

Generative design has long ceased to be a trade secret among design students; in some universities, it is now firmly integrated into the curriculum. From infographics to the visualization of sound, from the fine arts to architecture, and especially in the realm of communication design and media installations, generative design allows for dynamic, stunning, and fascinating applications.

Processing and vvvv have for many years been the programming environments of choice for artists and designers. However, more recently there has been a shift toward more web-centric applications, giving rise to new coding environments such as p5.js, a JavaScript library that is especially programmed for and by artists, designers, and other web users.

The first edition of *Generative Design* was written almost a decade ago, and its acclaimed underlying teaching methods are still unrivaled. In this updated edition, the authors create an even more accessible and up-to-date entry point into creative coding with the use of JavaScript. In the spirit of the first edition of *Generative Design*, the goal is to remove any fear of programming and demonstrate how existing program snippets can be manipulated and tweaked to achieve amazing results almost at the click of a button.

Generative design fundamentally changes the design process: the designer shifts from being a performer of

tasks to being a conductor, effectively orchestrating the decision-making process of the computer. This is what generative design is all about: iteratively developing different processes and then selecting those that produce the most visually compelling results. Designers and artists no longer have to use the tools dictated by computers and powerful but prescriptive design software and can now create their own tools, which generate amazing results independently, as many of the examples in the book demonstrate.

In four simple lessons, Color, Shape, Type, and Image, users learn to influence their results and to improve them by either varying parameters—as explained in detail in each step—or by changing entire algorithms. The explanations are easy to understand, and their execution requires little or even no programming; with p5.js and its rapidly growing community, it is becoming easier to lay the groundwork for advanced technologies and trends, from 3D to augmented reality. The p5.js community is very active and constantly provides new updates and plug-ins for extending the functionality of p5.js. This book shows what can be done with this knowledge and how to dive deeper into generative design and its community. After experimenting with the sketches in the book and completing initial tasks with the online p5.js editor, users can venture forth independently and explore and expand on the creative output of the p5.js community and beyond.

With the success of *Generative Design*, which has been translated into several languages, the authors realized that the key to teaching artists and designers how to code was to empower them through simple but satisfying incremental successes. Students could then build increasing complexity into their work based on these basic principles.

The book is supplemented by a website where users can download all of the programs (sketches) for free and start experimenting immediately. After completing the four tutorials, you will be able to visualize data, create infographics, visualize text analyses, and much more.

Have fun with creative coding.
Karin and Bertram Schmidt-Fridrichs

I	Introduction	3-41
I.0	Preface	3
I.1	Contents	6
I.2	Website	8
I.3	Projects	10
P	Basic Principles	42-225
P.0	Introduction to p5.js	42
P.0.0	p5.js, JavaScript, and Processing	44
P.0.1	The development environment	46
P.0.2	Language elements	48
P.0.3	Programming beautifully	56
P.1	Color	58
P.1.0	Hello, color	60
P.1.1	Color spectrum	62
P.1.1.1	Color spectrum in a grid	62
P.1.1.2	Color spectrum in a circle	64
P.1.2	Color palettes	66
P.1.2.1	Color palettes through interpolation	66
P.1.2.2	Color palettes from images	68
P.1.2.3	Color palettes from rules	72
P.2	Shape	78
P.2.0	Hello, shape	80
P.2.1	Grid	82
P.2.1.1	Alignment in a grid	82
P.2.1.2	Movement in a grid	86
P.2.1.3	Complex modules in a grid	90
P.2.1.4	Checkboxes in a grid	94
P.2.1.5	From grid to moiré	98
P.2.2	Agents	102
P.2.2.1	Dumb agents	102
P.2.2.2	Intelligent agents	104
P.2.2.3	Shapes from agents	108
P.2.2.4	Growth structure from agents	112
P.2.2.5	Structural density from agents	116
P.2.2.6	Agents on a pendulum	120
P.2.3	Drawing	126
P.2.3.1	Drawing with animated brushes	126
P.2.3.2	Relation and distance in drawing	130
P.2.3.3	Drawing with type	132
P.2.3.4	Drawing with dynamic brushes	134
P.2.3.5	Drawing with the pen tablet	138
P.2.3.6	Drawing with complex modules	142
P.2.3.7	Drawing with multiple brushes	146

P.3 Type	150
P.3.0 Hello, type	152
P.3.1 Text	154
P.3.1.1 Writing time-based text	154
P.3.1.2 Text as blueprint	156
P.3.1.3 Text image	160
P.3.1.4 Text diagram	166
P.3.2 Font outline	170
P.3.2.1 Dissolving the font outline	170
P.3.2.2 Varying the font outline	174
P.3.2.3 Font outline from agents	178
P.3.2.4 Parallel font outlines	180
P.3.2.5 Kinetic font	184
P.4 Image	188
P.4.0 Hello, image	190
P.4.1 Image cutouts	192
P.4.1.1 Image cutouts in a grid	192
P.4.1.2 Feedback of image cutouts	196
P.4.2 Image collection	198
P.4.2.1 Collage from image collection	198
P.4.2.2 Time-based image collection	202
P.4.3 Pixel values	204
P.4.3.1 Graphics from pixel values	204
P.4.3.2 Type from pixel values	210
P.4.3.3 Real-time pixel values	214
P.4.3.4 Emojis from pixel values	220

A Appendix	226–256
A.1 Looking ahead	228
A.2 Reflection	244
A.3 Bibliography	250
A.4 The authors	252
A.5 We thank	253
A.6 Copyright	254
A.7 Farewell	256

I.2

www.generative-gestaltung.de

Generative Design: Visualize, Program, and Create with Javascript in p5.js is a tried and tested tutorial that allows people to design with p5.js. It is not necessary to type in any code: all the programs in the book, called “sketches,” can be downloaded for free from the book’s website for experimentation. This symbol ➔ indicates the name of a sketch in the download package.

The code summary page shows the main features of the code and how it affects the program output. The book explains how the parameters of the code impact the outcome and how users can interact with the sketch to develop their own visual solutions.



[I.2 Website](http://www.generative-gestaltung.de)

8

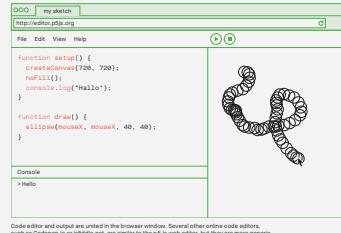
Generative Design

P.0.1 The development environment

Itching to get started? Good! Here's how to try out our programs, expand on them, or create completely new ones. Just download our code package with all the programs to the book. The link can be found at generative-gestaltung.de.

Variation 1: The p5.js Web Editor This is the easiest way to start. All you need is a browser and access to the internet.

- [1] Open the online editor of p5.js. This provides a comfortable environment in which to try something quickly.
- In the browser window, there is an area to edit on the left side. There are play and stop buttons to start and stop the program; a canvas on the right where your sketch will be rendered; and, at the bottom, the console, which will display any error messages or other text output from the program.
- [2] Upload the book's programs to the online editor, copy and paste the text, or copy one of the sketches from the book's collection.



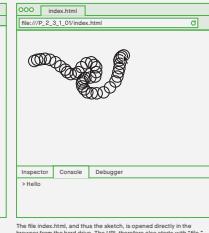
P.0 Introduction to p5.js

Variation 2: Code Editor and Browser The web editor is a great way to initially experiment with p5.js; in the long term, however, we recommend that you set up a local working environment, as described below.

- [1] Above all, a good code editor, such as Sublime Text, Atom, Brackets, or Coda, is essential.
- [2] Download our code package. The link can be found on the book's website: generative-gestaltung.de
- [3] You can now run the program by opening the index.html from one of the sketch folders (e.g., P_1_0_01) in the browser.
- [4] To modify a program, open the sketch.js file in a text editor, make some edits, and open the corresponding index.html in the browser. Any changes made in sketch.js must be saved before the browser content is updated. Reload the browser to view the changes.
- A more detailed guide to working with p5.js can be found on the p5.js website: p5js.org/get-started
- [5] Most of our code examples need to be run on a server to work. These files use external resources such as a document or external files and must be executed by a web server (the URLs of the sketch must start with "http://" or the browser will prohibit the use of these resources). Detailed explanations of how to use them can be found on the book's website.



P.0.1 The development environment



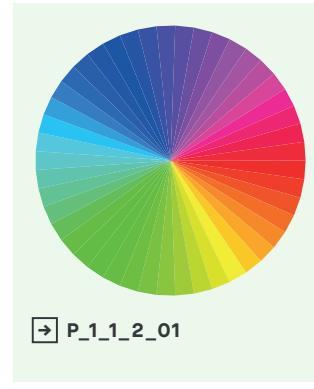
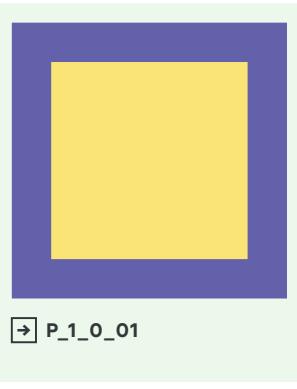
The file index.html, and thus the sketch, is opened directly in the browser from the hard drive. The URL, therefore also starts with "file://".

Hello and welcome to Generative Design. Here, you will find all of the sketches from the book and their associated code. Run the sketches directly in the browser with the p5.js-web-editor or locally on your machine by downloading the code package below.

[Download Code Package](#)

Library

P.1. Color

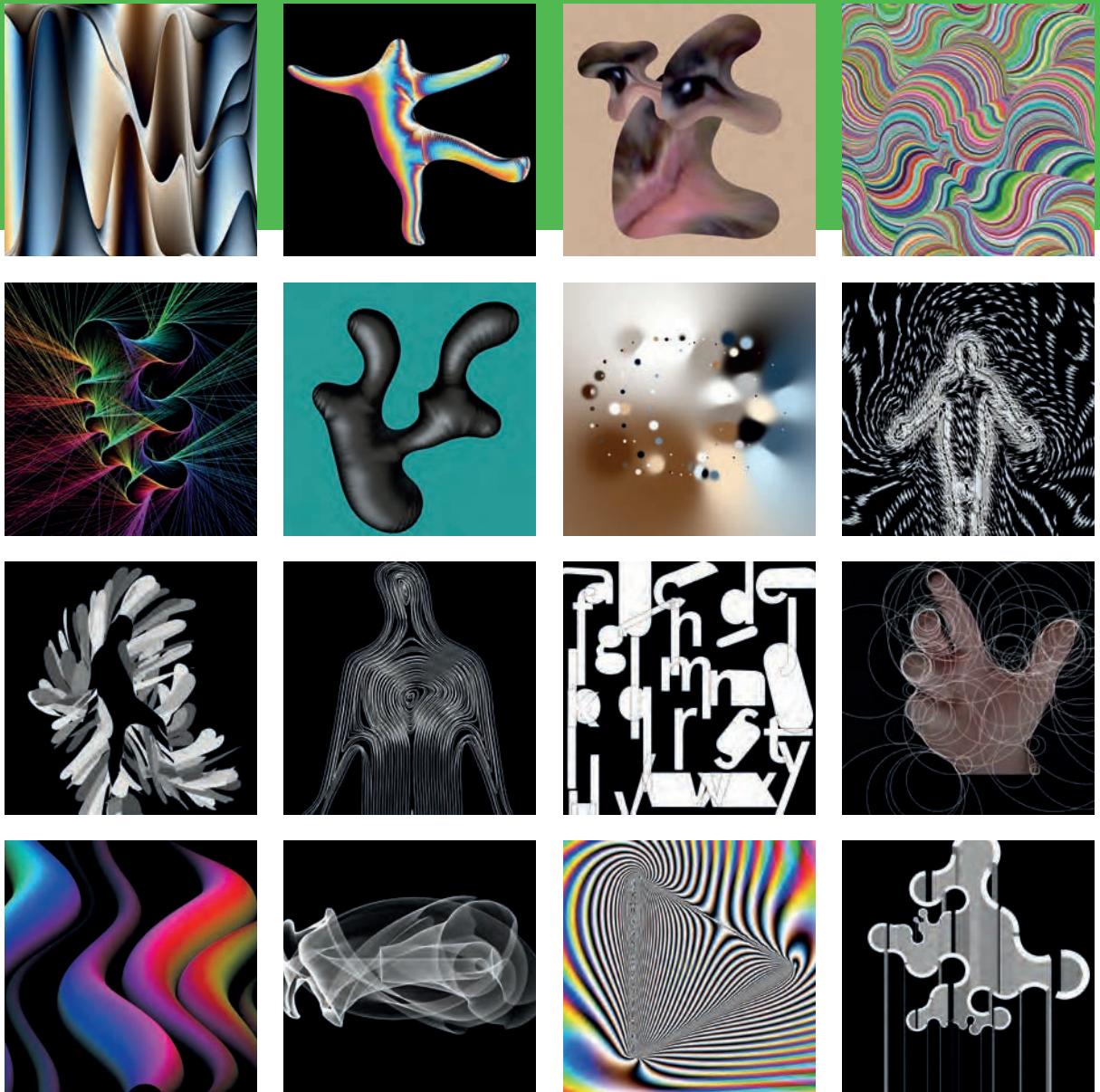


I.3

Projects

These thirteen works by various media artists, designers, and architects active in the field of generative design are intended to serve as a representative overview of the topic and a source of inspiration.

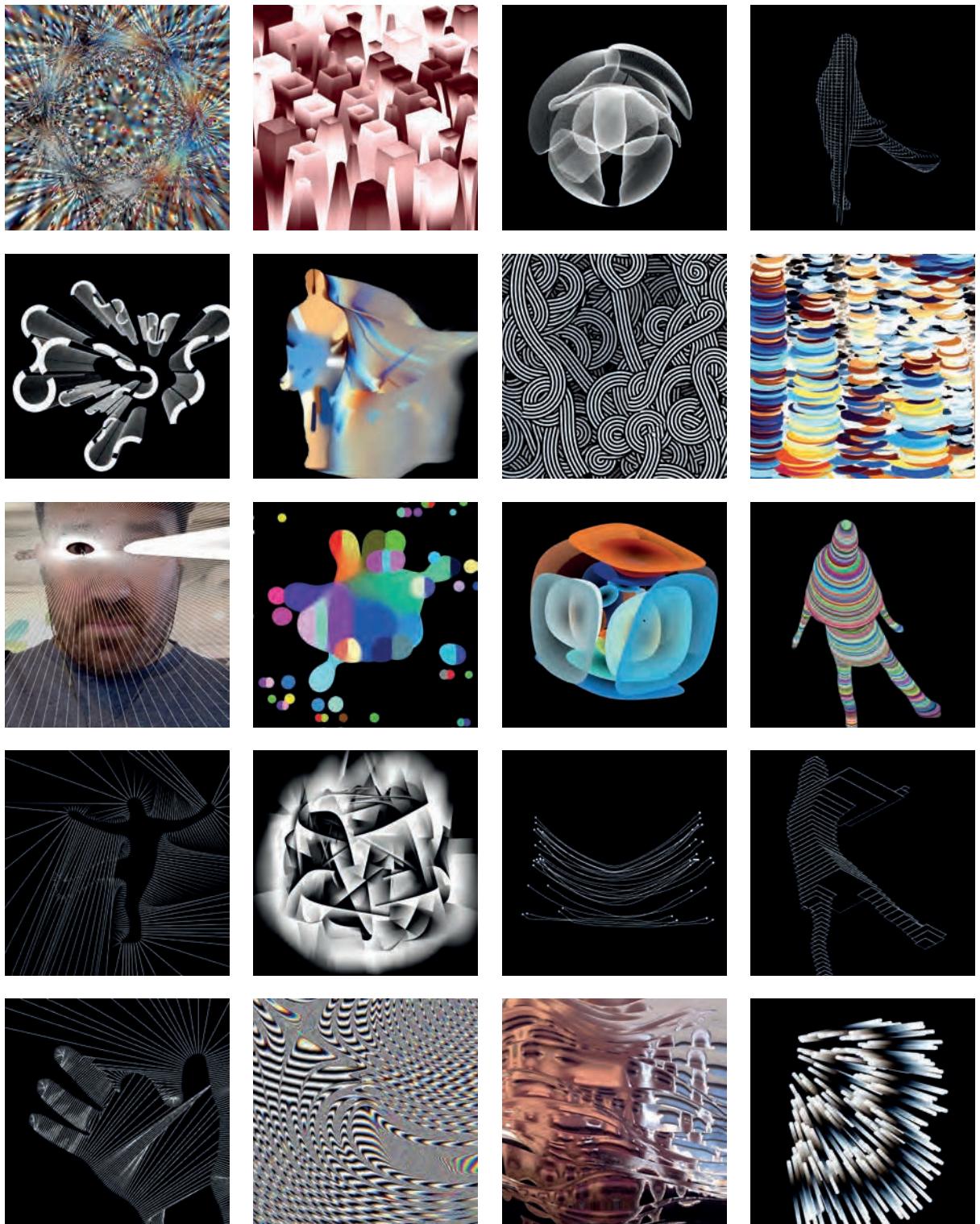
Daily Sketches is a series of short generative animations shared daily with the world by Zach Lieberman on social media for fast feedback. The sketches show the process of exploring new visual concepts using geometry, animation, gesture, form, and code. Lieberman describes his sketches of the day as follows: “A lot of times, as artists, we feel like we’re struggling to find our frequencies and what resonates with the frequencies of the world. This act of sketching is a kind of tuning of these frequencies.”





I.3 Projects

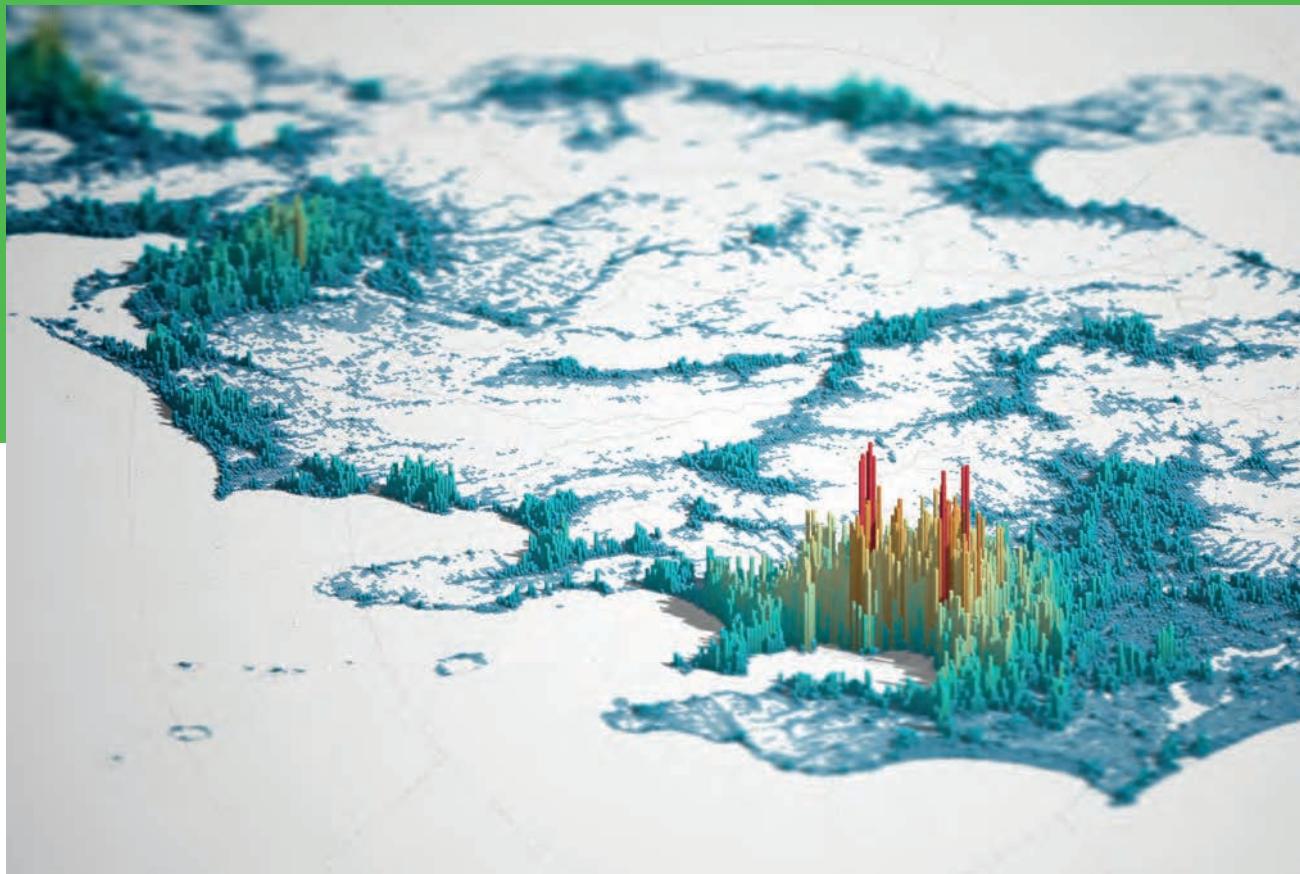
12



Design and Development
Shota Matsuda (Takram)

Photo Credits
Koki Nagahama

Planck is a web browser-based framework developed by Takram for the visualization of large geographical data sets. The framework is designed to achieve both analytical and immersive visual experience by using various techniques, such as parallel projection and depth of field. Three visualizations were created for Media Ambition Tokyo 2017, presenting data on Japan's estimated population in 2050, the languages people have tweeted in, and world air traffic.



02

2017

Planck
Takram

Interaction Design

Bjørn Karmann

Fashion Design

Julie Helles

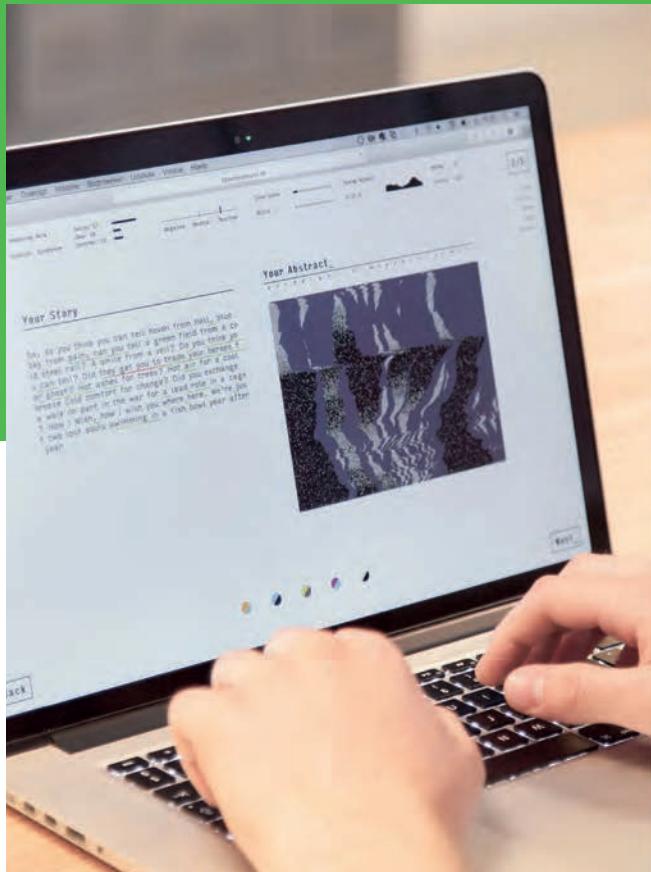
Textile Design

Kristine Boesen

Bachelor's Degree**Graduation Project**

Kolding Design School, DK

Fashion has always been a means of self-expression, but **Abstract_** takes individuality a step further by enabling a customer to write themselves into a piece of clothing. **Abstract_**'s interactive platform prompts the customer to write a personal story and uses the computer's camera to capture facial expressions. Data collected from the story, the rhythm of the keystrokes, and the customer's expression are then transformed into a visual representation and mapped onto a textile for clothing.



03

2015

Abstract_

Bjørn Karmann

Julie Helles

Kristine Boesen

04

2016

Rottlace – Björk

MIT Media Matter Group

Christoph Bader

Dominik Kolb

Prof. Neri Oxman

Stratasys Ltd.



Photo Credits
Santiago Felipe

Rottlace is part of a family of masks designed for the Icelandic singer-songwriter Björk. The design is informed by the geometric and material logic that underlies the human musculoskeletal system. The masks can be understood as “muscle textile”: bundled, continuous multimaterial structures providing formal and structural integrity as well as movement to the face and neck, resulting in an object that is designed as a synthetic whole without parts.

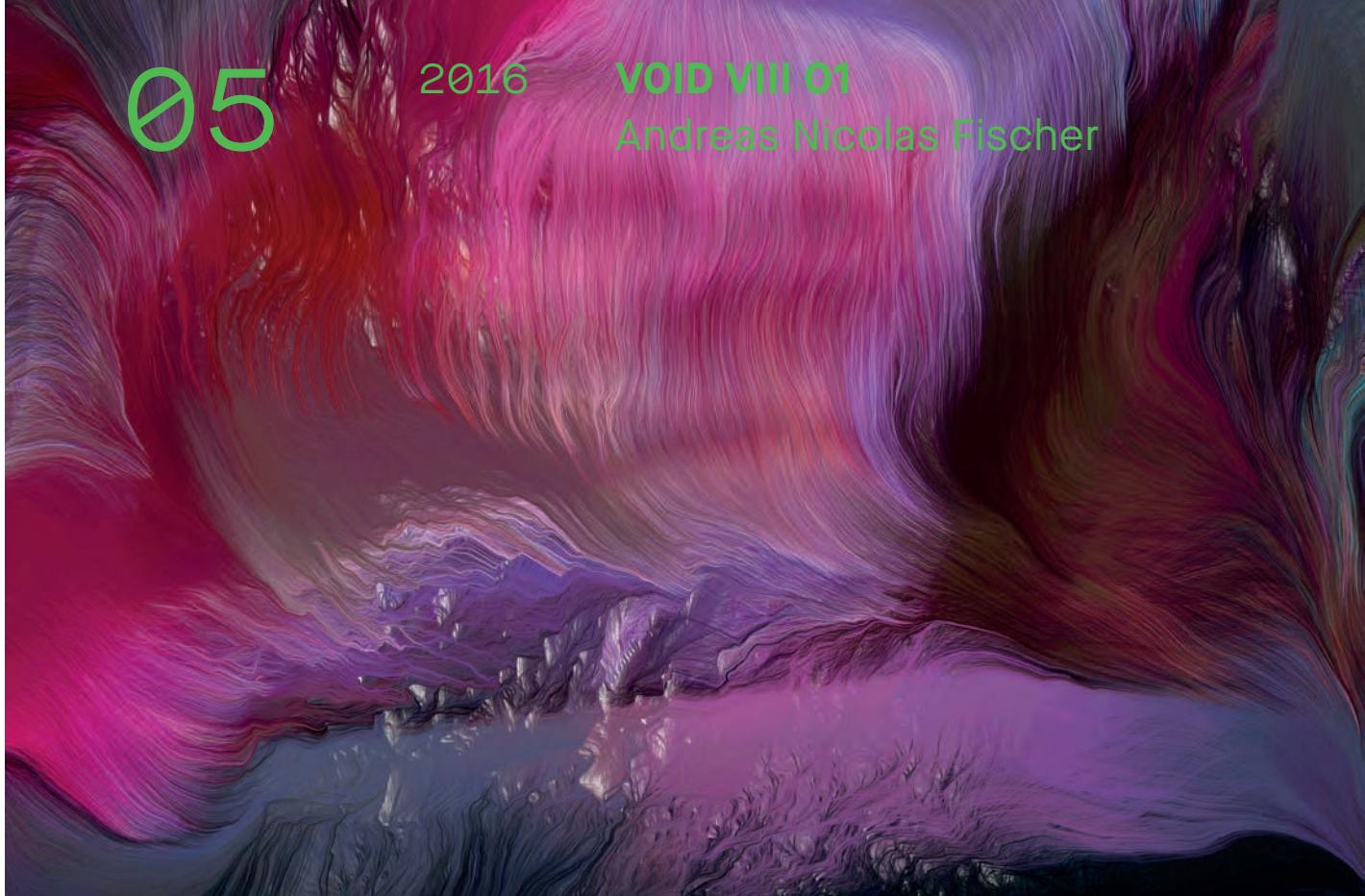


05

2016

VOID VIII 01

Andreas Nicolas Fischer



Primary Programming
Andreas Nicolas Fischer
and Benjamin Maus

Additional Programming
Abraham Pazos Solatie

VOID is a series of images created with custom generative software. A swarm of particles governed by an algorithm moves over a surface, leaving behind colorful traces. Over time, this results in an abstract composition that develops in unpredictable ways.

Commissioned by and in
collaboration with Monotype

Monotype: Type Reinvented is a series of three typographic installations that reflect how type can become “smart, dynamic, and emotional” through new digital approaches using interactivity, generative design, and data input. Popular Monotype typefaces are recontextualized and reimaged in new spaces and materials.



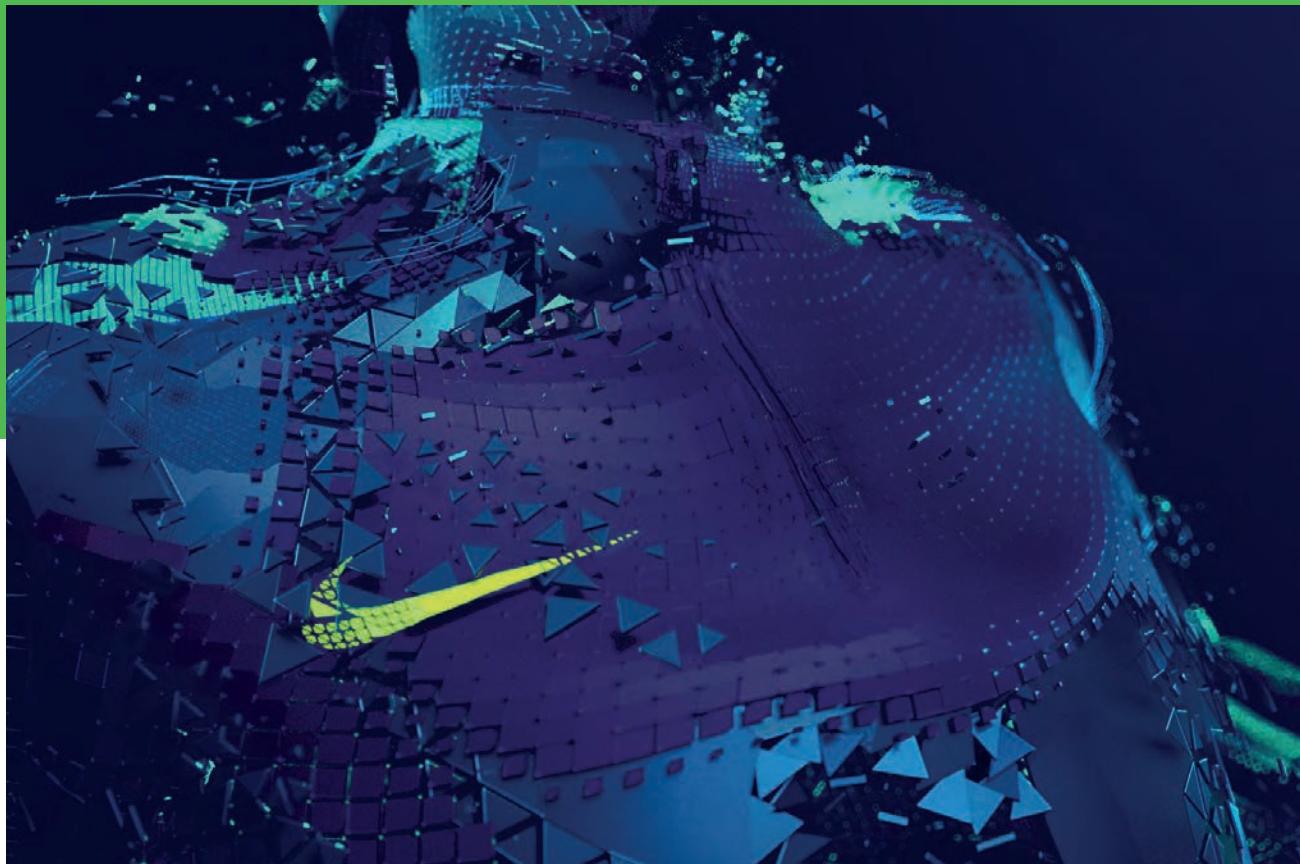
06

2017

Monotype:
Type Reinvented
Field

Client
Nike Global Football

Nike Strike Series FA16 is a series of short films and still imagery composed of inspiring 3D renderings that exemplify the power and precision of world-class athletes. Full-body scans were taken of professional football players to create specialized 3D models that manifest the true essence of these athletes. The data of their distinctive characteristics, such as speed, velocity, and physical skills, defined the visual execution of the players.

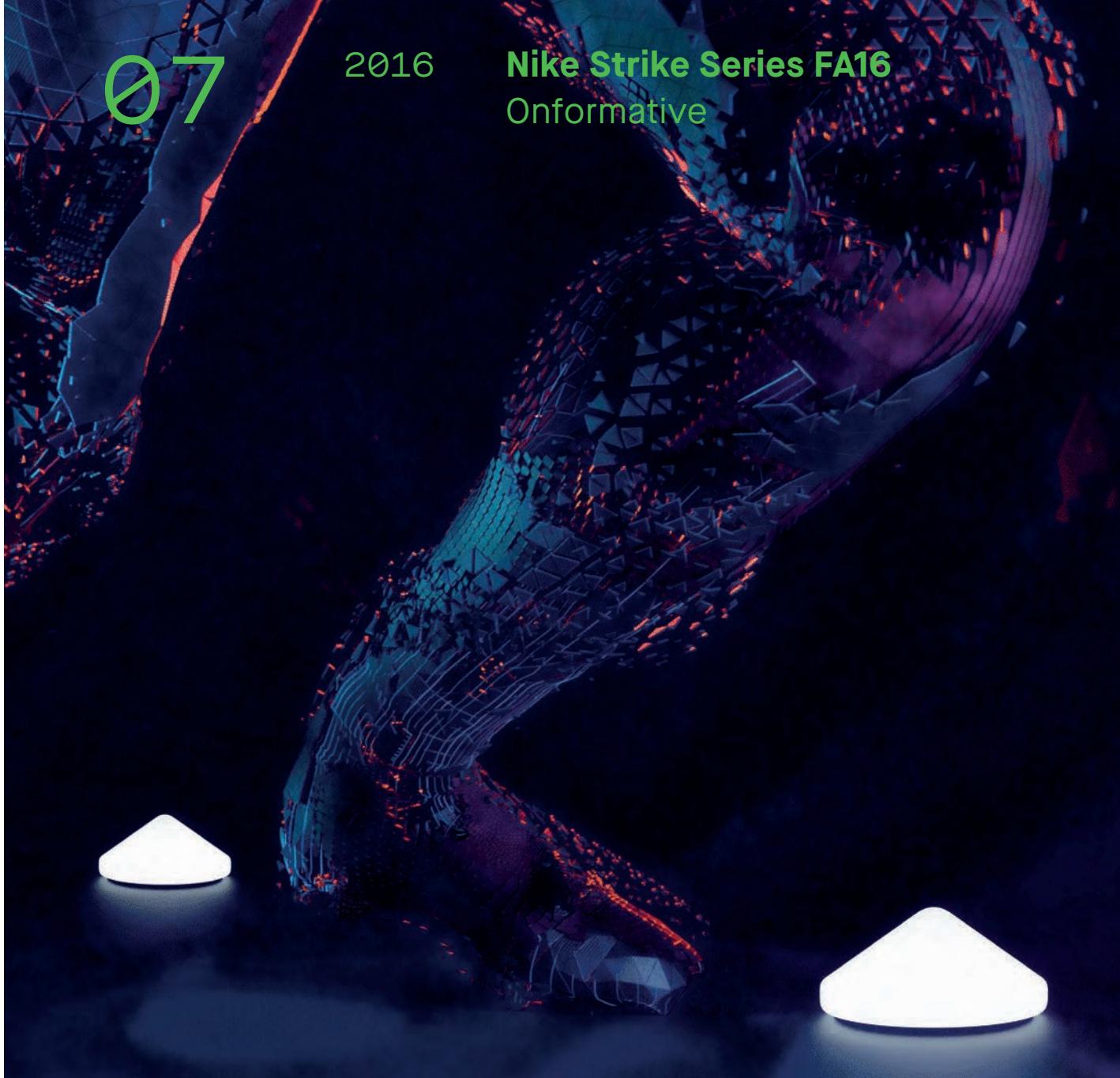


07

2016

Nike Strike Series FA16

Onformative



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Gross, Benedikt, et al. Generative Design Revised : Visualize, Program, and Create with JavaScript in P5.js, Princeton Architectural Press, 2018. ProQuest

Ebook Central, <http://ebookcentral.proquest.com/lib/nyulibrary-ebooks/detail.action?docID=5515144>.

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UCL Design Computational Lab

Design

Manuel Jimenez Garcia and
Gilles Retsin

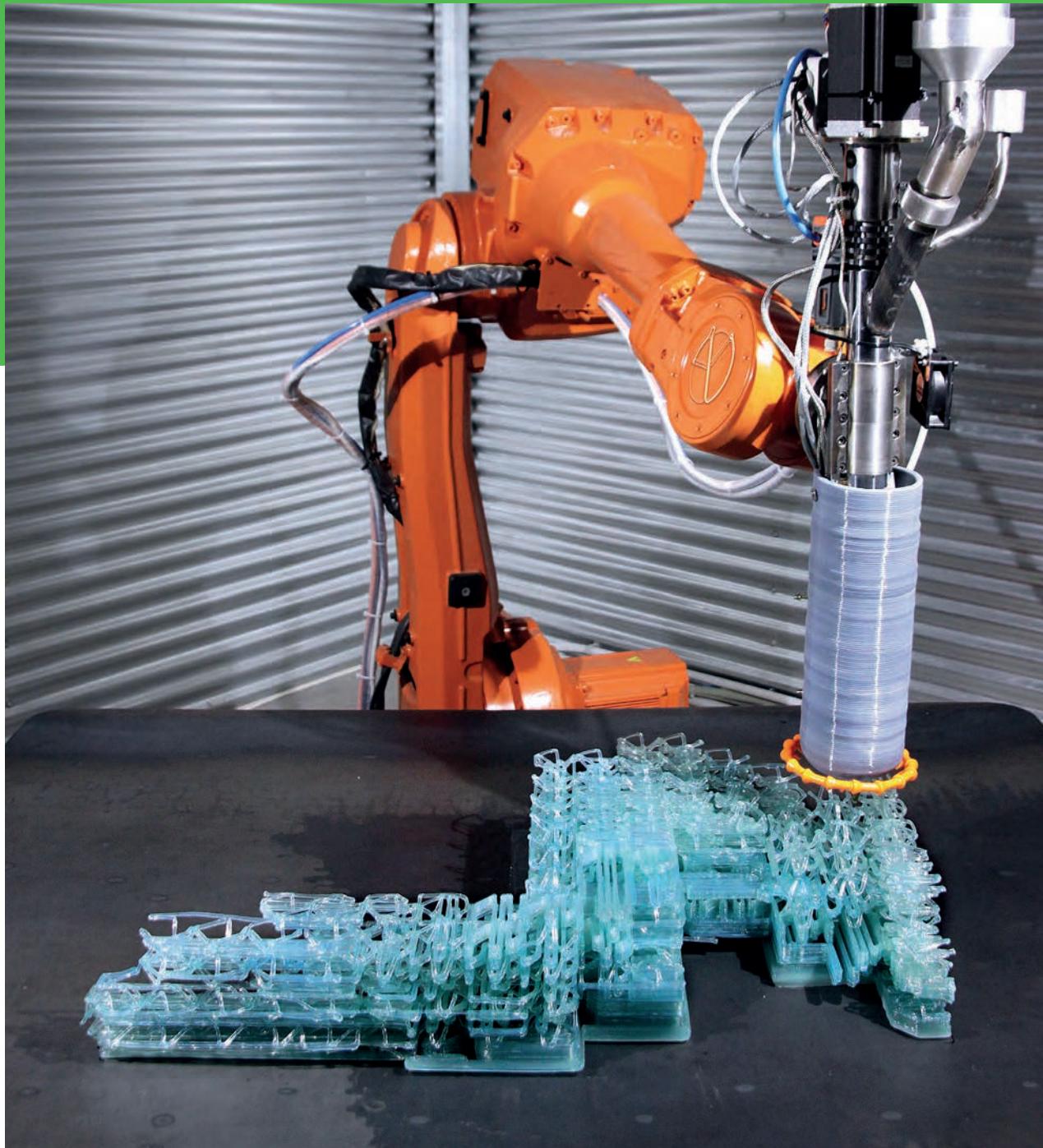
Fabrication Support

Nagami Design, Vicente Soler

Team

Manuel Jimenez Garcia,
Miguel Angel Jimenez Garcia,
Ignacio Viguera Ochoa,
Gilles Retsin, Vicente Soler

VoxelChair is the first prototype resulting from new and ongoing software innovation and development for robotic 3D printing. The software behind the VoxelChair draws on methodologies ranging from computational architecture to medical imaging to create new opportunities for designing and printing 3D compositions and structures. The creators suggest that “instead of designing the form of the chair, designers should design the behaviors and properties of the material directly.”



08

2016

VoxelChair v.1.0

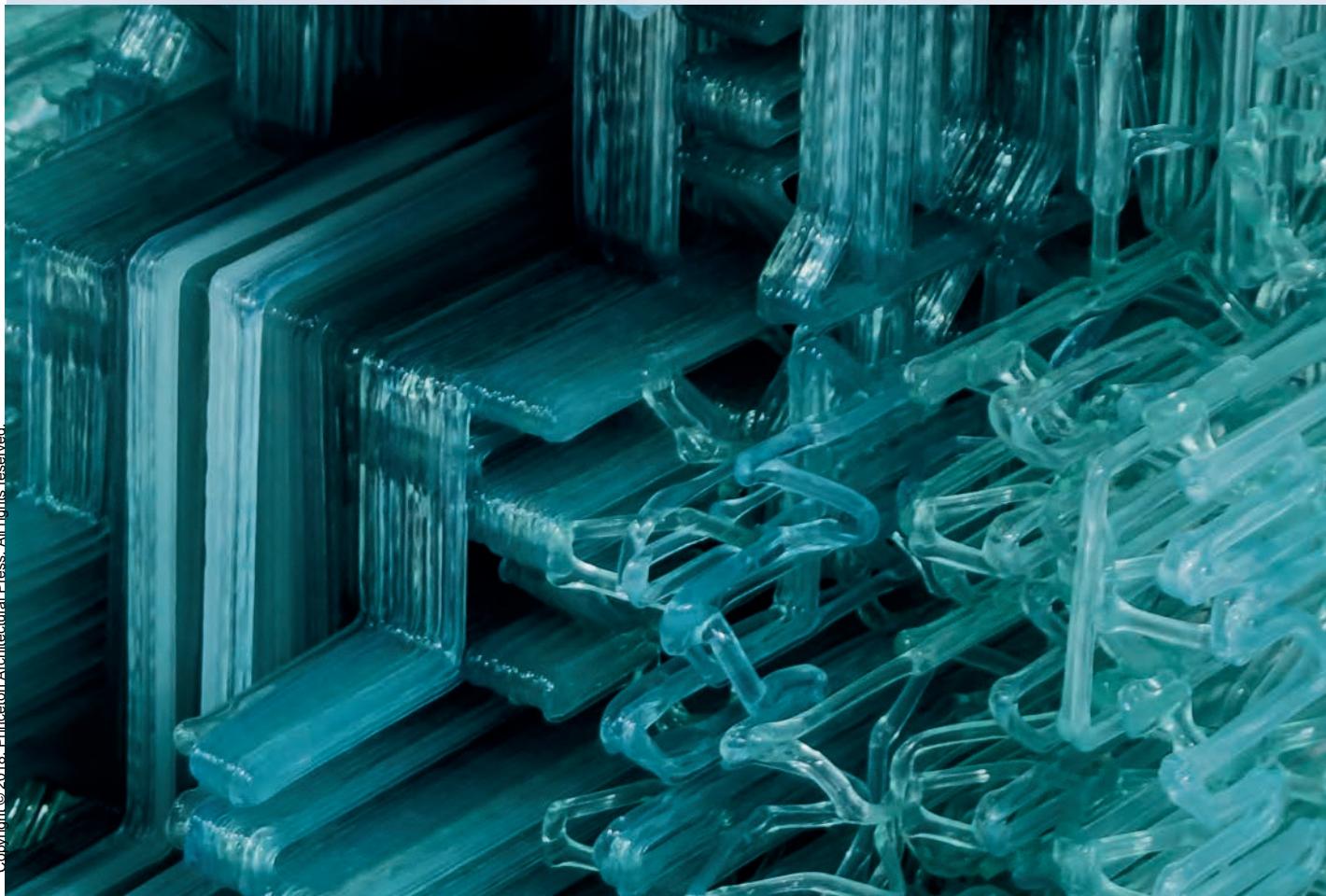
Manuel Jimenez García

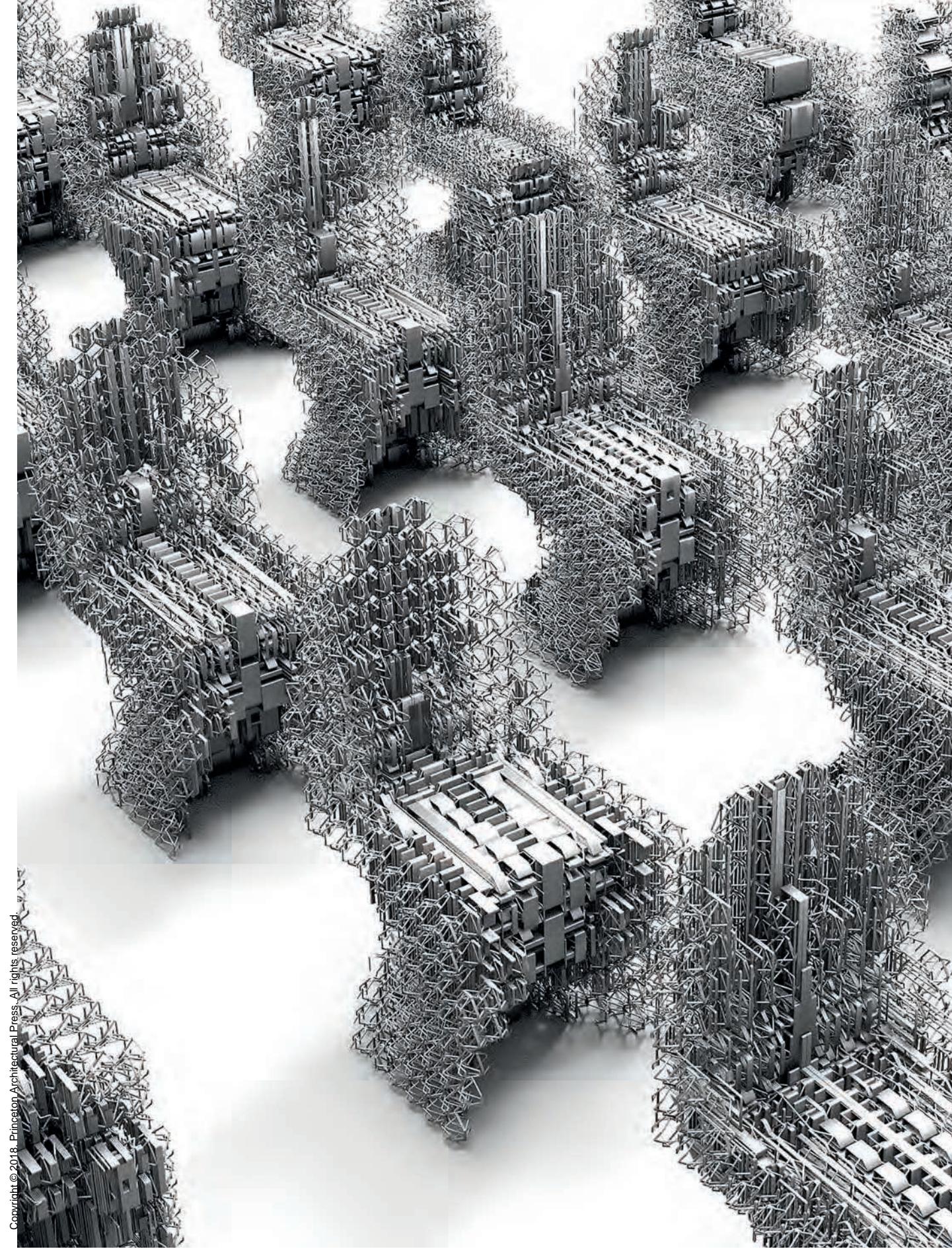
Gilles Retsin

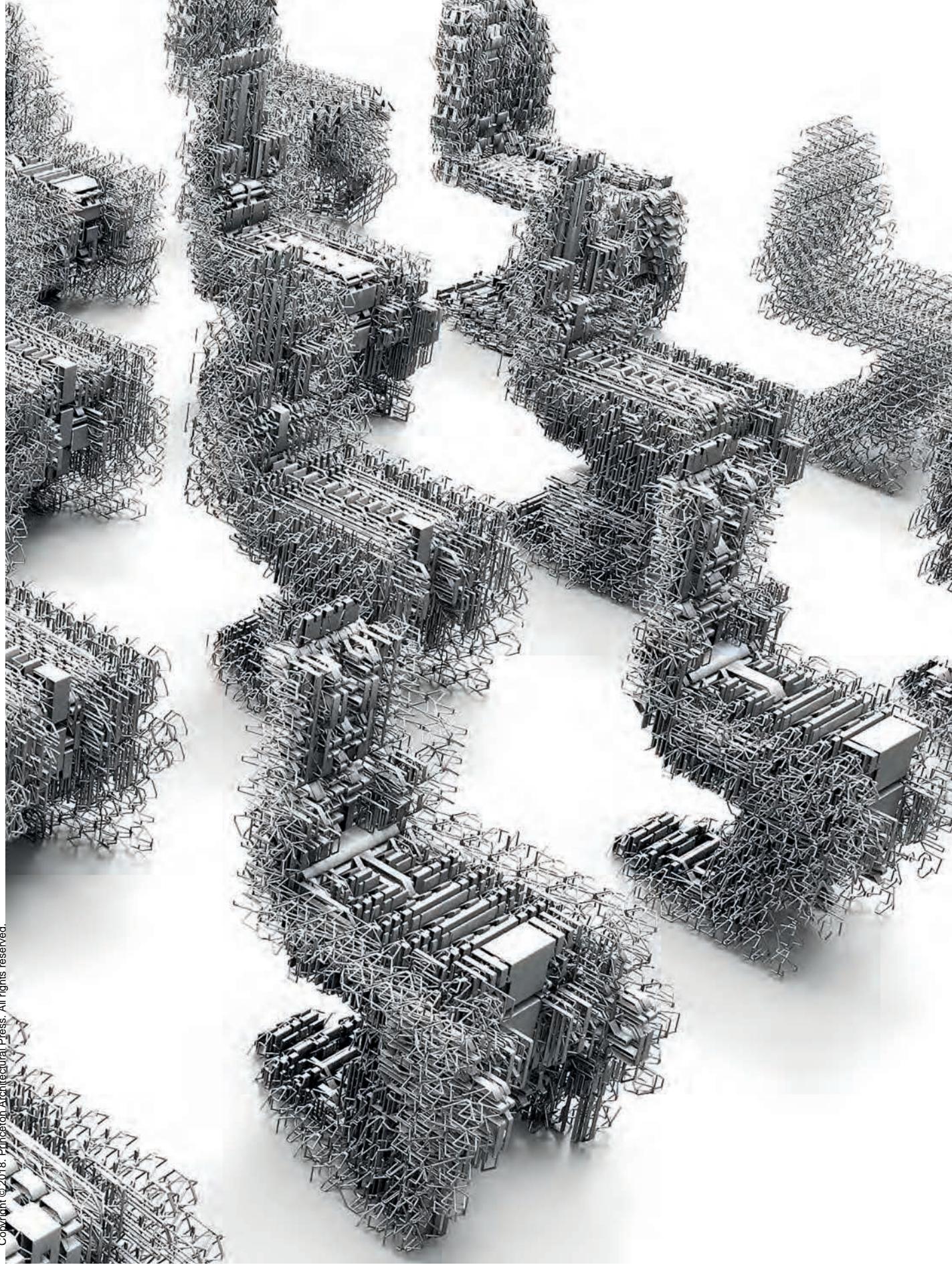
Nagami Design

Vicente Soler

UCL Design Computational Lab







Client
Dolby Laboratories

Collide is an art installation that transforms recorded motion data into abstract graphics and sound. Surreal imagery and an engaging soundscape create an immersive space that captures the essence of motion, color, and sound to represent the experience of “letting go.” Inspired by the phenomenon of synesthesia, the union of the senses, Collide creates a new language by combining original chamber music and painterly visuals.



09

2016

**Collide:
synaesthetic art installation
Onformative**



10

2017

Block Bills

Matthias Dörfelt

8330000000

1 4 8 9 1 4 3 2 0 6

Archival digital print on paper, 3.3 x 5.9 in.

Block Bills is a series of sixty-four generated banknotes representing blocks in a Bitcoin blockchain. A visual system defined by the artist Matthias Dörfelt uses both randomness and the unique aspects of each block in the selected blockchain to affect every aspect of each bill in the series. The bills are allusions to Dörfelt's ambivalence toward Bitcoin and cryptocurrencies; they bring these otherwise intangible and invisible constructions into a visually and emotionally tangible context.



Map and Road Network Data
OpenStreetMap

Routing Engine
GraphHopper

Roads to Rome is a data visualization project that explores the idiom “All roads lead to Rome.” The outcome is both information visualization and data art and unveils mobility patterns at a very large scale. The visualizations were created using routing algorithms on existing street infrastructure (OpenStreetMap) from the city to continent scale. In addition to their aesthetic quality, the resulting images bring insights into the ways in which road infrastructures reflect regional, political, and geographical situations.



11

2015

Roads to Rome

Benedikt Groß

Philipp Schmitt

Raphael Reimann

moovel lab

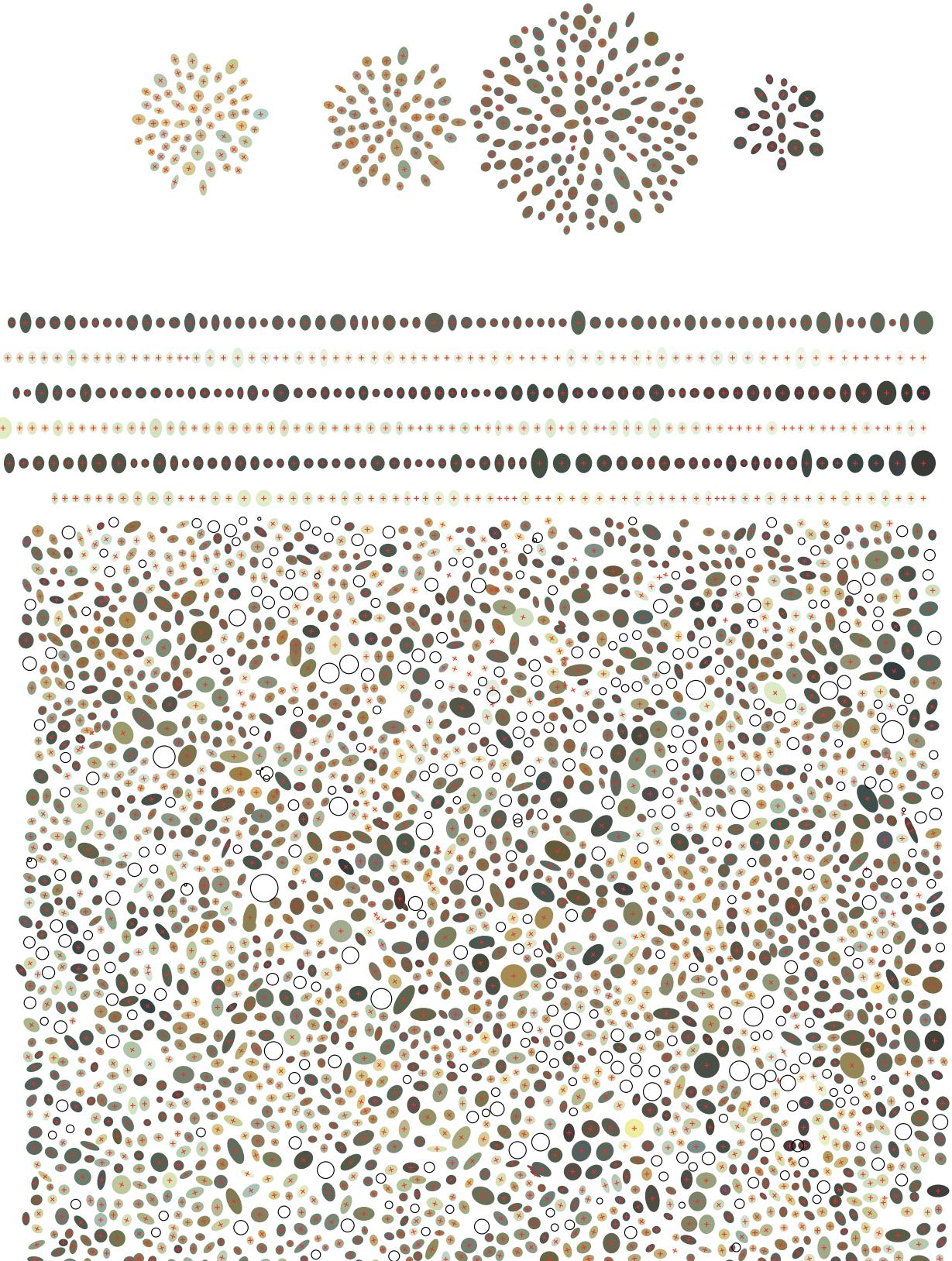
12

2015

Jller

Benjamin Maus

Prokop Bartoníček



**Additional Mechanics
and Electronics**
Tomislav Arnaudov

Developed at
pebe/lab (Prague)
and FELD (Berlin)

Jller is part of an ongoing research project in the fields of industrial automation and historical geology. This apparatus uses computer vision to sort pebbles from a specific river by their geologic age. The installation displays natural geological history in an automated sorting process that constitutes a performance in its own right.









Font Design
Marco Berends

Machine Learning MSc Thesis
Ankita Agrawal, Institute
for Artificial Intelligence,
HS Ravensburg-Weingarten

Funding and Support
Kickstarter Backers

Aerial Imagery
USGS (United States
Geological Survey)

Contrary to popular belief, much of the world has yet to be fully mapped. Every day, satellites orbit the earth, taking countless pictures, yet there is very limited knowledge about what exactly was captured among the unique things in these pictures and how they can be found and classified. **Aerial Bold**—a planet-wide letter search mission—questions this and draws attention to this potential.

