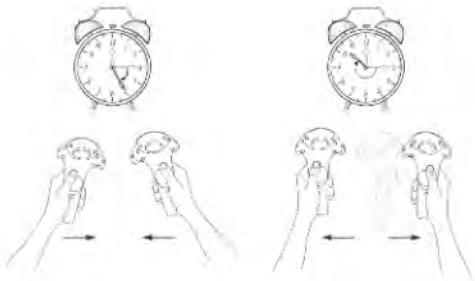
1 Virtual scene of time control

This project is a VR-based experience, which provides an immersive environment and instantaneous responses to the participant's hands movement. To create the illusion of controlling time in the scene, the distance between two controllers is tracked, and the 3d animations of gameobjects are played in a speed accordingly. The scene constructed in VR is a collection of events associated with the perception of time, e.g. falling raindrops, drifting lanterns, a revolving moon, flocking fish. The speed of spatial sounds is also changed as time changes , emphasizing the perception of time from another sensory input.

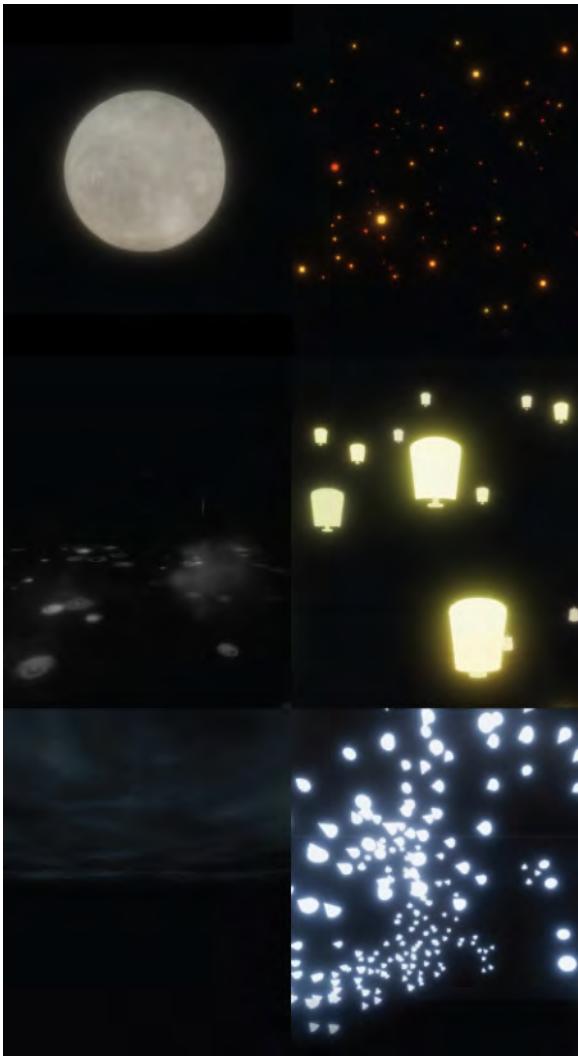
Video

<https://www.youtube.com/watch?v=j99owJZ0hpE&feature=youtu.be>

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2 Manipulating time with VR controllers



3 Animated events associated with time perception



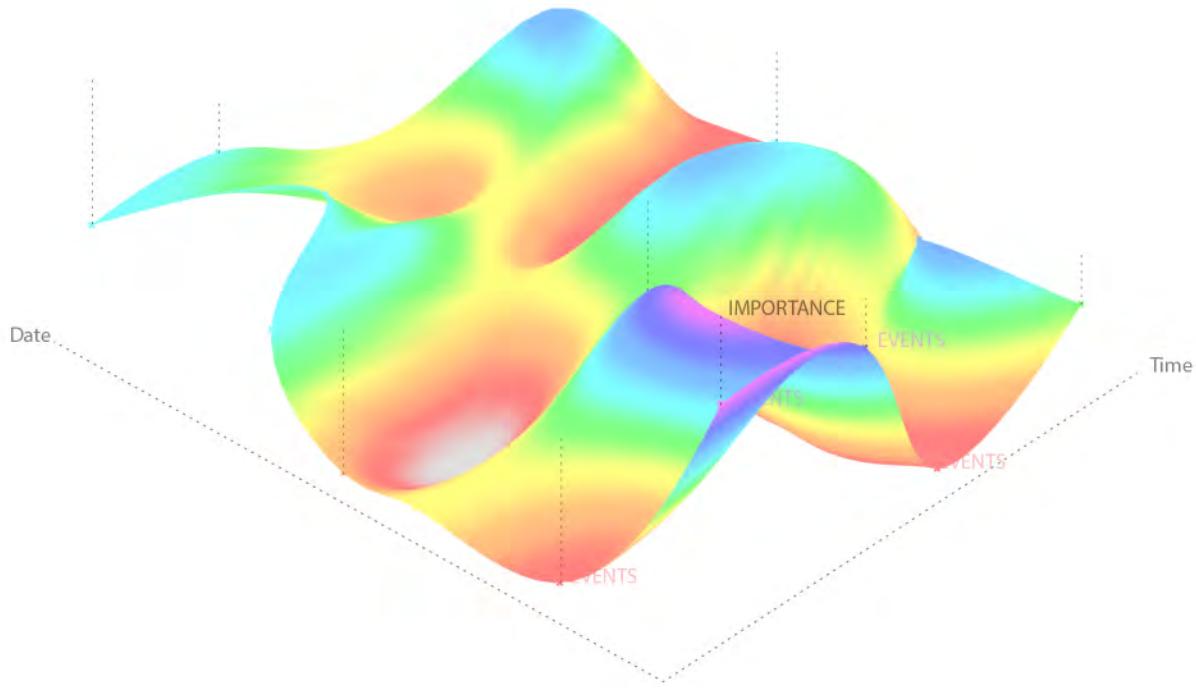
4 A user journey of time control

FLOATING SCHEDULER

Cruising the Cloud of ‘What I Did’

Jungeun Goo
MAUD 2020

Ye Chan Shin
MAUD 2020



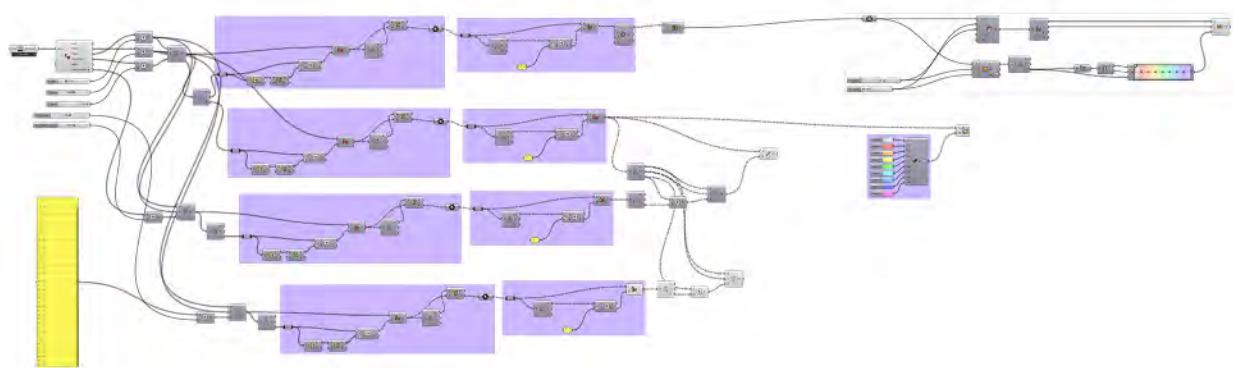
1 3D scheduler model

A scheduler is a planning tool that allows users to build and visualize schedules. However, it seems there are limitations in showing the plans at once in one 2D blank box, even though several visually improved planning methods exist by making users explore different sections through several clicks.

Instead of having text on the scheduler, the schedule data are represented by the location, the color, the shape, and the size of the points in the designed platform, such as the date and the time, the purpose of the meeting, whom I meet, and etc. The points cloud can be seen not only on the phone screen but also over your head when you wear a VR headset. While walking through the data clouds, you may be able to touch the mesh to listen to what you said or heard through the linked data you might record. Also, the visually powerful 3d scheduler would help you quickly look back on what you did in the past.

Video
<https://youtu.be/pqdqmjryEFE>

Learn More
<https://www.facebook.com/pg/3D-SChedular-107591717408994/posts/>



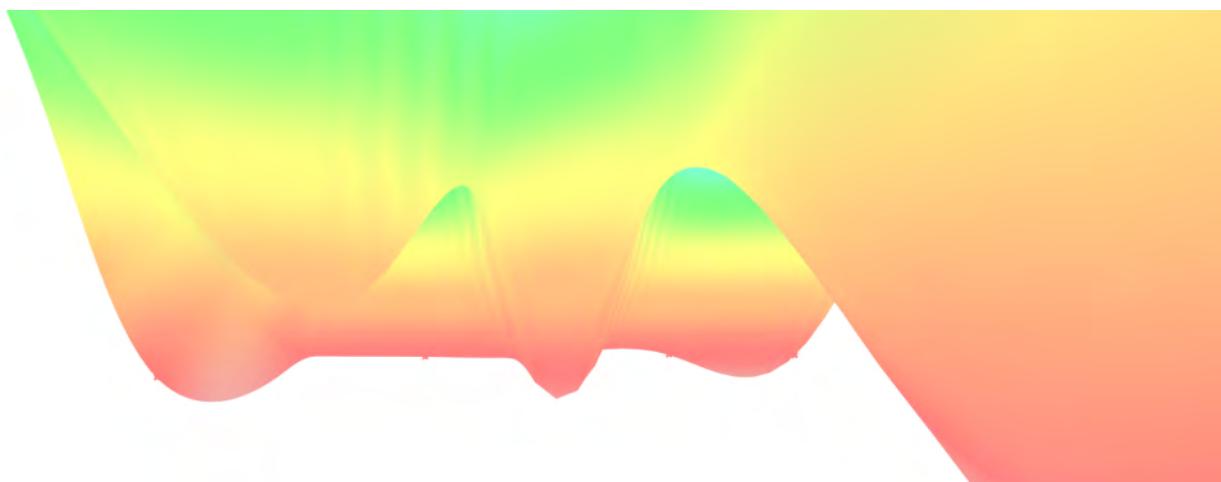
2 Code and grasshopper model

3 Current 2D text scheduler

	Variables	
Group	A	B
Gen- Pedia/Pedia List to display content	PL-W Tutoring Content same score	PL-W Tutoring Content different score
Level 2024 Tutoring & Instructional Content	Level 2A Tutoring & Instructional Content	Level 2B Tutoring & Instructional Content
Group A-1 Tutoring 2.00-2.05 Instructional Content	Level 4A Tutoring 2.00-2.05 Instructional Content	Level 4B Tutoring 2.00-2.05 Instructional Content
Level 4C Tutoring 2.00-2.05 Instructional Content	Level 4C Tutoring 2.00-2.05 Instructional Content	Level 4D Tutoring 2.00-2.05 Instructional Content



4 3D visualization parameter points



5 Virtual experience of the 3D scheduler

DEAR SLEEP

Zhaodi Wang
MLA I 2020

Visualize Sleep Data by Quilting



1 Quilt sample 1

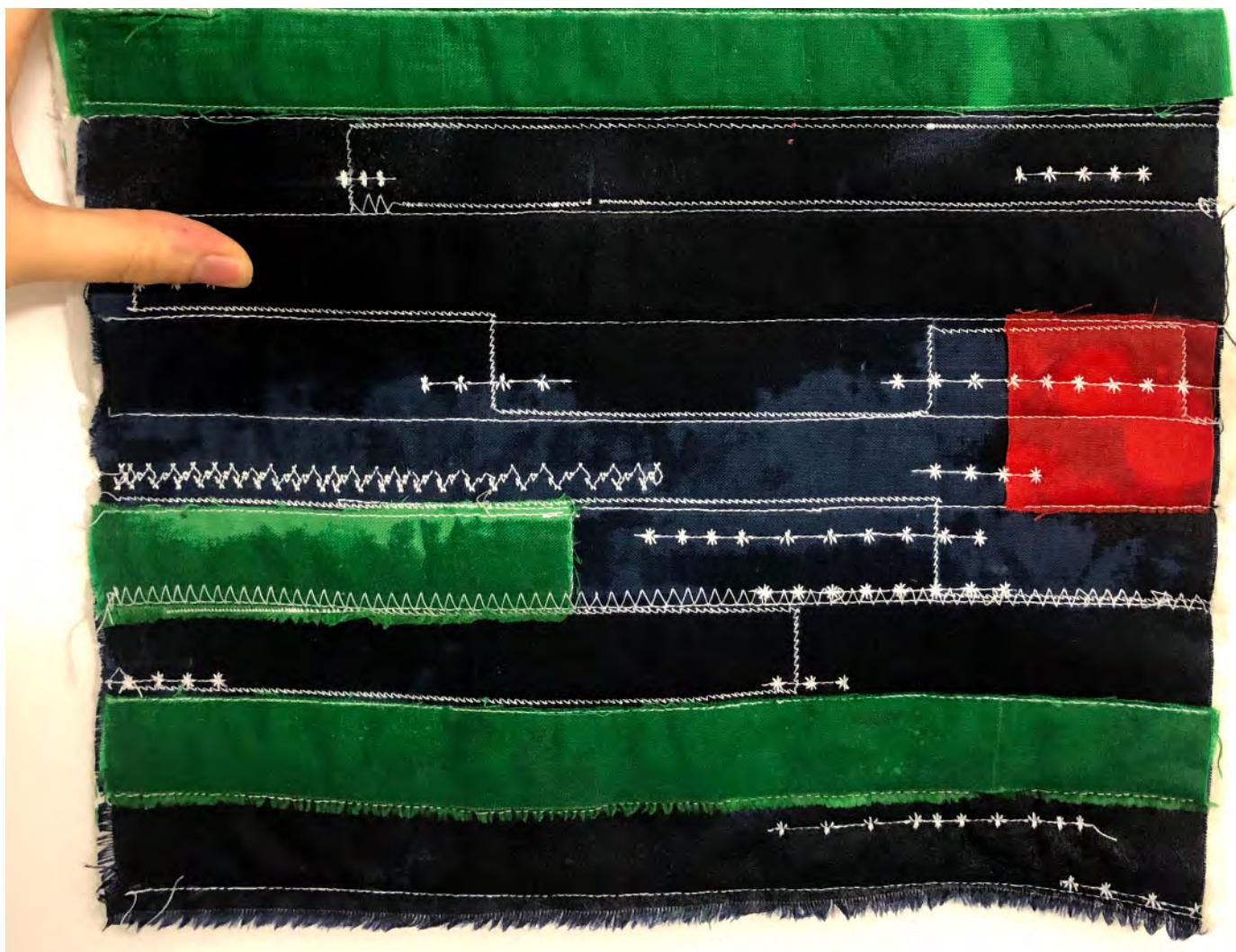
The project transfers my personal sleep data into a textile with computational design tool.

I use my phone to track sleep every day and it records a bunch of data about my daily sleep like time, regularity, quality, etc by analyzing the acoustic data from microphone. By utilizing this app, I got to understand my sleep habits better and become more aware of improving the sleep quality as well as the elements that enhance the sleep cycle. Sleep, as one of the most crucial behaviors in our daily routine, represents de-stressing, sensitive moments, dreams and a productive new day. Rather than understanding it from the numbers and charts, the project translates it into a more tangible and emotional artifact. It intends to re-interpret the sleep data into different textile patterns or various knitting methods. The data would change the shape, intensity and color of the textile. For instance, a tighter stitch represents the moment of waking up in the morning while loose stitching stands for a sweet dream. The fabrics with different patterns will be stitched together to make a quilt to assist me for better sleep, physically and emotionally.

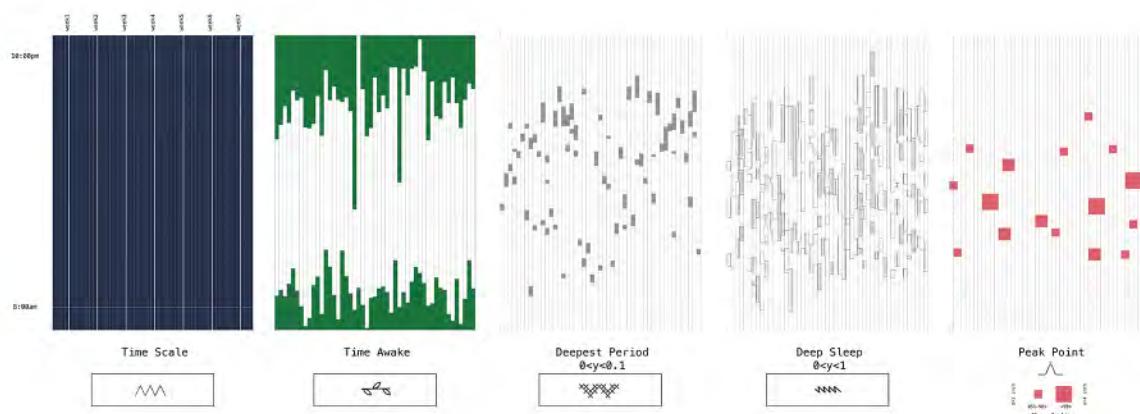
Video

<https://youtu.be/xZXrHI37uXk>

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2 Quilt sample 2



3 Sleep data visualization and legend

REPAVING BOSTON

Plugin for Paving Generation

Jianyu Li
MDes CC 2021

Lianliu Guo
MLA I 2021



1 Boston City Hall Plaza paving design

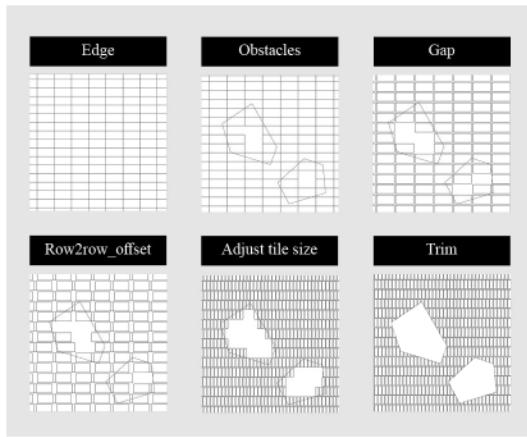
In this final project, our group focuses on how to create a new plugin to generate paving patterns for specified sites creatively and efficiently. We focus on the realistic construction level and put the combination of design process and construction results into consideration. We explore the possibilities of the paving patterns and comprehensively analyze the savings of the paving materials in the realistic construction process, which is more detailed and practical than the ordinary paving generation plugin.

To use this plugin, people should first input the boundaries and obstacles inside the area. Then they can input the size of the tiles to generate the paving. In order to make the final result more closer to one's expectations, they can input images to construct the patterns of the paving. Furthermore, one can input the reference curves or points to further adjust the pattern. Besides, on the boundary, the plugin can help designers to choose between tiles in different size and calculate the amount of material savings for them. This plugin is suitable for sites in various forms. In the final project, we use this plugin to redesign the Boston city hall Plaza and Downtown crossing Plaza as two examples for users.

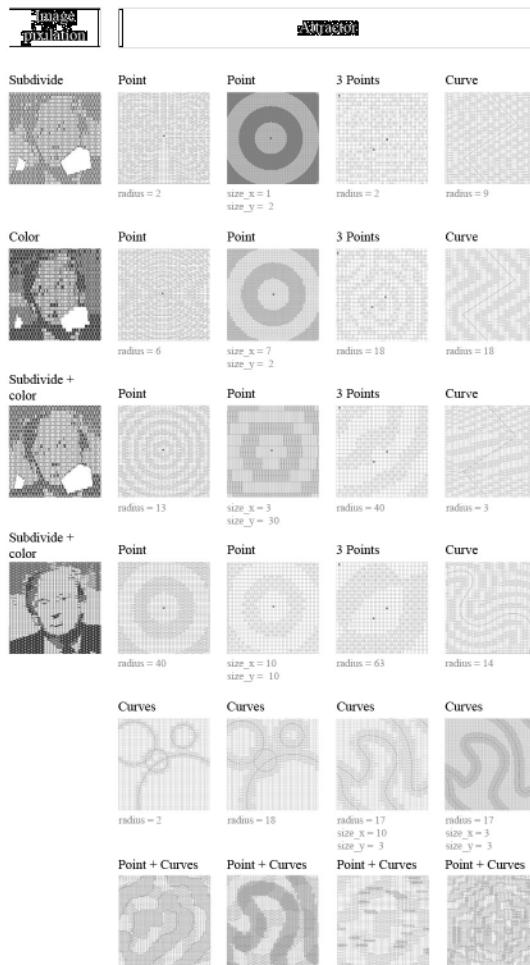
Video

https://www.youtube.com/watch?v=r3sg7M-_Ybg

GSD6338 Introduction to Computational Design



2 The plugin's working flow



3 The paving pattern design with variable parameters



4 The conceptual rendering of Downtown Crossing paving design

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