3-DJ

SAMPLING AS DESIGN

by

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Honors Bachelor of Architectural Studies
University of Waterloo, 2011

Submitted to the Department of Architecture on January 15, 2015
in partial fulfillment of the requirements for the degree of

MASTER OF ARCHITECTURE

at the

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3-DJ

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ABSTRACT

3D Sampling is introduced as a new spatial craft that can be applied to architectural design, akin to how sampling is applied in the field of electronic music. Through the development of 3-DJ, a prototype design software, I propose a design methodology that enables a designer to evaluate, remix, and implement qualities identified from 3D scans to generate architectural features that would otherwise be impossible using conventional computer modeling methods. I demonstrate, through the production of physical prototypes and empirical testing, that material qualities derived from the geometry of the 3D scan can be isolated and enhanced. Finally, I show how 3D Sampling can be applied in the design process through three case studies, involving the design of optical, haptic, and camouflage material qualities and performances, suggestive of applications at landscape, architectural, and product design scales.

Figure 1 Haptic rustication : CNC Milled Mahogany

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And finally special thanks to my parents, Vijay and Susan Patel, without whom I would never have had the chance to pursue my lifelong dream of studying at MIT.

Figure 2 Project Documentation & Indexing

CONTENTS

Glossary of Terms

123D CATCH
a free app that lets you create 3D scans of virtually any object
-
3-D PRINTING
a printing process that involves making three-dimensional objects from digital models by applying many thin layers of quick-drying material on top of each other
-
3-D SCANNER
a device that analyses a real-world object or environment to collect data on its shape and possibly its appearance; this data can then be used to construct digital three-dimensional models
-
3-D SAMPLING
a method for design that uses the data captured from 3-D scanners
-
3-D TEXTURE MAPPING
the projection of a 2.5 texture onto a surface through stretching and deformation about the normals of the curves describing the surface
-
AUTHENTICITY
not false or copied; genuine; real:
-
ANALYZE
to examine methodically by separating into parts and studying their interrelations
-
ANALYZE (3-DJ)
the process of isolating and selecting desirable qualties in a sample
-
ANALOG
non-digital data
-
AMATEUR
with the invention of any new medium, everyone is by definition a beginner
-
ALGORITHM
a system created to achieve a desired result or resolve a particular problem.
-
AMPLITUDE
the measure of a signal, such as an acoustic signal's volume or the degree of concurrent in an electrical communication
-
APPROPRIATION
the act of setting apart or taking for one's own use
-
ATLAS
a visual form of knowledge: a gathering of geographical maps in a volume, and more generally, a collection of multiplicity of things gathered based on elective affinities
-
BANDWIDTH
a collection or group of frequencies
-
BANK
a connected set of objects or filters that combine to produce one signal
-
BUFFER
a block of memory for recording or editing information before it is saved in a more lasting manner
-
CAMOUFLAGE
a device or stratagem used for concealment
-
CLOUD ATLAS
a pictorial key to the nomenclature of clouds
-
CLOUDY BAY
a hidden and quiet paradise nestled inside the South Bruny National Park, in the Australian state of Tasmania
-
CLOUD GENERATOR
a 3D modeling app, written in the Processing language, for manipulating the pointclouds generated by 3-D scanning
-
COPY
an imitation, reproduction, or transcript of an original
-
CHORUSING
combining a time-delayed and original signal
-
CUT (3-DJ)
the process of extracting a bracketed selection of data from a point cloud
-
CUT & PASTE
a process in which data is moved from one part of a composition and inserted elsewhere
-
CROSS-FADE LOOPING
a section of data at the start of a loop combines with data at the loop's end resulting in an even changeover
-
CRAFT
to make or construct with care or ingenuity
-
DELANAY TRIANGULATION
a particular way of joining a set of points to make a triangular mesh
-
EMPIRICAL
derived from or guided by experience or experiment; to test through trial and error
-
EXPLICIT KNOWLEDGE
is knowledge that has been articulated, codified, and stored in certain media
-
FILTER
a process through which a substance is passed to remove suspended impurities or to recover solids
-
FILTER (MUSIC)
an instrument that removes specific frequencies from a signal's tone
-
HAPTIC
relating to or based on the sense of touch
-
INTERFACE
the link between multiple devices
-
LAPACIAN SMOOTHING
an algorithm to smooth a polygonal mesh, whereby for each vertex in the mesh, a new position is chosen based on the position of neighbors and the vertex is moved there
-
LA DI DA DI
the fifth-most sampled song of all time; made in 1984 by hip-hop the hip Slick Rick and Doug E. Fresh
-
LIDAR
a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light
-
LOOP (3-DJ)
the repetition and propagation of samples
-

LOOP (MUSIC)
a piece of material that plays over and over; in a sequencer, a loop repeats a musical phrase; in a sampler, loops are used to allow samples of finite length to be sustained indefinitely
-
MASH-UP
a creative combination or mixing of content from different sources
-
MEDIUM
a means of effecting or conveying something
-
MESH
a collection of vertices, edges and faces that defines the shape of a polyhedral object in 3D computer graphics and solid modeling
-
MIX
to combine into one mass, collection, or assemblage, generally with a thorough blending of the constituents
-
MIX (3-DJ)
the superposition, mapping, and juxtaposition of samples
-
MIXER
a hardware or software device that combines multiple audio signals into one destination signal
-
MONOME
a family of minimalist interface devices for computers, which do not produce any sound on their own; they must be connected to a computer via USB, in which an app affords use to the device
-
MONITOR
to observe, record, or detect an operation or condition with instruments that have no effect upon the operation or condition
-
NOISE REDUCTION
a system for reducing analogue tape noise or for reducing the level of hiss present in a recording
-
NORMALIZE
increases a waveform's level to its highest before it becomes distorted
-
OYSTER
any of the various marine bivalve mollusks that have a rough irregular shell closed by a single adductor muscle; something that is or can be readily made to serve one's personal ends
-
PROCEDURAL TEXTURE
a computer-generated image created using an algorithm intended to create a realistic representation of natural elements
-
PHOTOGRAMMETRY
the science of making measurements from photographs, especially for recovering the exact positions of surface points
-
POINT-CLOUD
a set of data points in a coordinate system, usually defined by X, Y, and Z coordinates, and often are intended to represent the external surface of an object
-
PROCESSING
an open-source programming language, initially developed to teach computer programming fundamentals within a visual context,
-
SAMPLE (MUSIC)
a sound or short piece of audio stored digitally in a computer; the word sample may refer to either a single moment in a digital audio stream or a complete sound or digital audio stream made up of a collection of individual samples
-
REAL-TIME
happening simultaneously with an individual's actions
-
RHINOCEROS
one of the standard 3D modeling tools used by designers and architects to create, edit, analyze, document, render, animate, and translate NURBS curves, surfaces, and solids
-
SAMPLING (3-DJ)
a short extract of point cloud data generated from 3-D scanning
-
SIMULATION
imitation or enactment, as of something anticipated or in testing
-
STEREOLITHOGRAPHY
a 3D printing technology used for producing by curing a photo-reactive resin with a UV laser or another similar power source
-
TACIT KNOWLEDGE
unwritten, unspoken, and hidden knowledge held by every human being, based on emotions, experiences, insights, intuition, observations and internalized information
-
TOPOLOGY
the way in which constituent parts are interrelated or arranged
-
TRANSPARENCY
having the property of transmitting rays of light through its substance so that bodies situated beyond or behind can be distinctly seen
-
WAVEFORM
an electronically-produced signal
-
ZPRINTING
a 3D printing technology, where an inkjet-like printing head moves across a bed of powder, selectively depositing a liquid binding material in the shape of the section, a fresh layer of powder is spread across the top of the model, and the process is repeated until the part is complete
-
-

Figure 3 Rock formation, 3-D captures in Tasmania (Photograph)

Figure 4 Haptic Rustication (Detail)

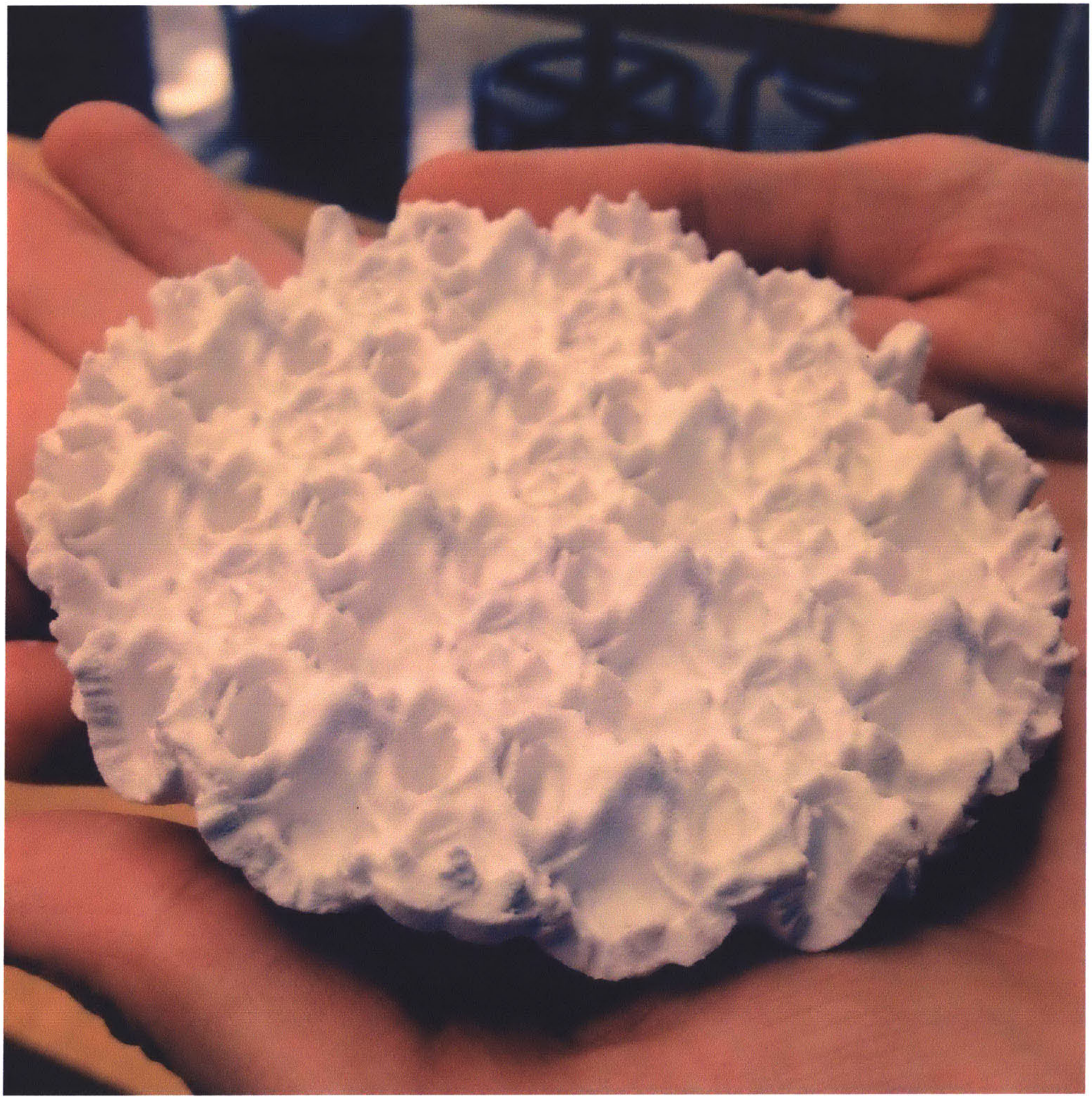

Figure 05 3-D Printed Specimen

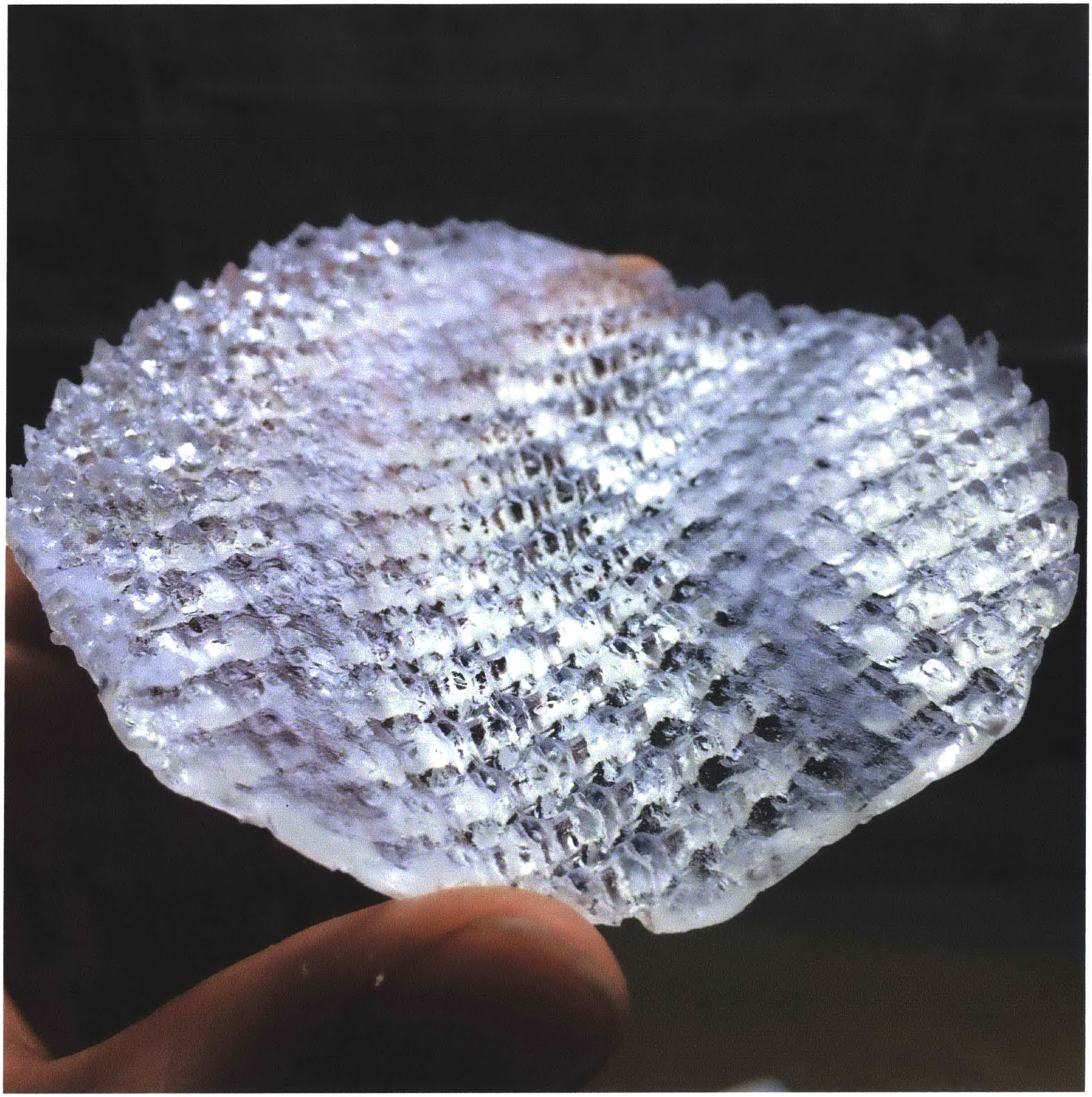

Figure 06 3-D Printed Optical Specimen (Steriolithography)

Figure 07 Fabrication (in progress)

Figure 08 Fabrication (in Progress)

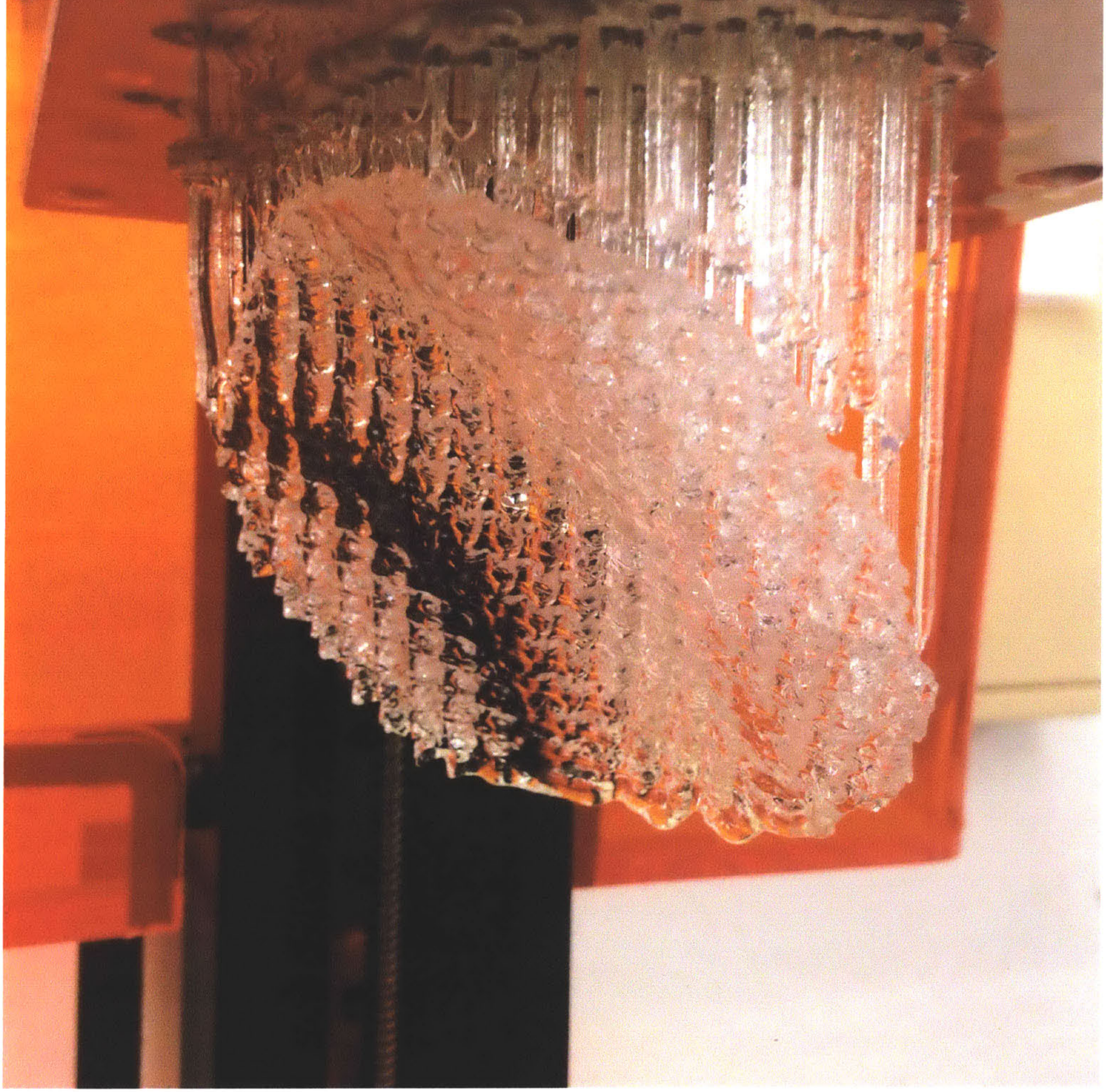

Figure 09 Steriolithography

Figure 10 Photographic documentation

Figure 11 Iterative testing

INTRODUCTION

This thesis is a part of a revolution in architectural sensibilities. Within arm's reach, hand-held 3-D scanning technologies, such as photogrammetry, enable anyone with a smart-phone to digitally capture physical objects from the real world as point cloud data. For architects, 3-D scanning is an exciting new medium which allows a user to sample vast quantities of field data describing the geometry and properties of real-world objects and environments which can be applied in the process of design. While the computer has increased the efficiency of drawing and has provided architects with the means to produce shapes and forms far too complex to attempt via analogue means, computation has also negated subjective forms of experience that have traditionally been applied in the field of design. 3-D scanning offers to bring the processes of digital modelling and physical making closer together.

Presently, the tools and procedures provided by modern Computer Aided Design (CAD) systems work gradually from abstraction to definition. The rules of computer modeling software precede and constrain the form of the objects generated. However, 3-D scans permit us to reverse this methodology, making detailed digital replicas of physical objects the starting point for design. While the use of 3-D printing is becoming established practice in architectural design, 3-D scanning, its natural complement, remains relatively obscure.

This thesis responds by developing a conceptual and technical framework around 3-D scanning; a new design methodology, akin to music sampling, which enables a designer to evaluate, remix, and use the best features from real world samples to generate architectural features that would otherwise be impossible using conventional computer modeling methods. When paired with 3-D printing technologies, this offers the potential for new opportunities within the practice computer modeling.

An architect and researcher, my role becomes that of design enabler; curating the experience of applying 3-D scans within the design process by tackling the technical challenges involved with manipulating 3-D data: in particular, the challenge of controlling the complexities of point clouds, which may consist of millions of data points. This research will drive-test a method that lets users design around the qualities, performances, and geometry of materials, while connecting subjective forms of knowledge to the otherwise explicitly-defined framework of computational design.

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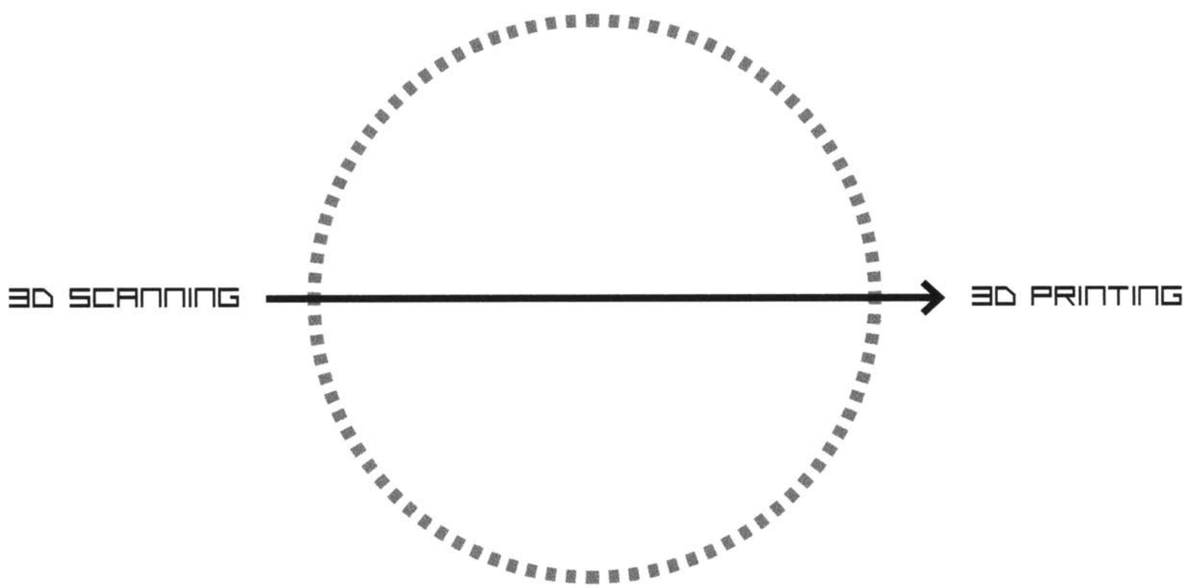

3D SCANNING
3D PRINTING

3-D SCANNING

3-D scanners collect data about the geometry and color of real-world objects. Although these devices employ many technologies and assume many forms, they all measure and create replicas of physical spaces, generating output lists of geo-spatial coordinates and color values called point clouds. 3-D laser scanning was first invented in the 1960s, but the technology was not widely adapted in engineering until the late 1990s. With the 2010 release of "Microsoft Kinect" – a line of motion-sensing input devices developed for the X-BOX video game console – 3-D scanning entered into everyday use.

Recent developments in hand-held 3-D scanning for smart-devices will make the technology accessible to a wider pool of users. Google's "Project Tango" promises to further promote 3-D scanning as a contemporary medium, somewhat like photography or video, which produces copies indistinguishable from the originals. "Project Tango" involves the development of a series of smart-phone and tablet devices able to capture spatial data about the real world using embedded infrared depth sensors. When paired with existing communication technologies, crowd-sourced 3-D scan data could facilitate the construction of a new virtual territory; mirroring the real world and having profound and unforeseen repercussions on the fields of design, architecture, and urban planning.

PHOTOGRAMMETRY

Photogrammetry, one of the earliest 3-D scanning technologies, is the science of taking measurements from photographs. It is used in several fields – archeology and forensics, for instance – but its most world-shaping application so far lies in cartography. In this context, photogrammetry has historically meant aerial photogrammetry, where multiple overlapping photos of the ground are taken along the flight-path of a plane mounted with a camera. Combining methods from optics and projective geometry these photographs are used to calculate exact coordinate positions which are translated into 2-D topographical maps.

Figure 10 Dwelling from Northern Kenya, captured using 123d catch.

Figure 12 OYSTERS, Generated from *123d CATCH*

More recently, photogrammetry has come to refer to close-range photogrammetry, where the output is no longer terrain models or topographical maps, but instead fully textured 3-D models. 123d Catch, developed by AutoDesk, is one example of close-range photogrammetry which transforms everyday cameras into devices that can map and digitize the physical world. 123d Catch is a free online and mobile platform that generates fully-textured 3-D models from photographs that users upload to AutoDesk's server. 123d Catch also has an online archive which enables users to share and download their generated models, thus germinating a community around 3-D scanning. Close-range photogrammetry could challenge the way architects produce recordings of field conditions. Modeling is no longer a painstaking process of measuring – hereafter reserved only for exceptional cases – but becomes convenient and immediate. The model ceases to be an abstraction, as older models were, but contains all the true-to-life details from the photographs used in generation. In contrast to conventional site sketches and mappings, inherently limited by pen and paper, 3D scanning renders the scale and material of reproduction irrelevant.

Hand-held 3-D scanning technologies such as photogrammetry allow anyone with a smartphone to digitally capture physical objects and environments from the real world as point cloud data. When combined with technologies such as 3-D printing or augmented reality, the accessibility of 3-D scanning offers a unique capacity for manipulating, appropriating, and experiencing the city in new way. How will 3-D photogrammetry transform the process of design?

Figure 15 Cloudy Bay, Tasmania

Figure 16

Cloudy Bay, Tasmania

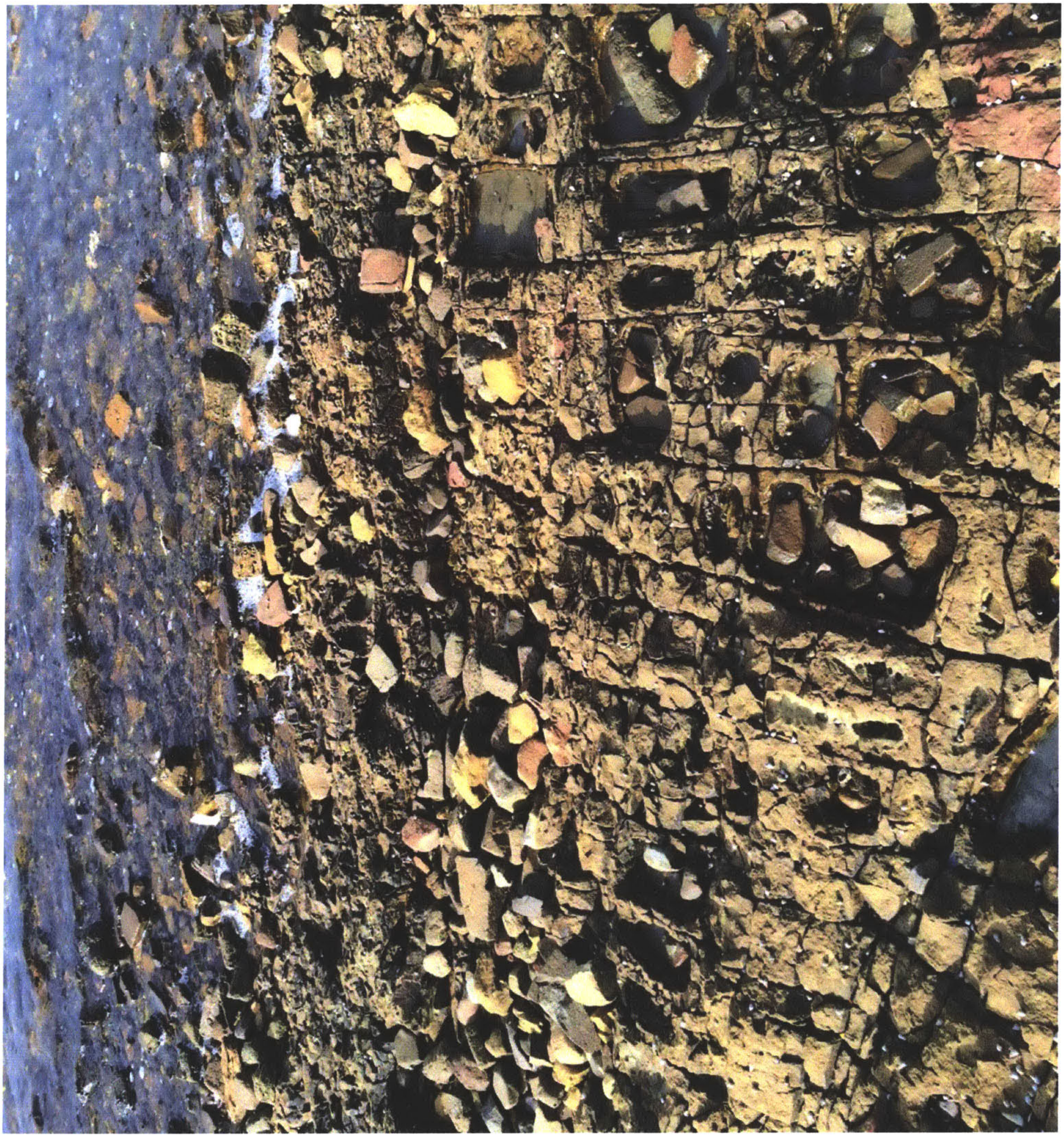
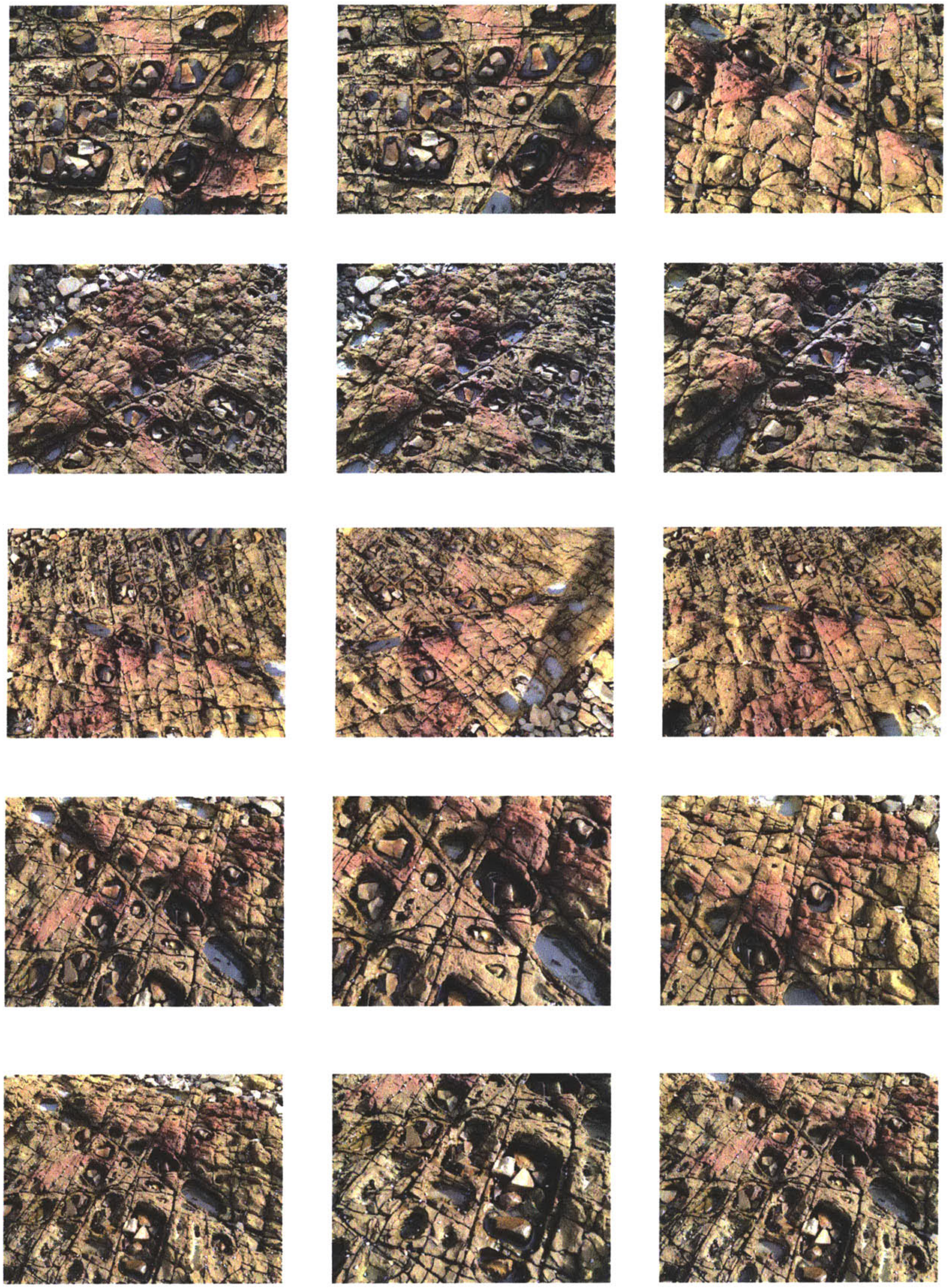


Figure 17 Rock Formation, Cloudy Bay, Tasmania

Figure 18 Rock Formation, Cloudy Bay, Tasmania



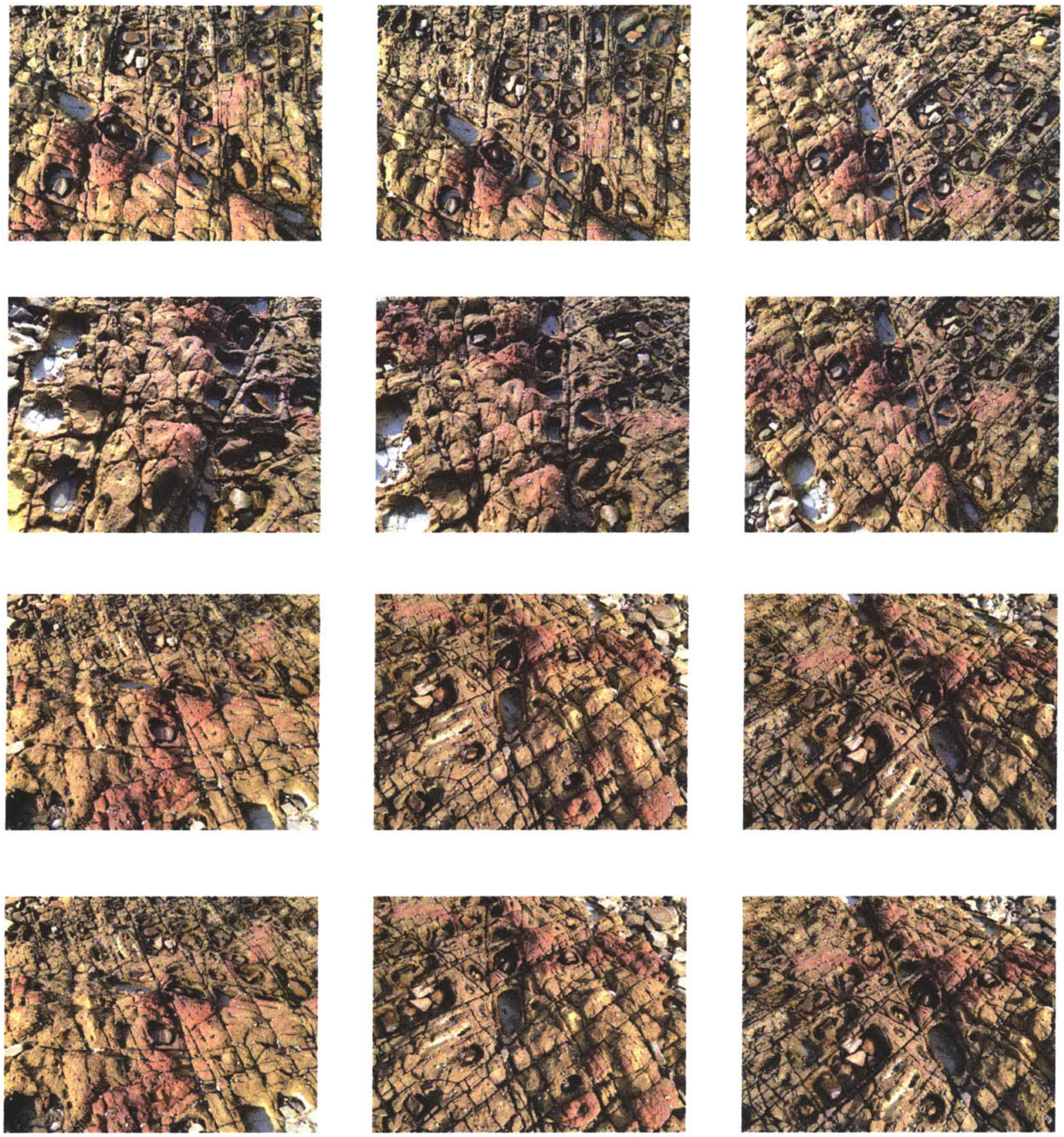


Figure 20 123d catch generates 3-D models from photographs .

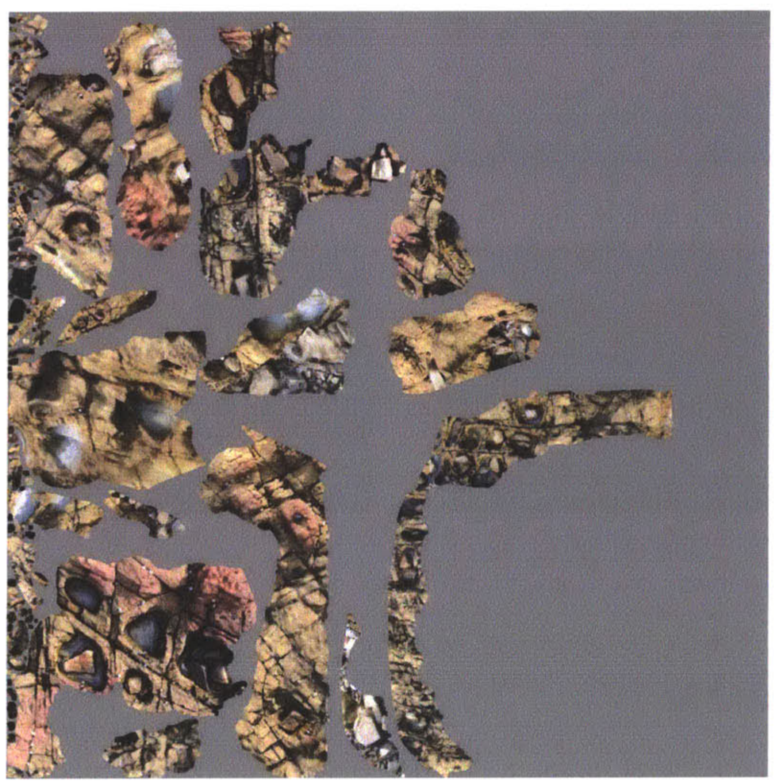


Figure 19

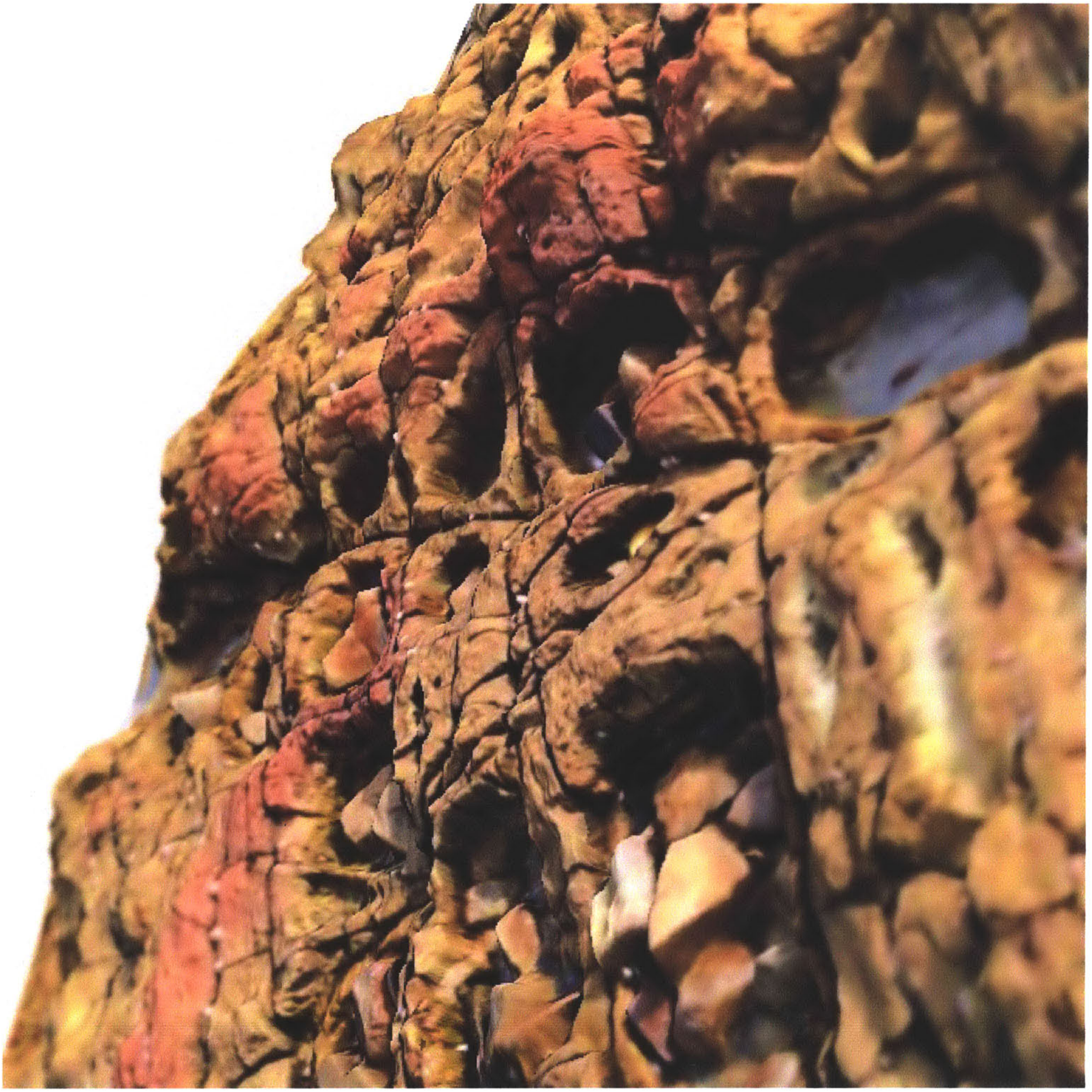


Figure 20 Model of rock formation generated from 123d catch.

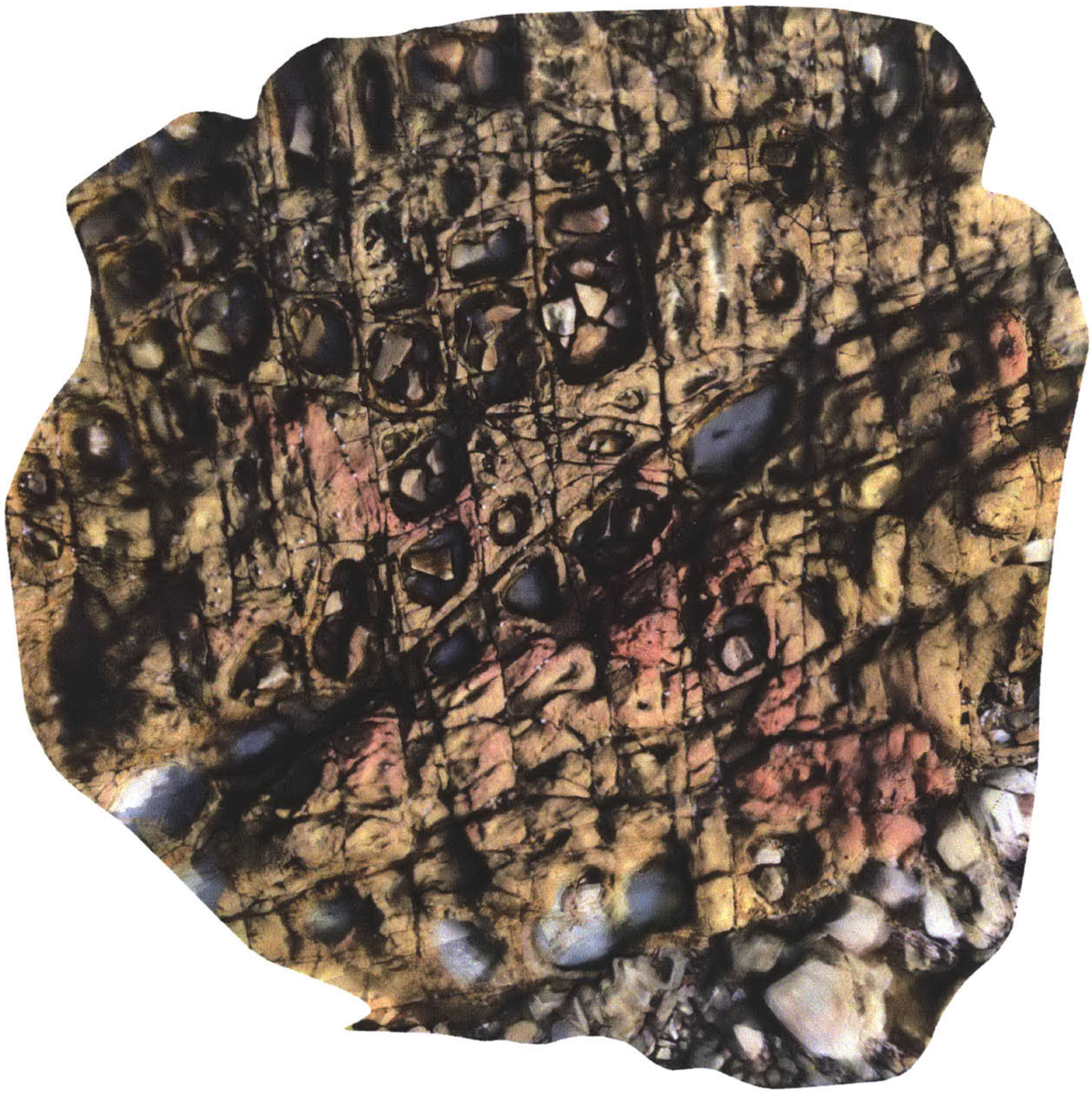


Figure 21 Rock formation model - texture

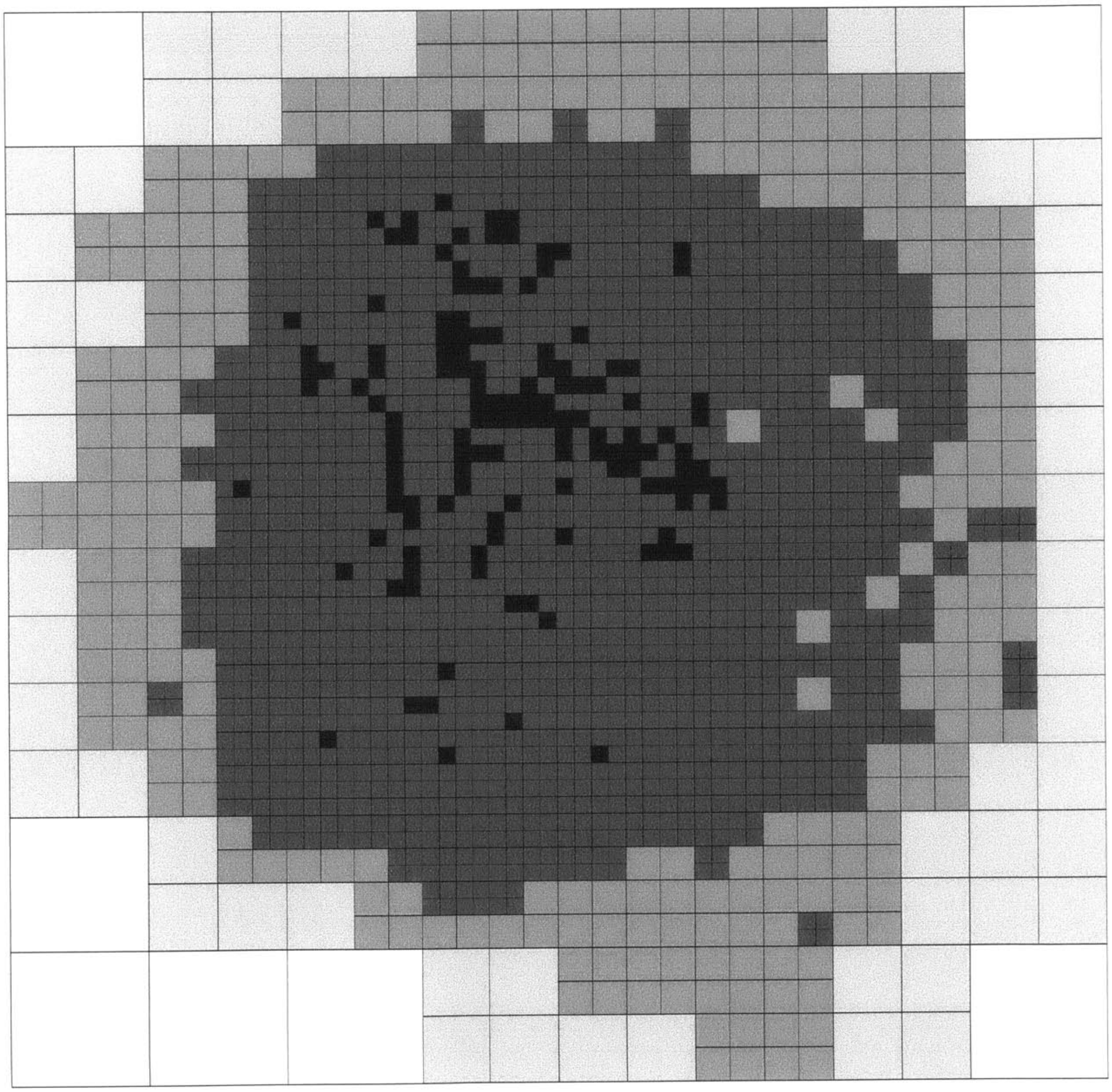


Figure 22 Rock formation model - octree

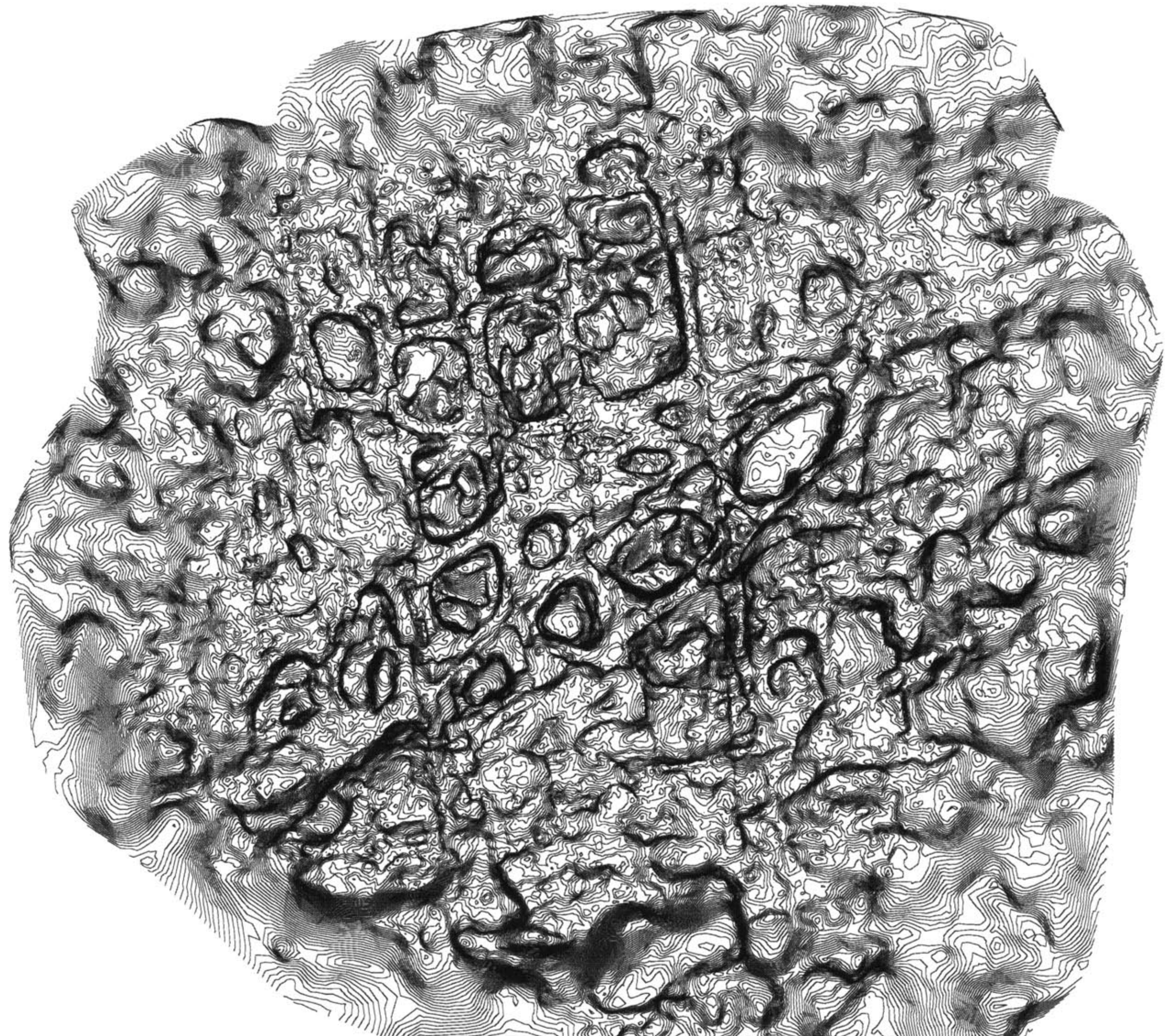


Figure 23 Rock Formation - Contours

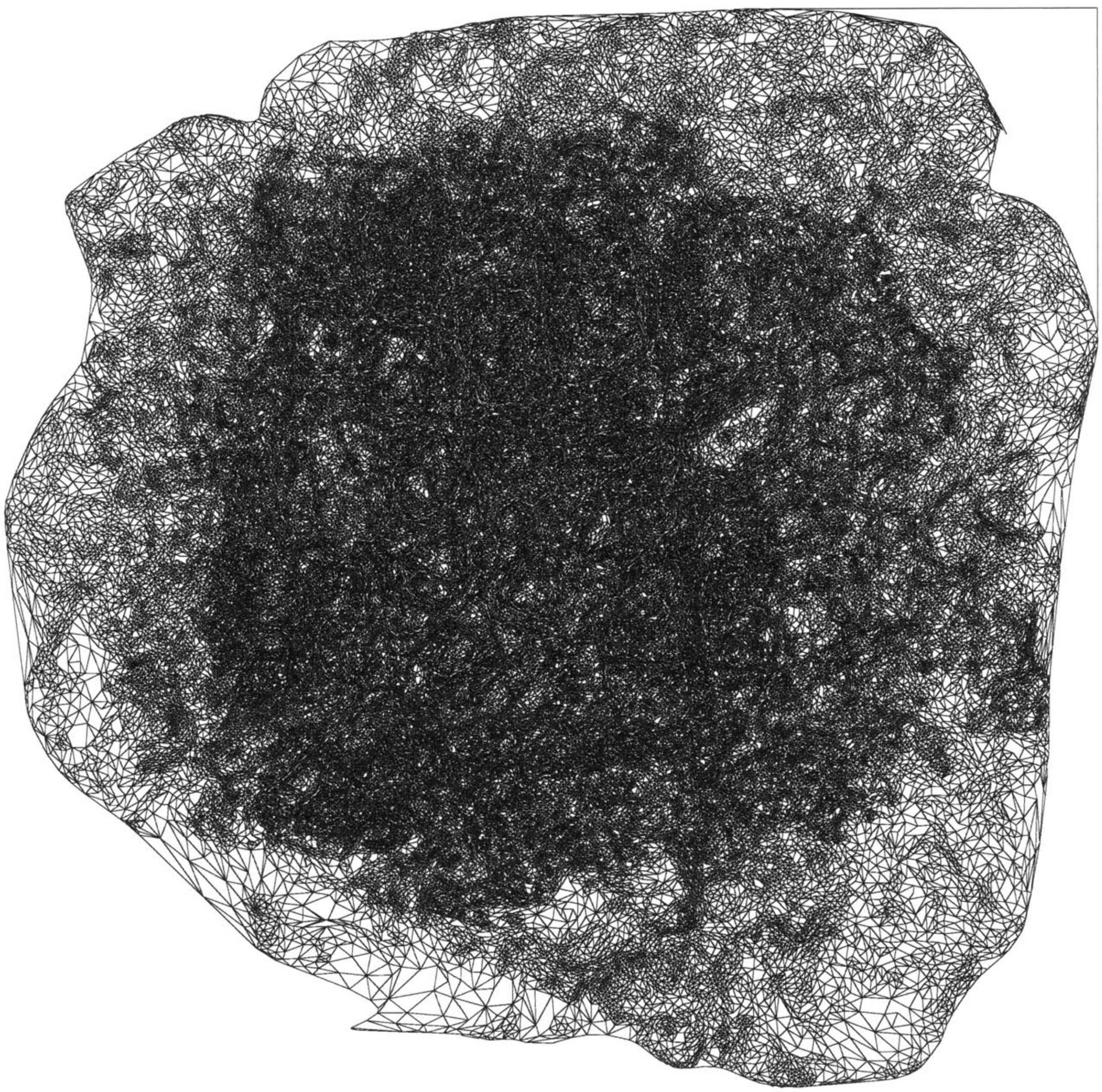
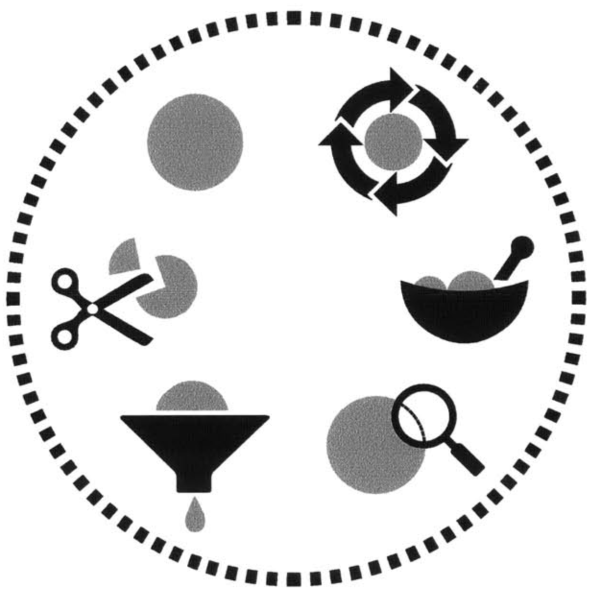


Figure 24 Rock Formation - Triangulation

3-D SCANNING



3-D PRINTING

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3-D SAMPLING

This thesis proposes 3-D Sampling as a new design method that seeks to instrumentalize the data produced from the 3-D scanner and apply it within the design process. Sampling, appropriating, hacking, and copying are among the accepted modes of creative production within our contemporary culture. Like photography, 3-D scanning presents us with devices, tools, and methods in which copies can be made indistinguishable from originals. While not always explicitly stated within architectural practice, the use of external design precedents, research, and first-hand observations as forms of knowledge are often considered more efficient strategies in developing designs than initiating projects from a tabula rasa. Architects deploy these sampling strategies to legitimize their designs by producing personal or collective narratives that in some way mediate between the conditions exterior to any given project and the design process. While legitimizing narratives have historically been part of architectural discourse, with the rise of digital technologies and networks, the narratives of architectural production are "now fluid, multiple, and generally smaller; they are often adaptations of the best parts of a number of earlier stories; and they rely on and produce the need for research."(Miljacki, 2011)

To better understand how these technologies could extend the application of sampling strategies to architecture, we must can consider how they are employed by other disciplines.

Sample-Based Music

The Djs of the 1970s created the earliest form of hip hop by remixing and mashing together music tracks on vinyl records using two turn-tables and an audio mixer. In composing electronic music, samples are recorded from both found analogue or electronically-generated sources. In addition to the mash-up of selected tracks, artists apply techniques such as digital signal processing, convolution, algorithmic filtering, and mixing to the found sounds in their desired composition. In his 2013 TED talk, renowned DJ Mark Ronson claims that music artists use sampling to form and strengthen the narrative of their work by drawing from the narratives of other pieces of music which allude to the message the artist is trying to convey. Beyond simple copying, the most sophisticated sampling relies on a deep musical understanding of the material used in combination with aesthetic ends that are in no way contained in the pre-existing musical

Figure 25 Video Sampling - “Cirrus”, Bonobo

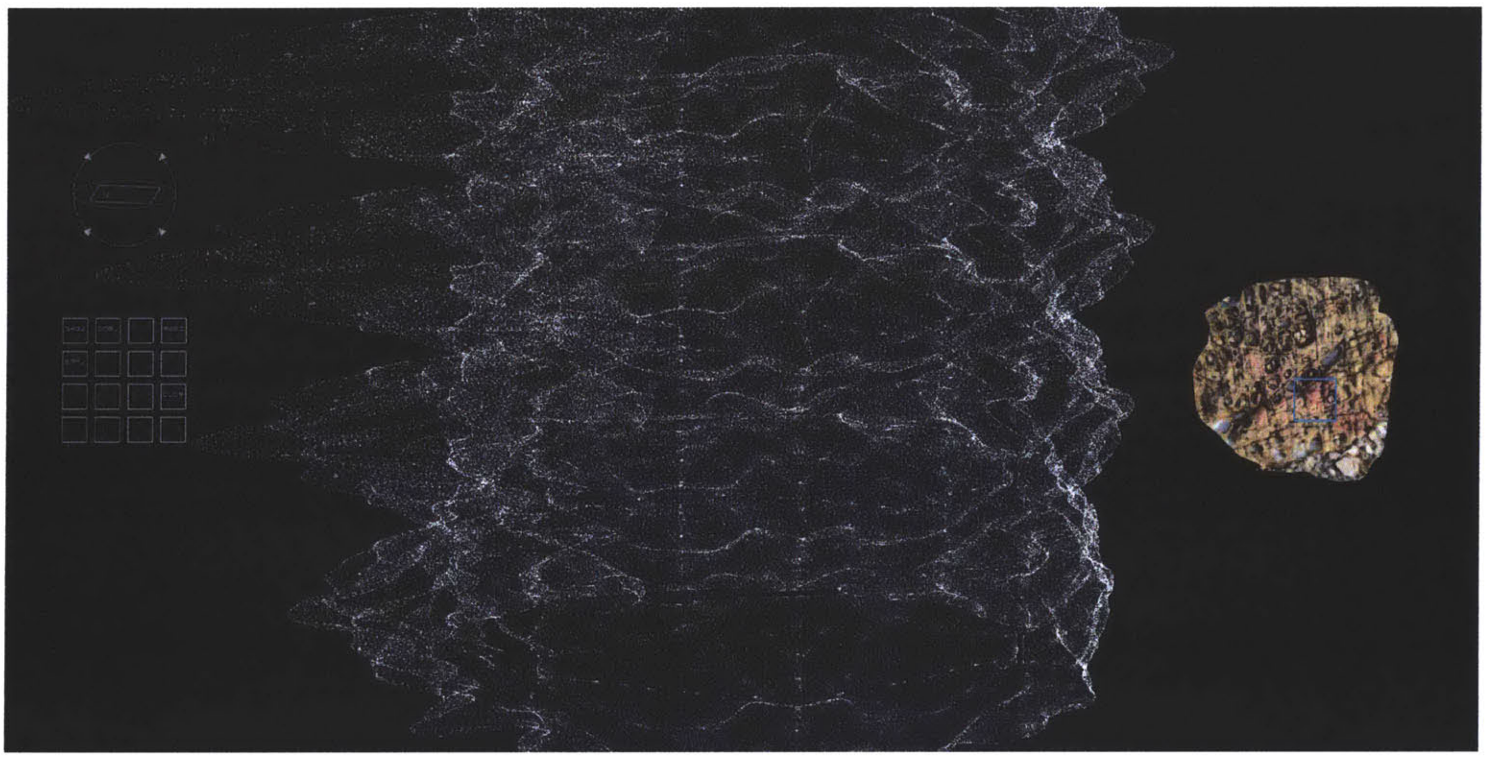
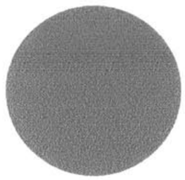


Figure 26 Cloud Generator; a 3-D Modeling application fo 3-D scans

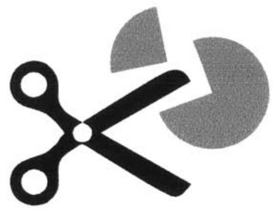
3-DJ: CLOUD GENERATOR

What if we could instantly use the spatial, optical, haptic, and acoustic qualities of objects as we experience them to produce designs?

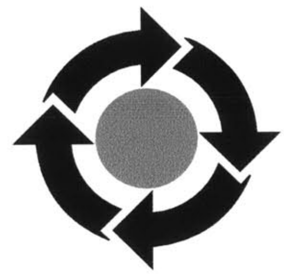
CLOUD GENERATOR is a speculative 3-D modeling application developed for this thesis for manipulating the point clouds generated by 3-D scanning. Written in the open-source Processing programming language, the aim of CLOUD GENERATOR is to address and investigate the technological barriers that prevent designers from using 3-D scanning as part of the design process by bridging between 3-D scanning and 3-D printing. CLOUD GENERATOR recognizes the practices, methods, and procedures of design established in sample-based music, and organizes the experience of designing with 3-D scans into five operations – cut, mix, filter, analyze, and loop – to produce new 2.5-D variations. Analyze - provides feedback. CLOUD GENERATOR allows a user take a sample and remix, manipulate, and evaluate it at any step with respect to design criteria such as tactility, volume, light, and materials. The process may continue until a desirable solution is achieved by the design.



SAMPLE



CUT



LOOP

FILTER

ANALYZE

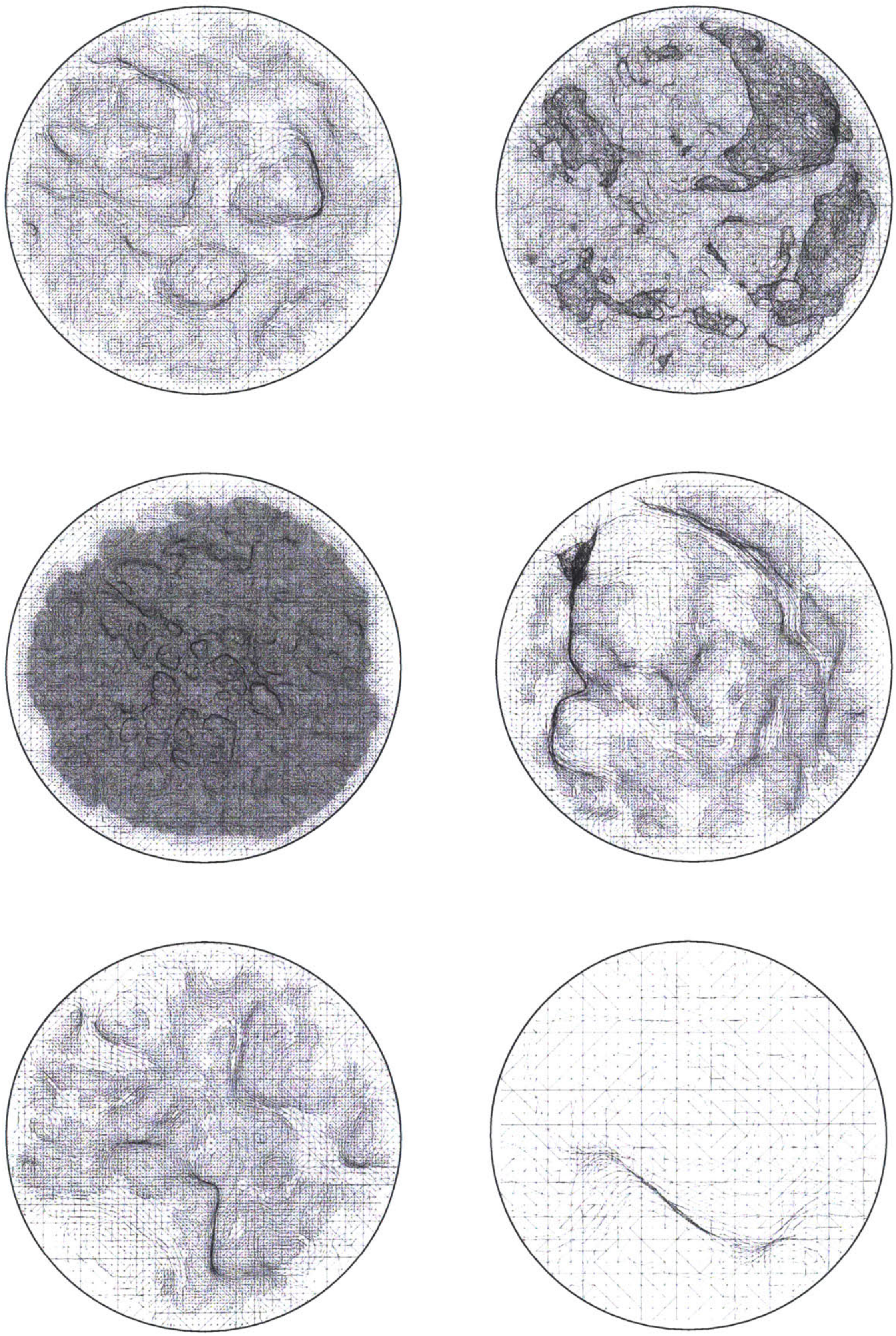
MIX

- O P

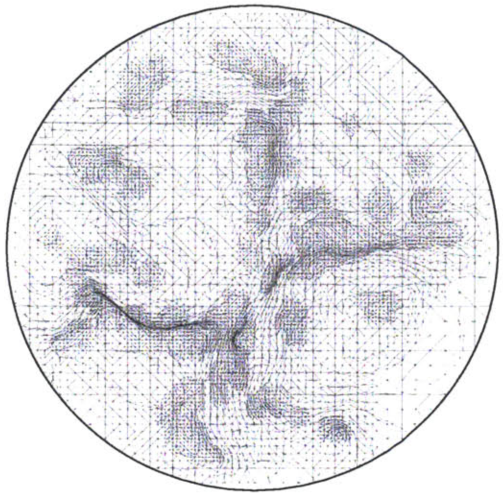
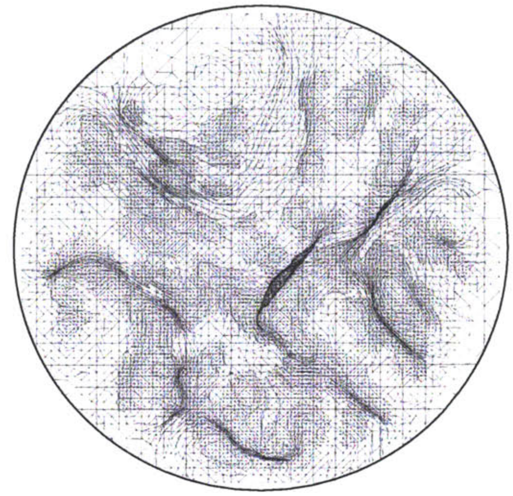
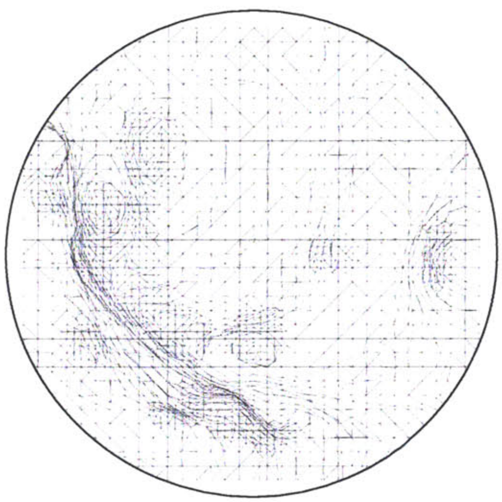
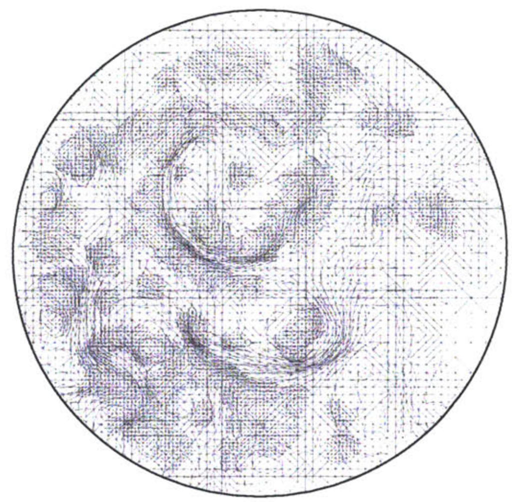
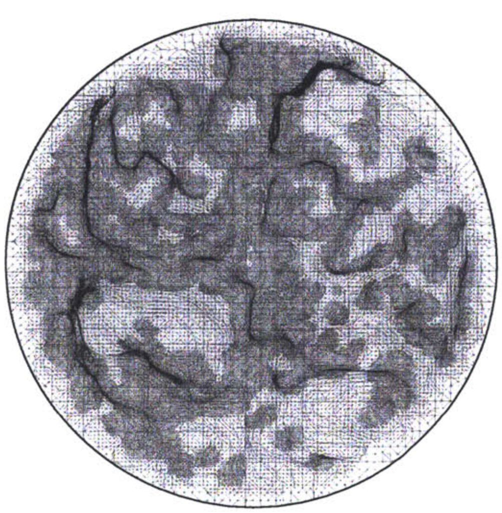
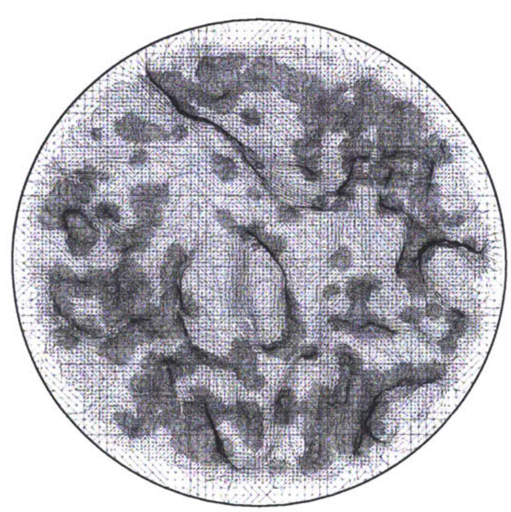
E R A

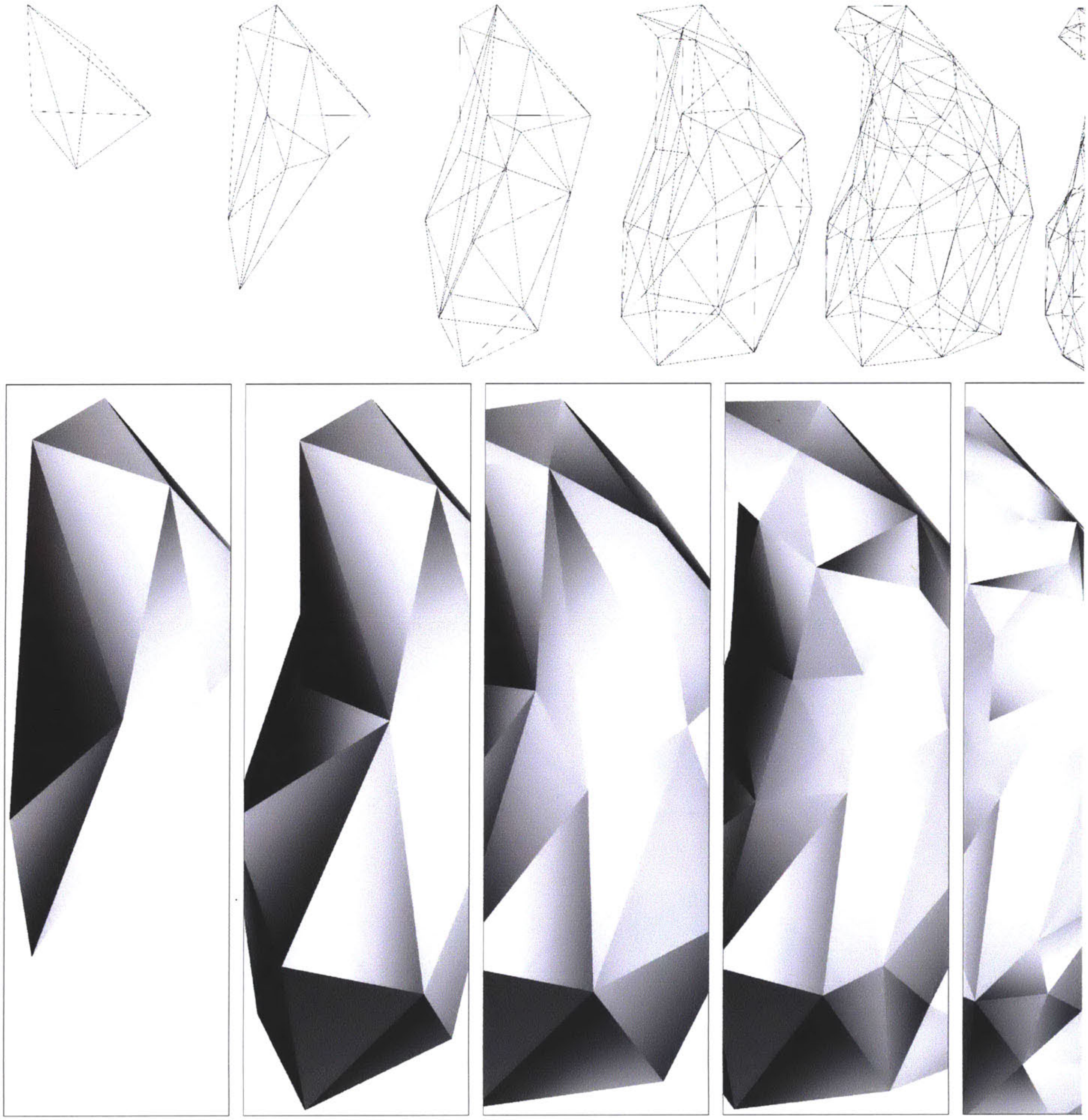
T I O

N S -



CUT



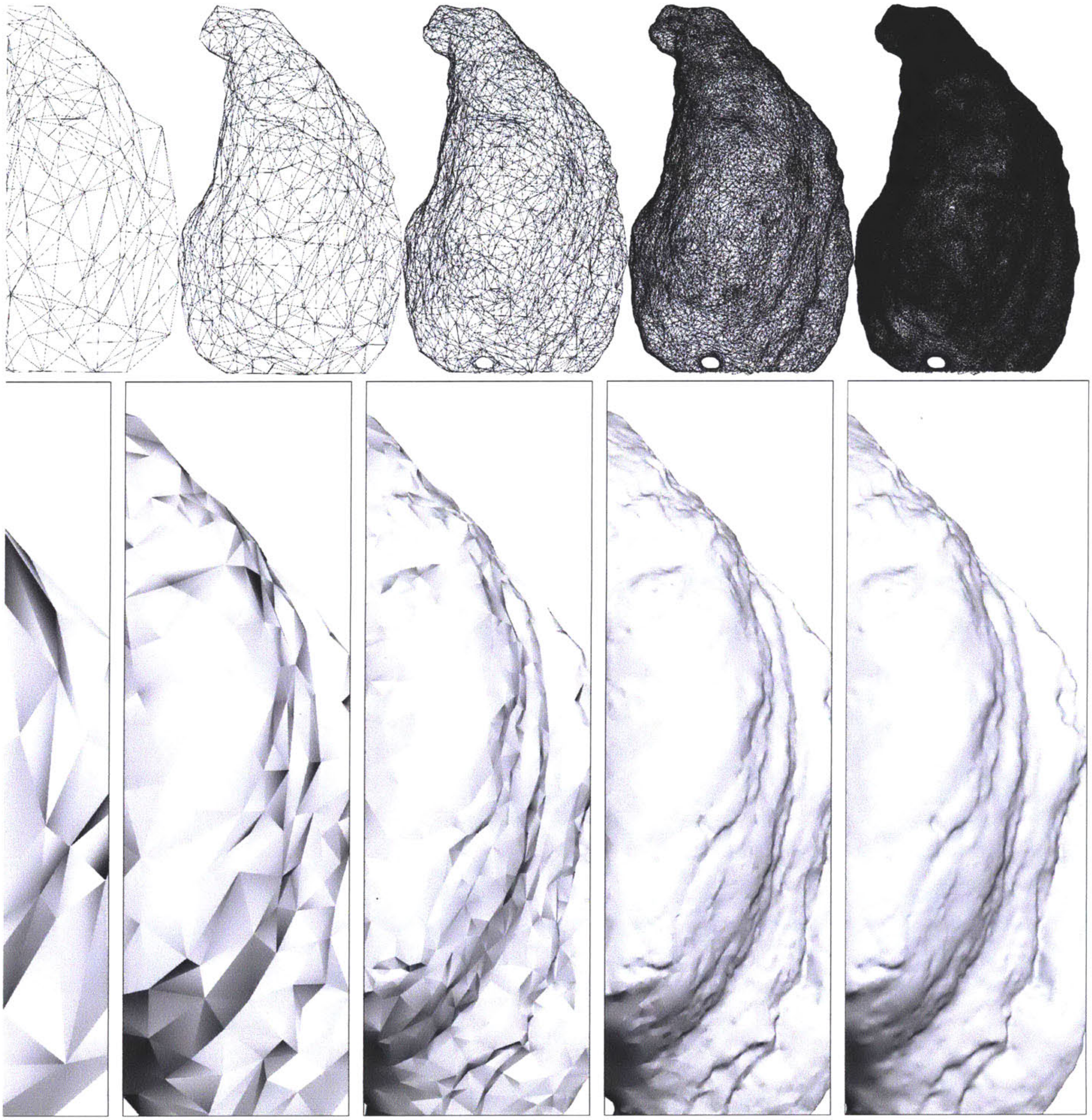
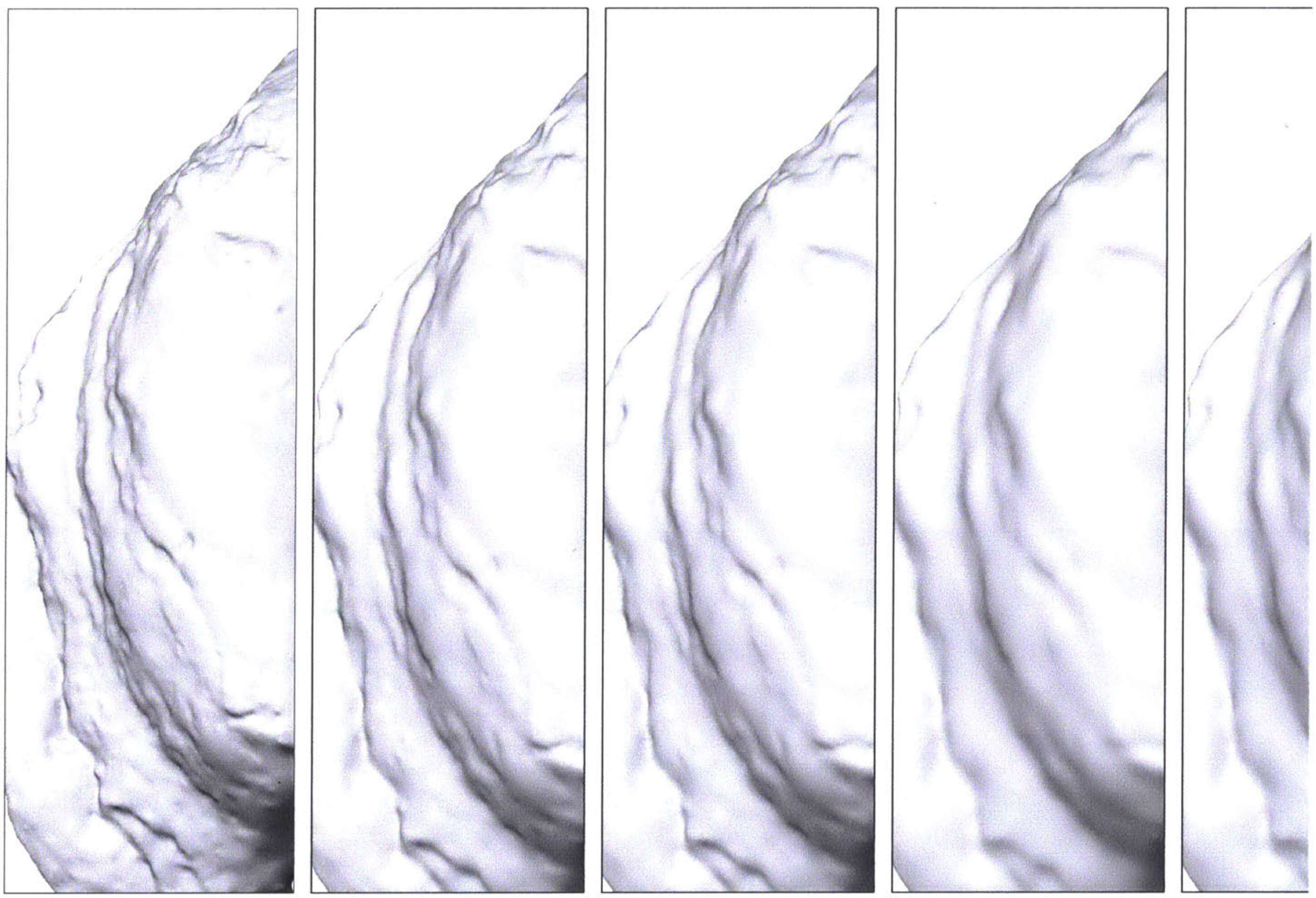


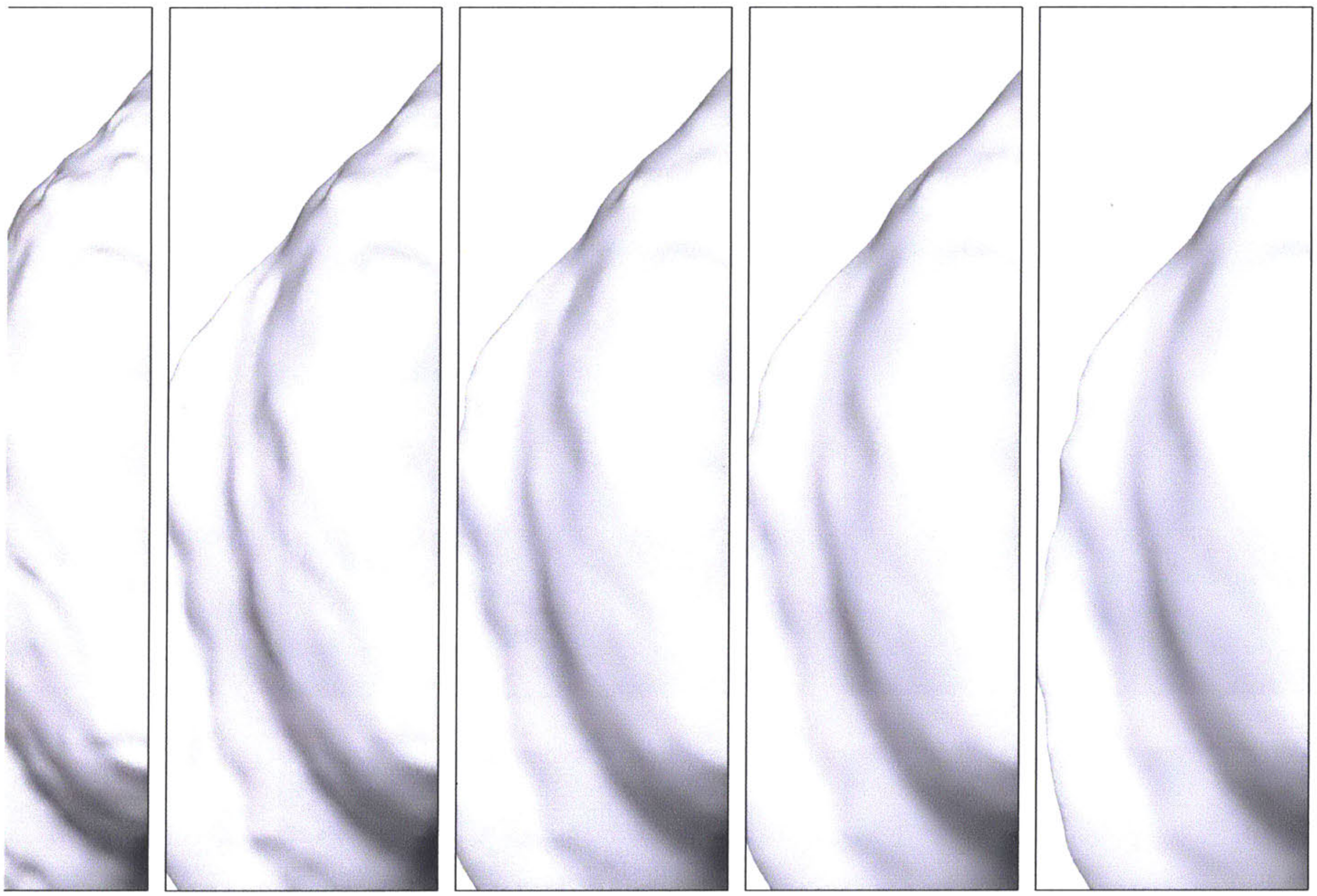
Figure 27 - A mesh - reduction algorithm applied to an oyster shell.

Figure 28 -

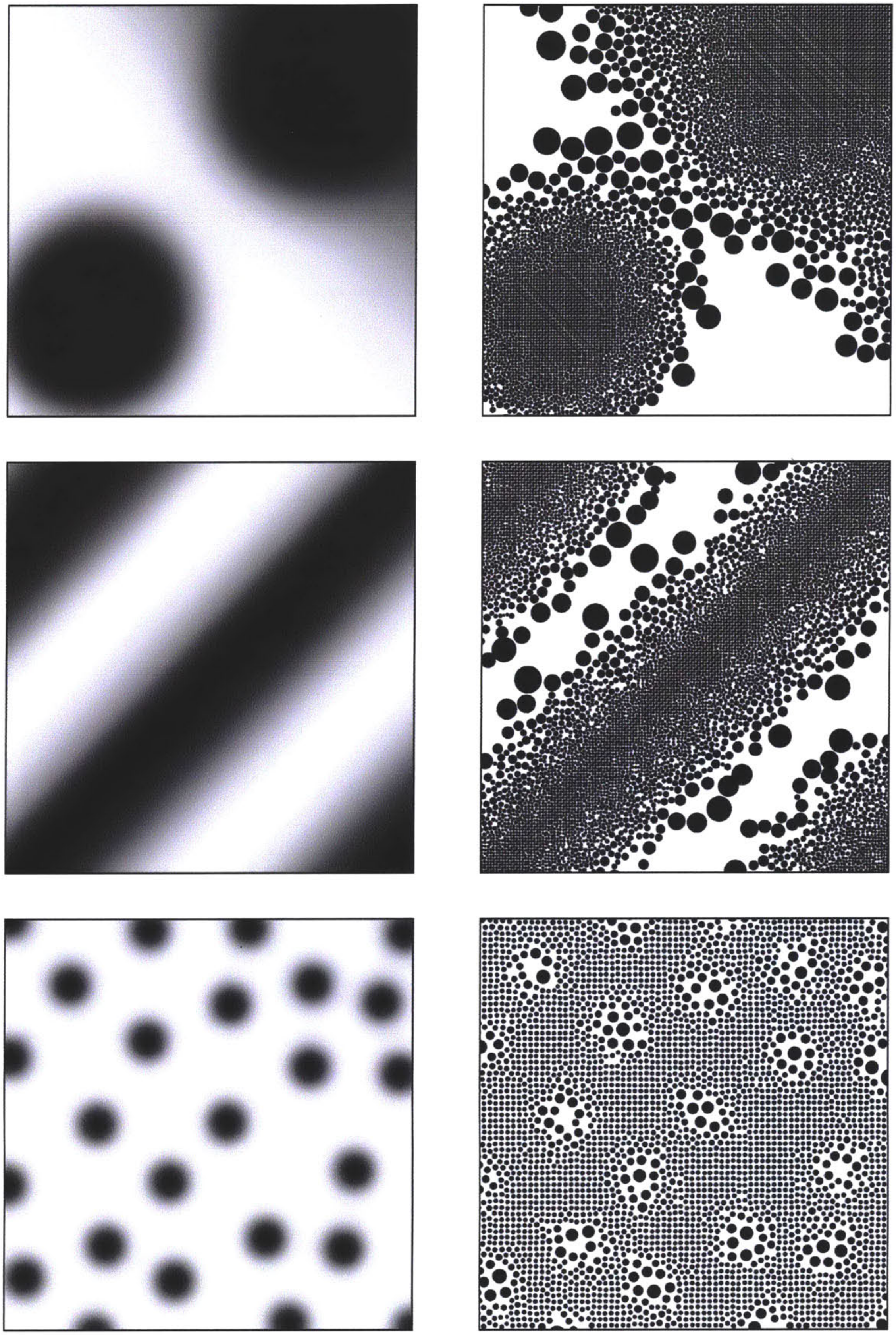
LAPACIAN SMOOTHING (FILTER)

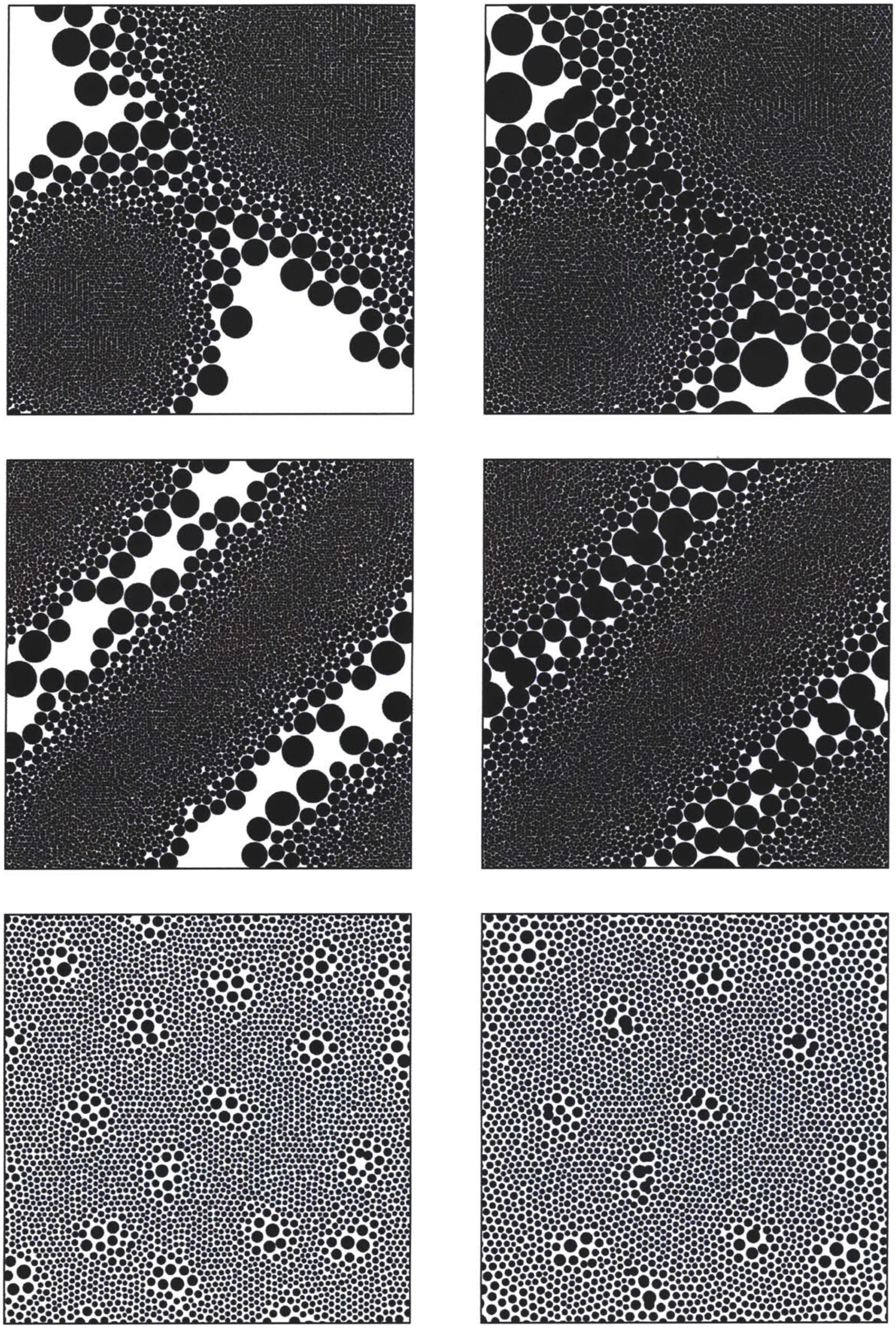
An algorithm to smooth a polygonal mesh, whereby for each vertex in the mesh, a new position is calculated based on the position of neighbors and the vertex is moved there.





FILTER





MIX

MIX

Figure 29 -

3-D TEXTURE MAPPING (MIX)

The projection of a 2.5 D procedural texture onto a surface through stretching and deformation about the normals of the curves describing the surface.

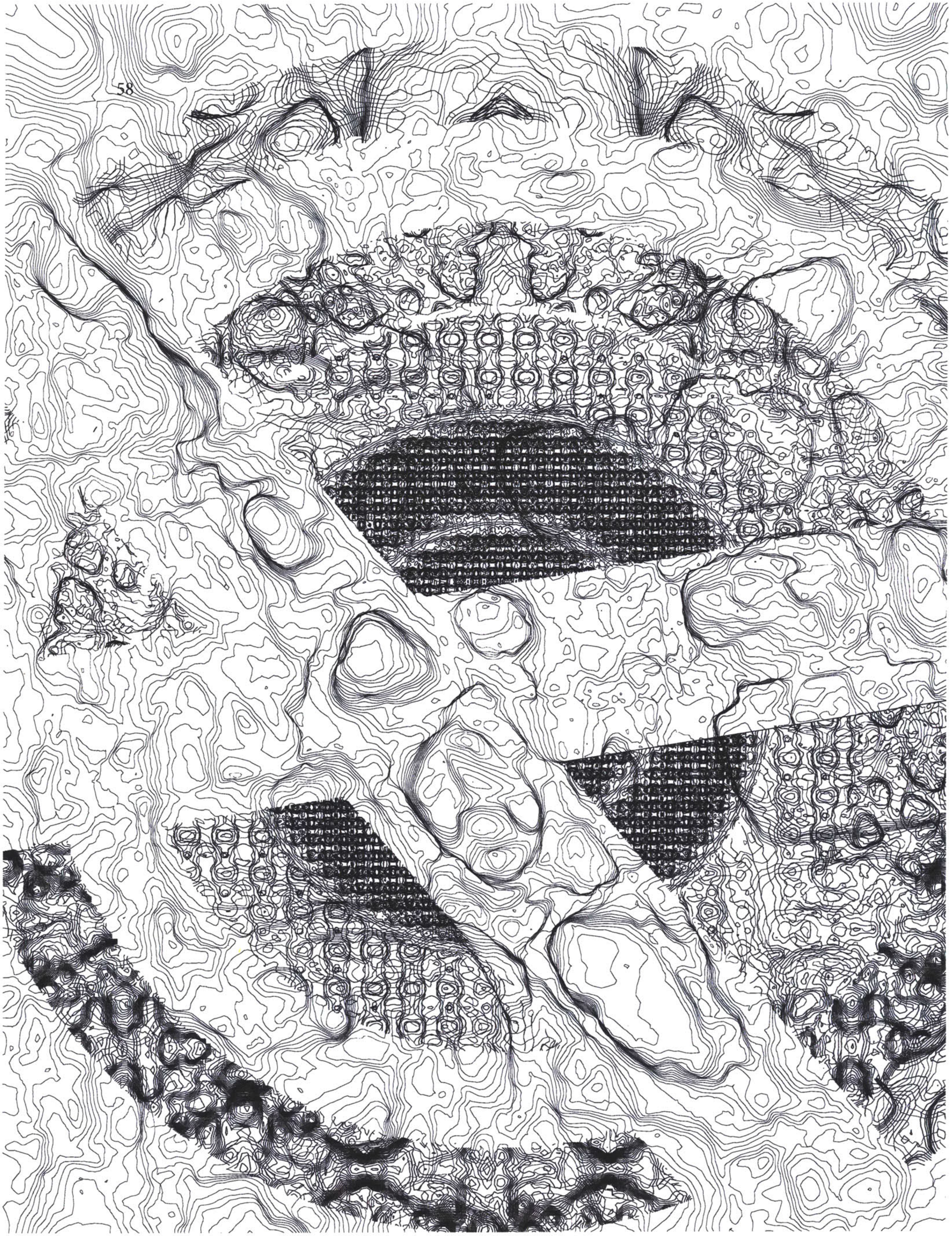


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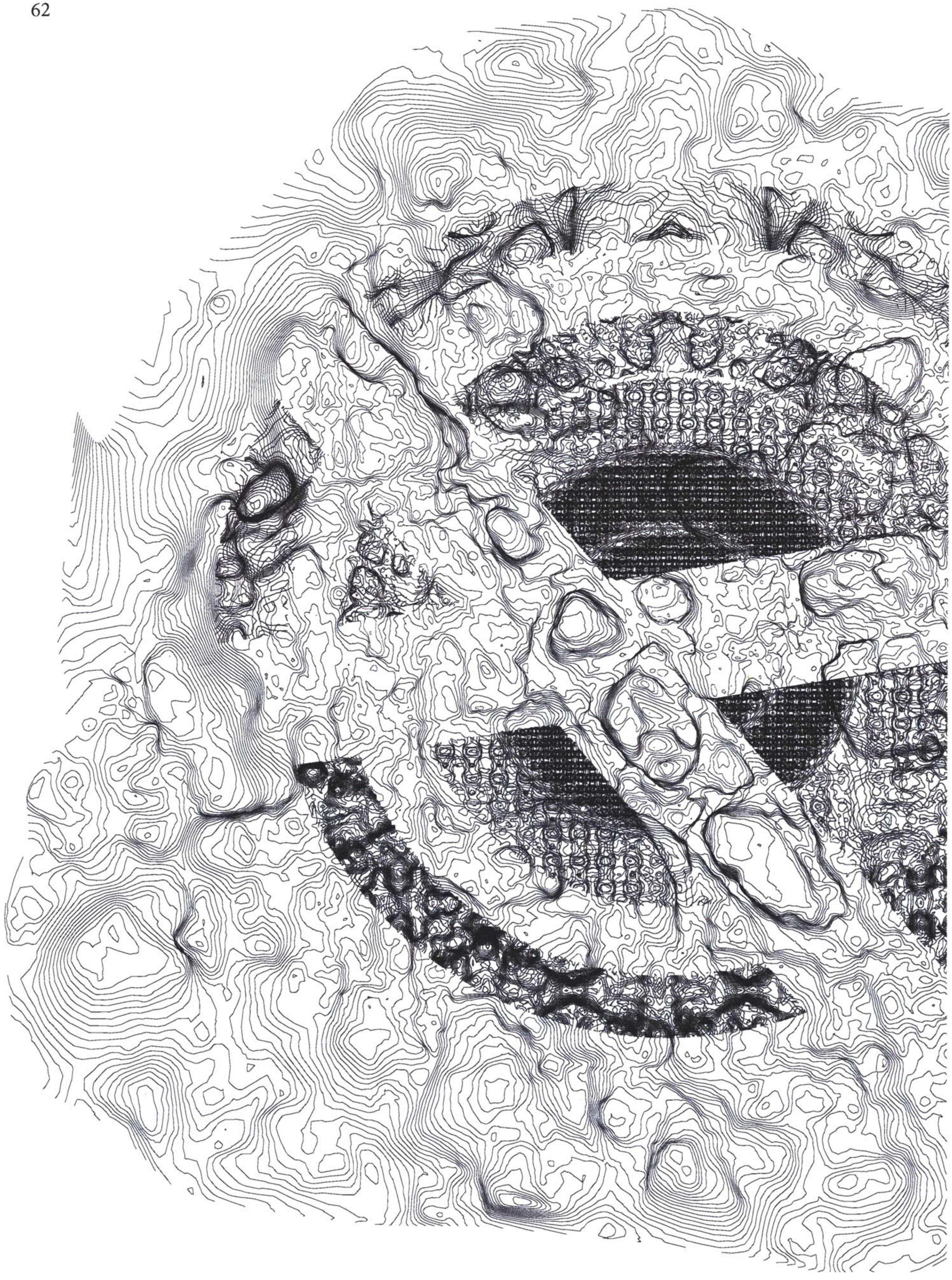
Figure 30 Water shedding & flow

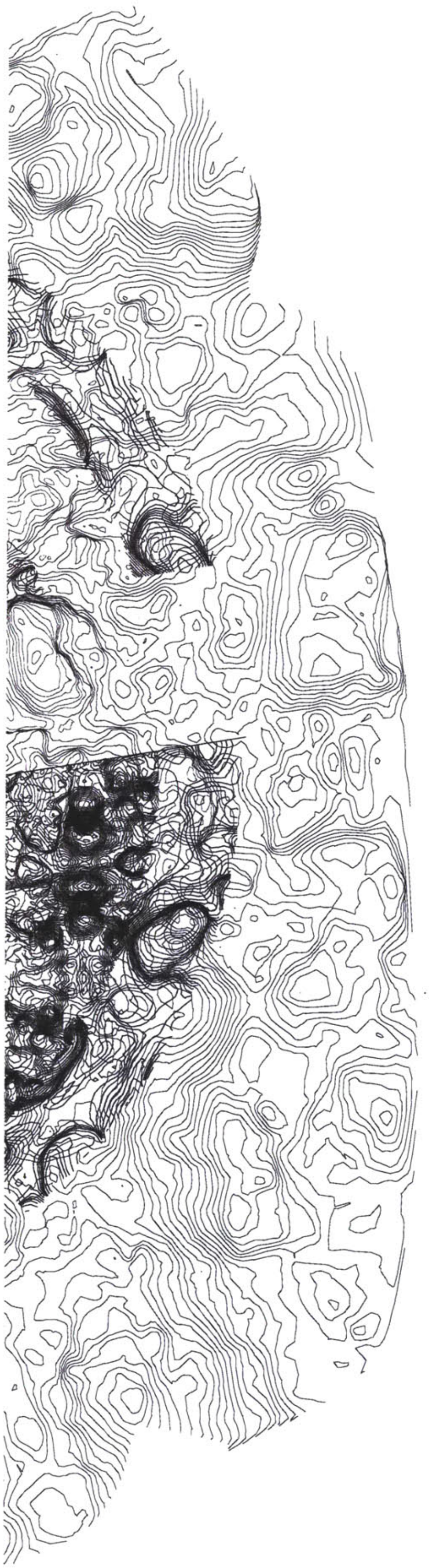
CASE STUDIES : PER-FORMATIVE RUSTICATION

What if we could instantly use the spatial, optical, haptic, and acoustic qualities of objects as we experience them to produce designs?

Rustication is a term that has come to historically define architecture the most extreme examples of surface textures. Allowing architects to manipulate geometry at increasingly refined scales, powerful computational tools and precise fabrication mediums like 3-D scanning and 3-D printing, has revived interest in the subject of Mark Gage's 2010 "Disheveled Geometries" at the Yale School of Architecture.

CLOUD GENERATOR is applied to the topic of per-formative rustication, to test and evaluate the operations of sample, cut, mix, loop, and analyze within the design process, and to discover new opportunities for the modeling tool. Taking the base condition of architectural flatness as a given conditions, three per-formative textures. optical, haptic, and camouflage were explored. As a control the same sample, a rock formation captured in Tasmania was used as the starting point. This objective of the case study, as a first test, is not to seek out the most efficient solution, but rather to demonstrate that the emergent qualities of a 3-D geometry can be altered, manipulated and remixed to produce a vast range of per-formative architectural effects.

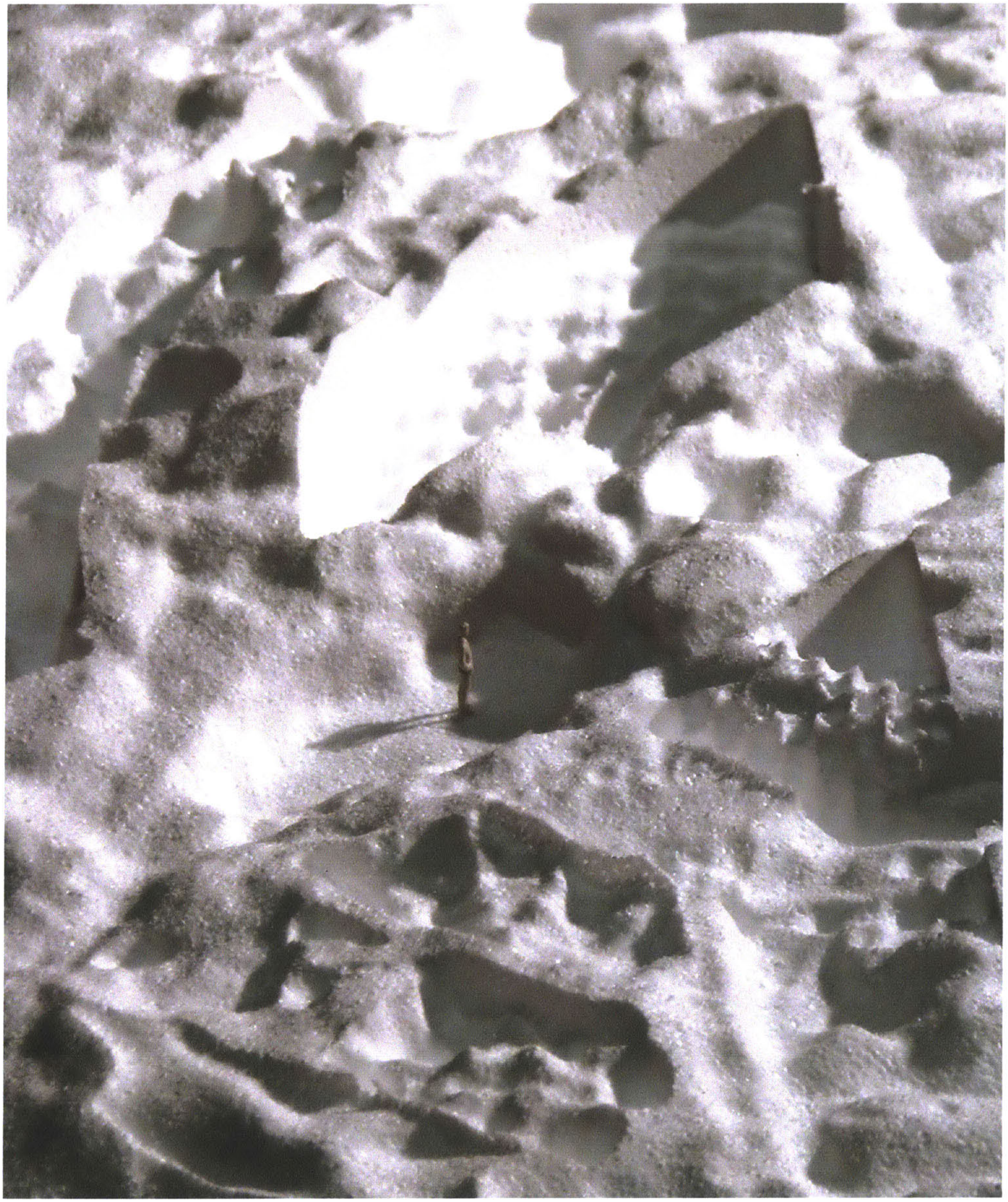


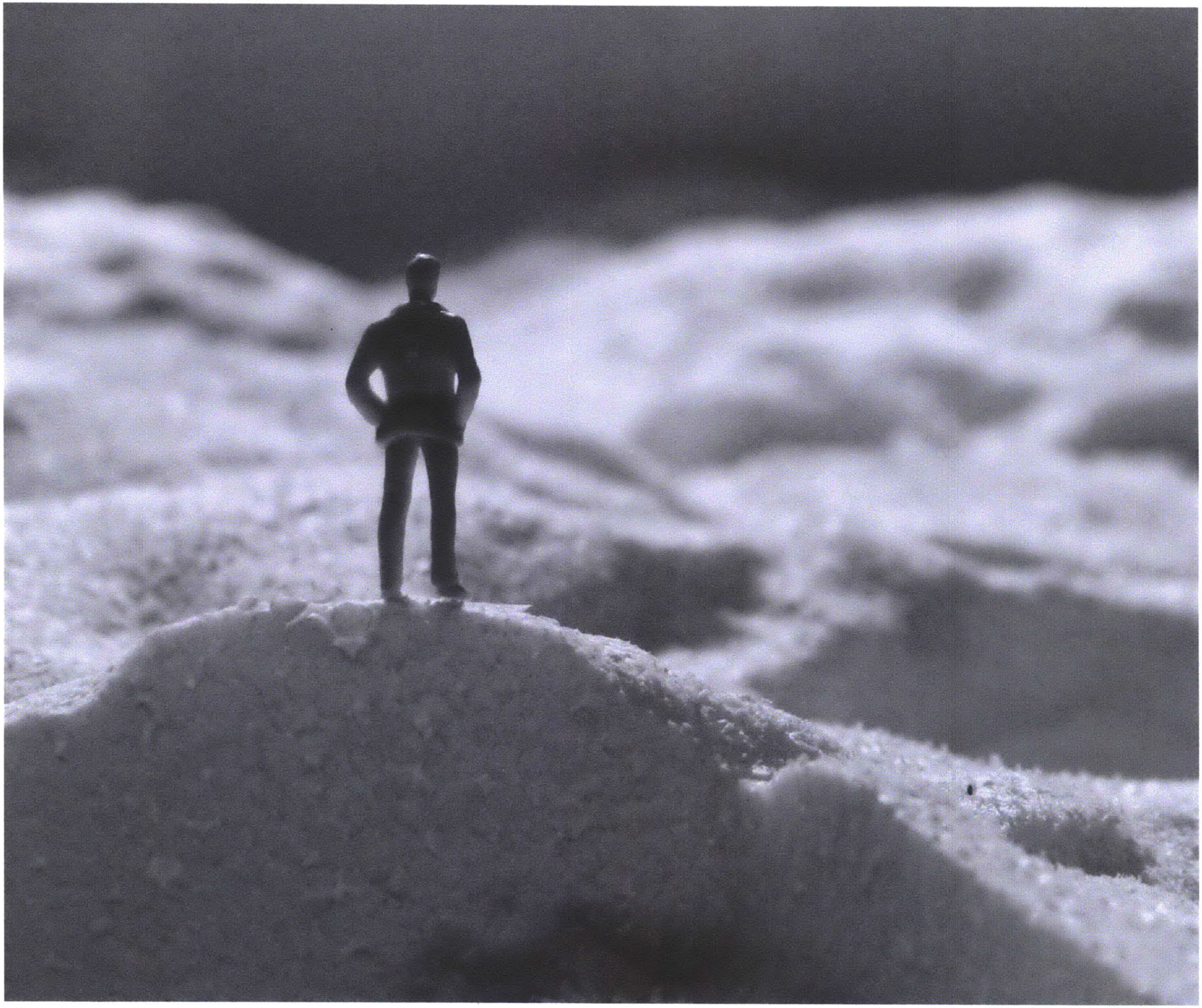


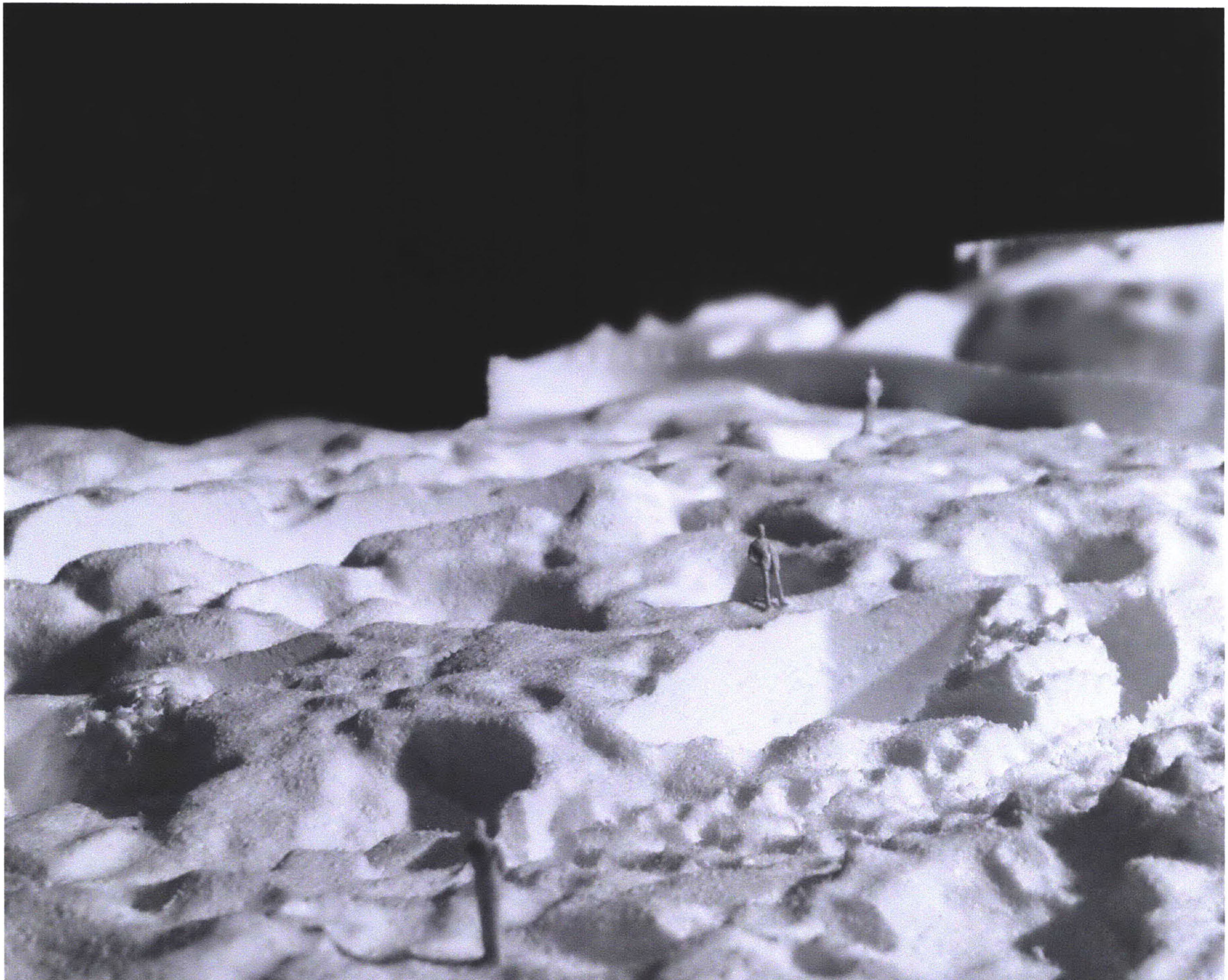
LANDSCAPE / CAMOUFLAGE TEXTURE

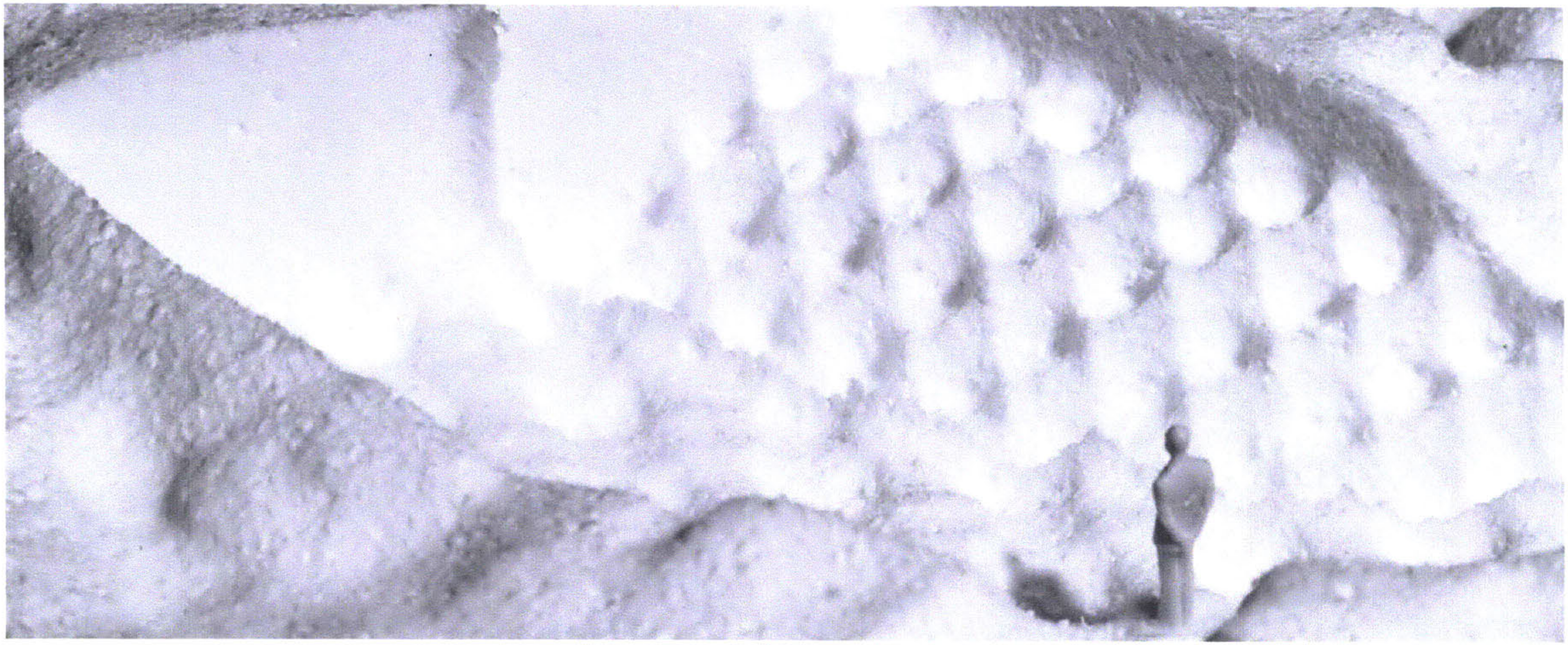
The first case study tests applications at landscape scale, exploring how features from a landscape can be 3-D scanned and blended at multiple scales to define space. The operations of cutting, mixing, and looping, were applied within CLOUDGENERATOR and applied combined through a technique of superposition, to produce landscape concieved at many scales.

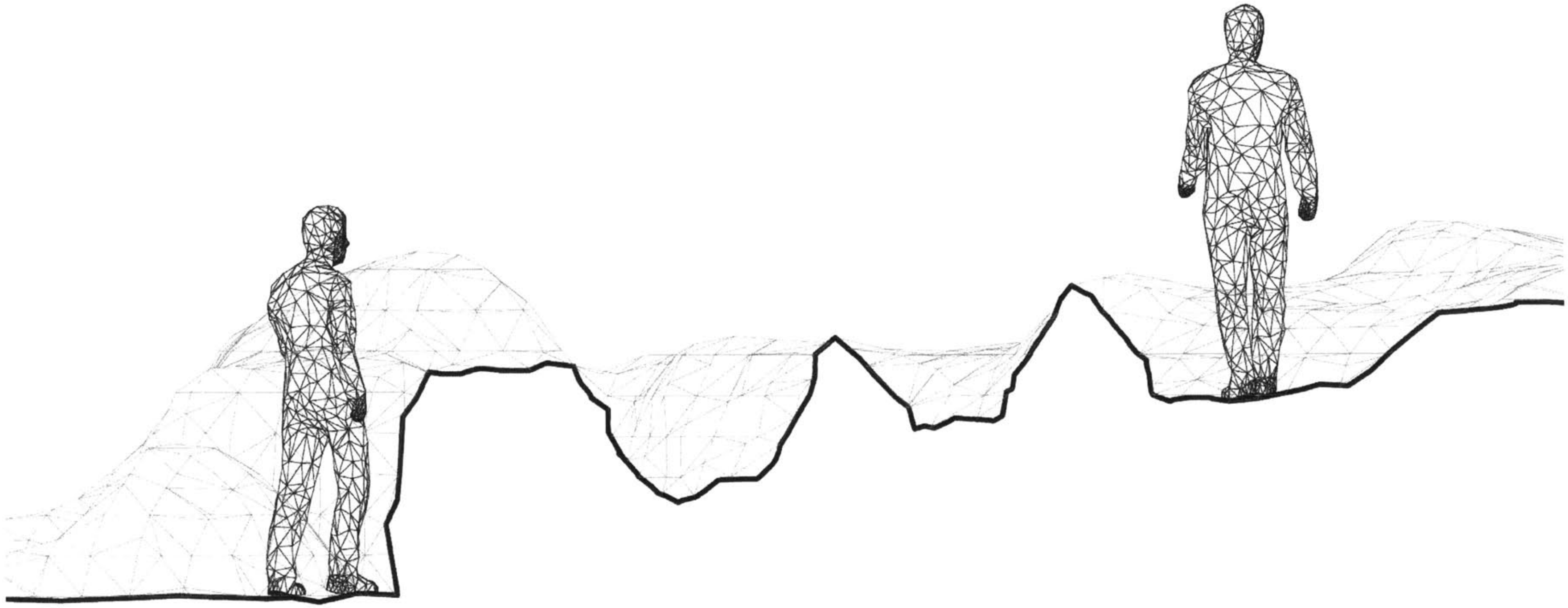
Using the human body as a datum, we observe 3 scales in the model: A landscape scale - suggestive of a connection to a broader context, A proto-architectural scale - suggestive of more enclosed an initimate spaces, and finally the human scale - suggestive of ways in which a person might directly engage with the landscape.

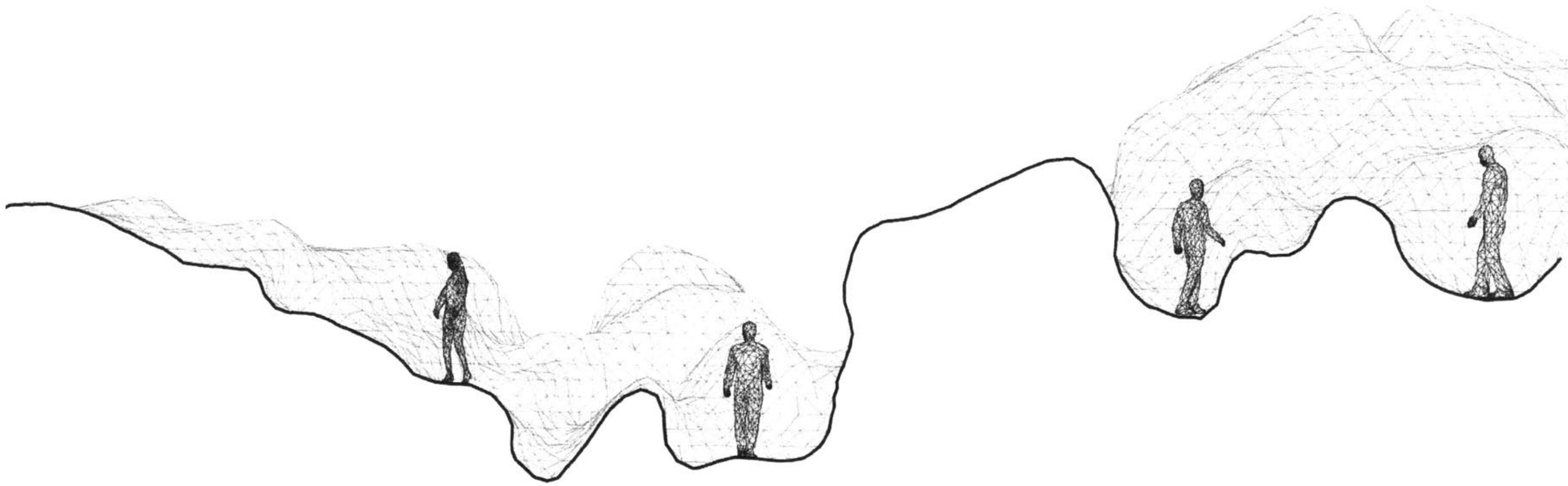


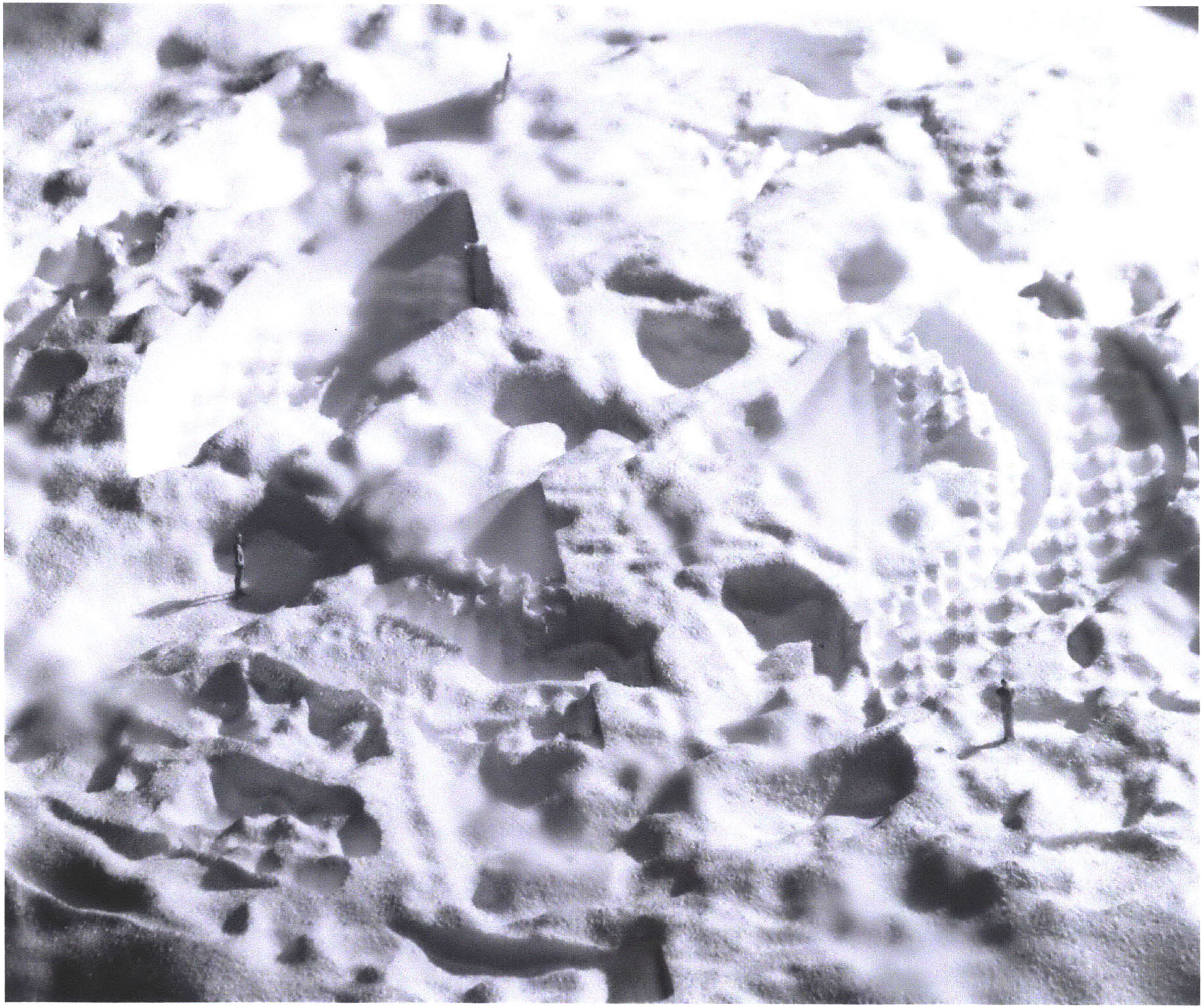








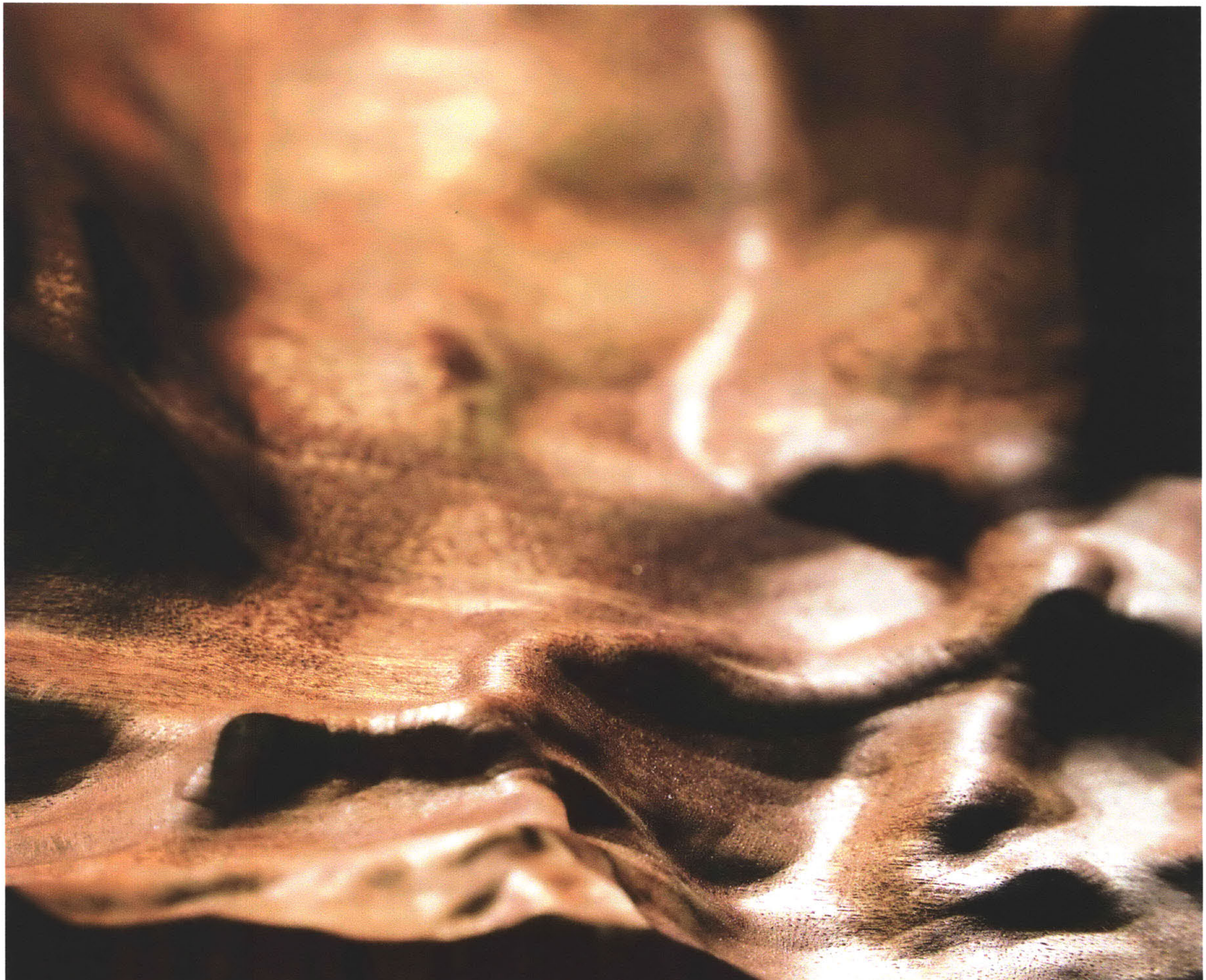


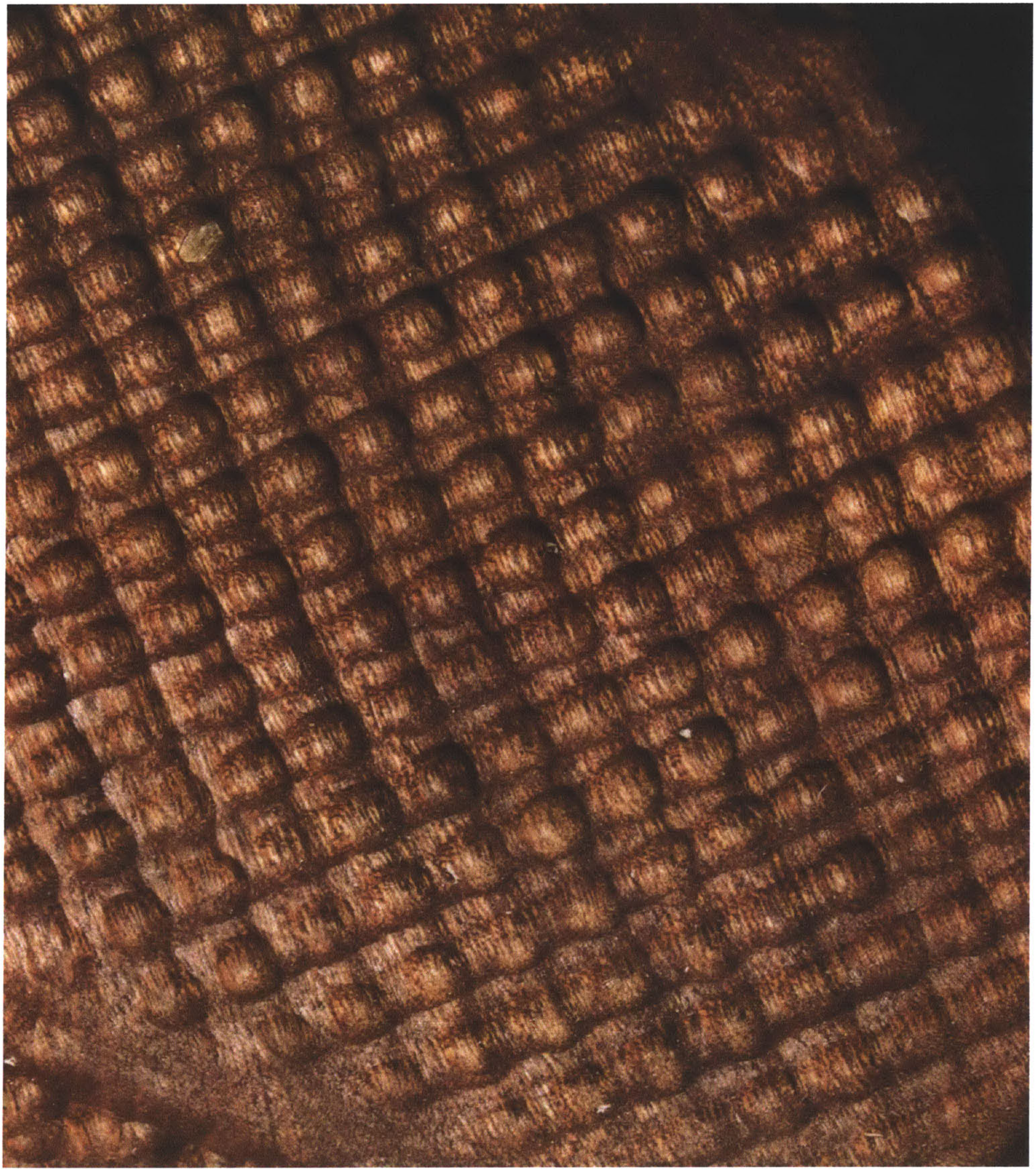


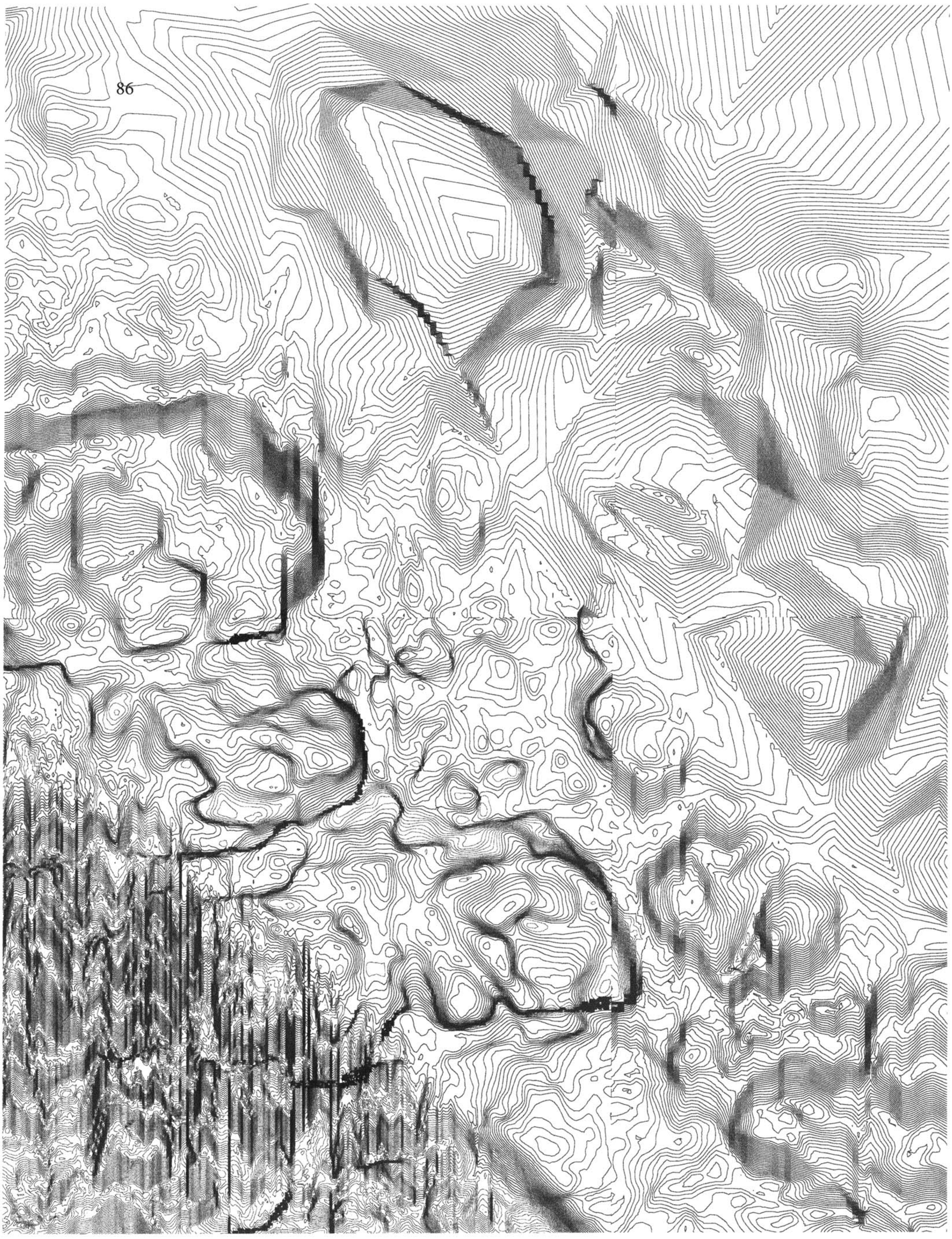
HAPTIC TEXTURES

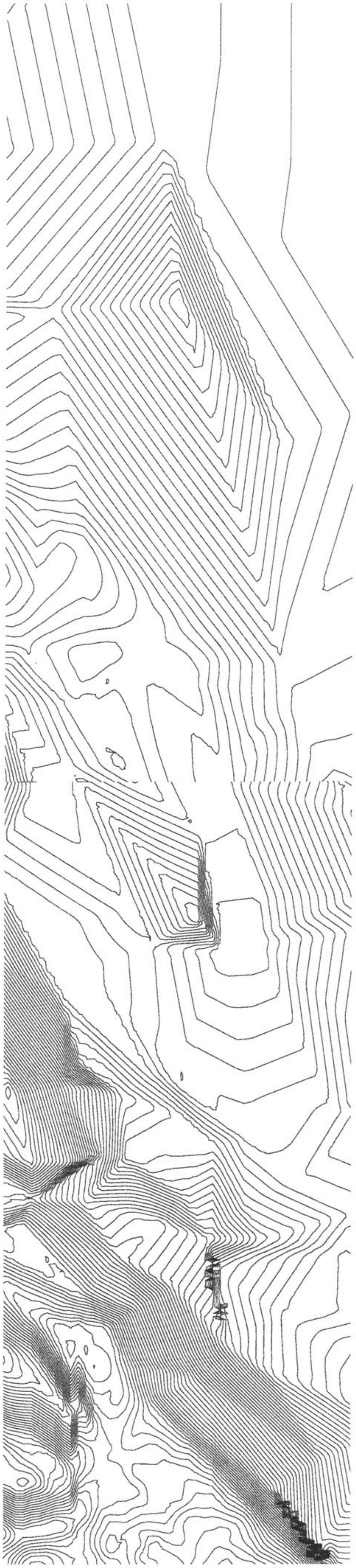
The second case study explored applications at product design scale, exploring how one might use the tool to generate tactile qualities of grip, comfort, roughness and smoothness. The software operations of CLOUDGENERATOR were combined and applied in multiple ways to demonstrate how tactile qualities can be differentiated, enhanced - and ultimate controlled with the design tool.

One thing we realized, is that the material in which the new texture was applied changed the nature of the original scan. For instance otherwise un-altered geometry cut from the rock sample, becomes smooth like a piece of cloth when milled into wood. Applying a filter however, makes the sample sharp to the touch. Applying a loop however, makes the sample sharp to the touch. We realized one interesting opportunity implicit in the tool was the ability to produce gradients between differentiated tactile experiences.



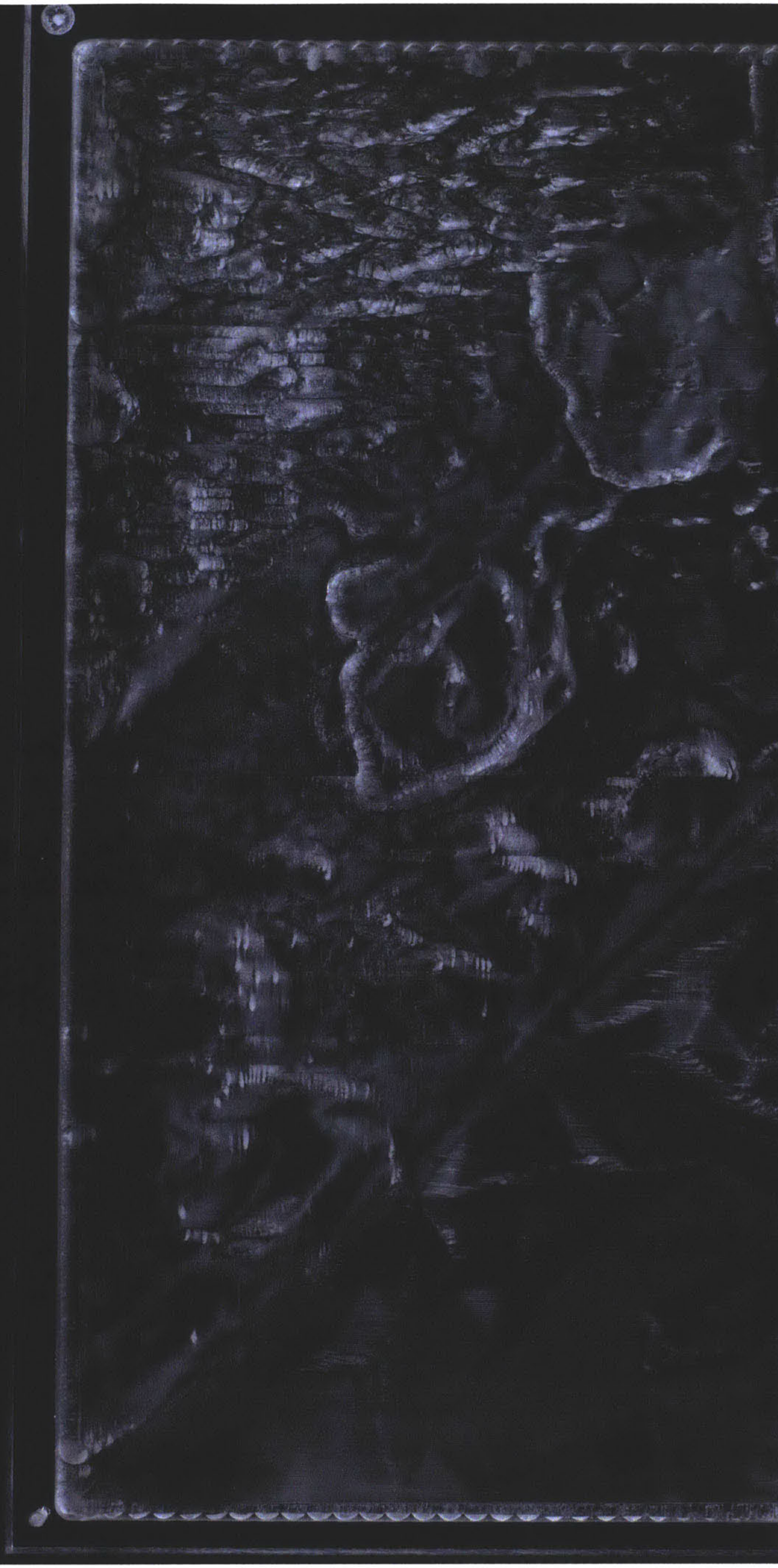


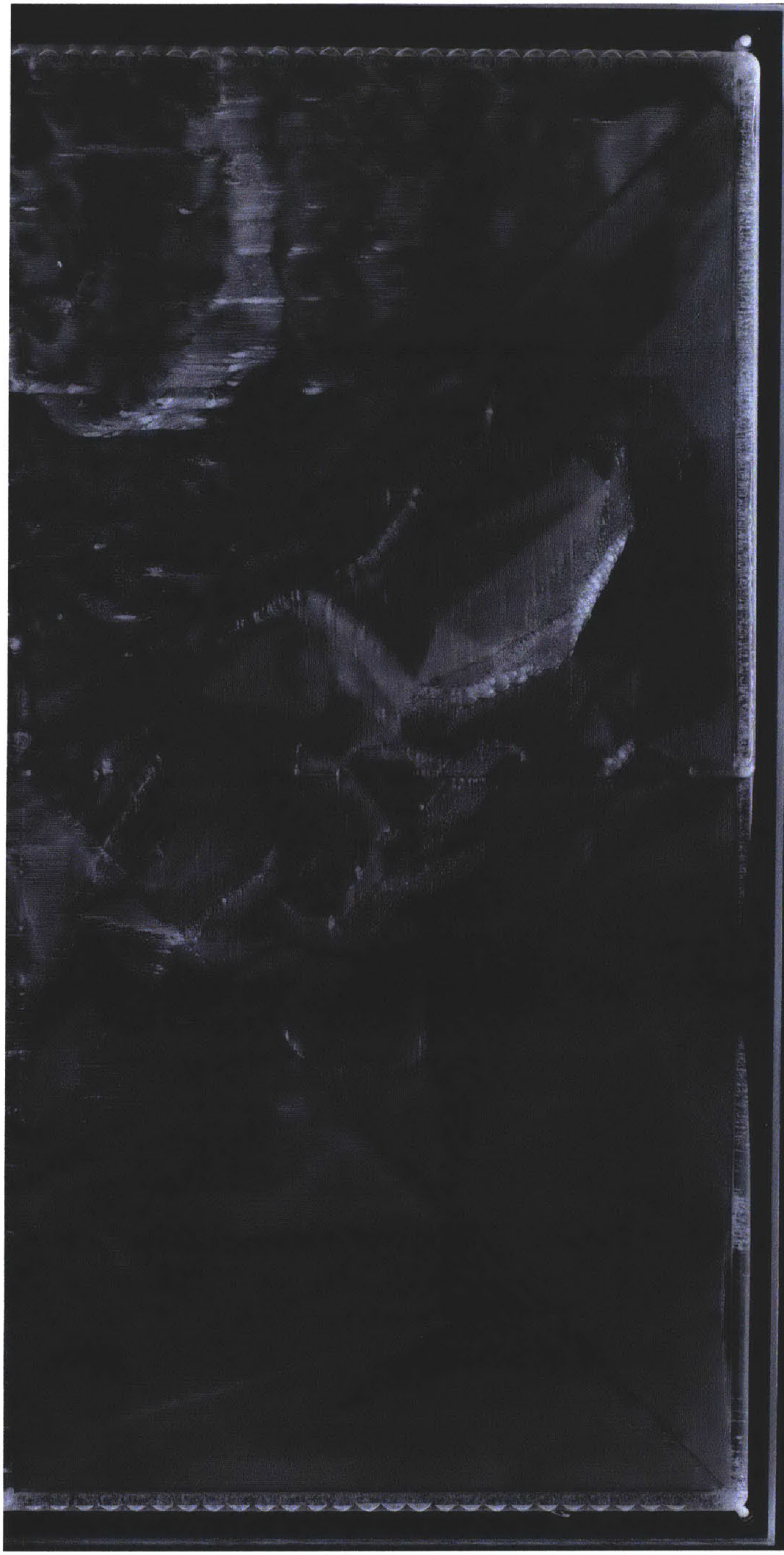


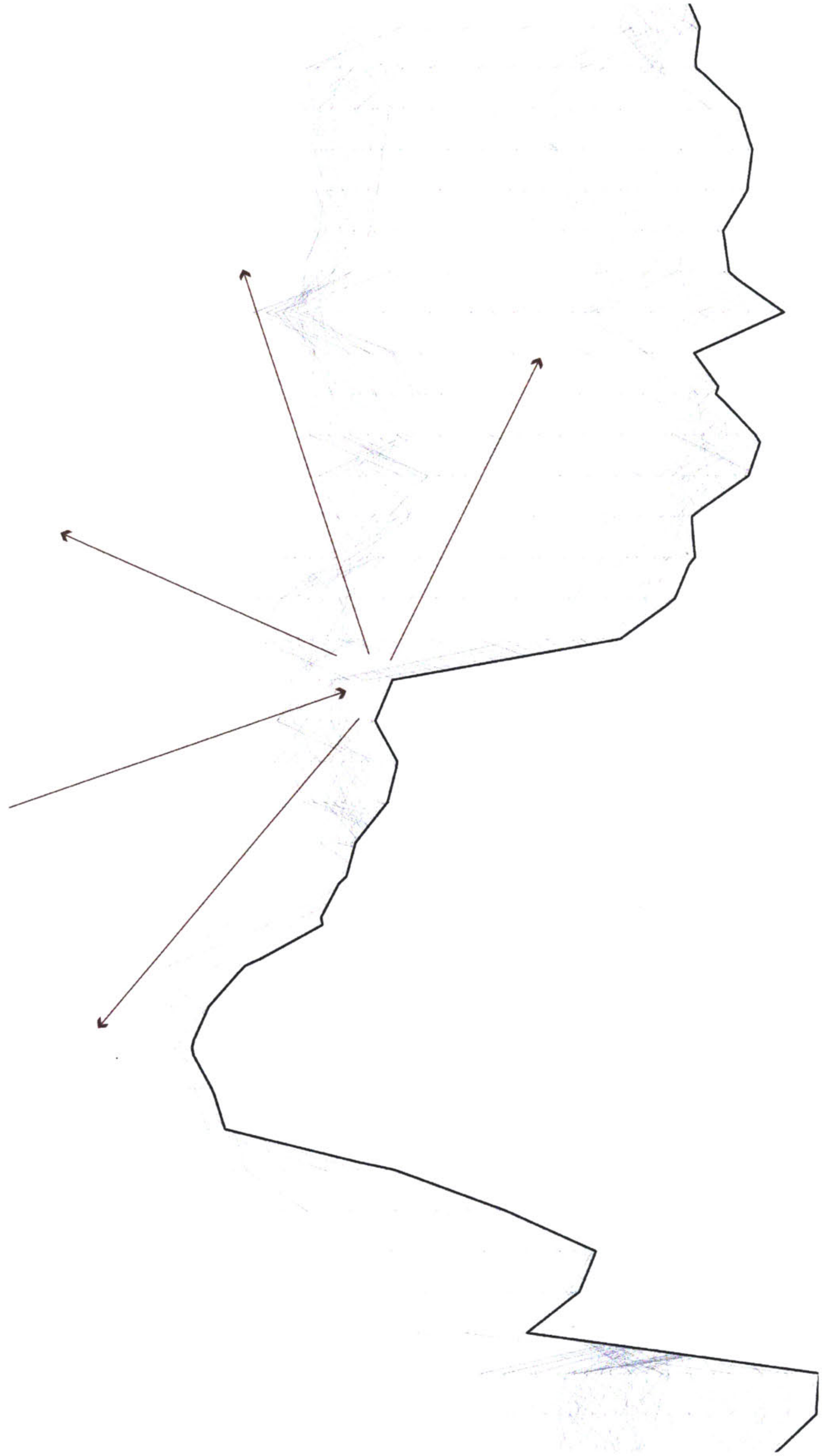


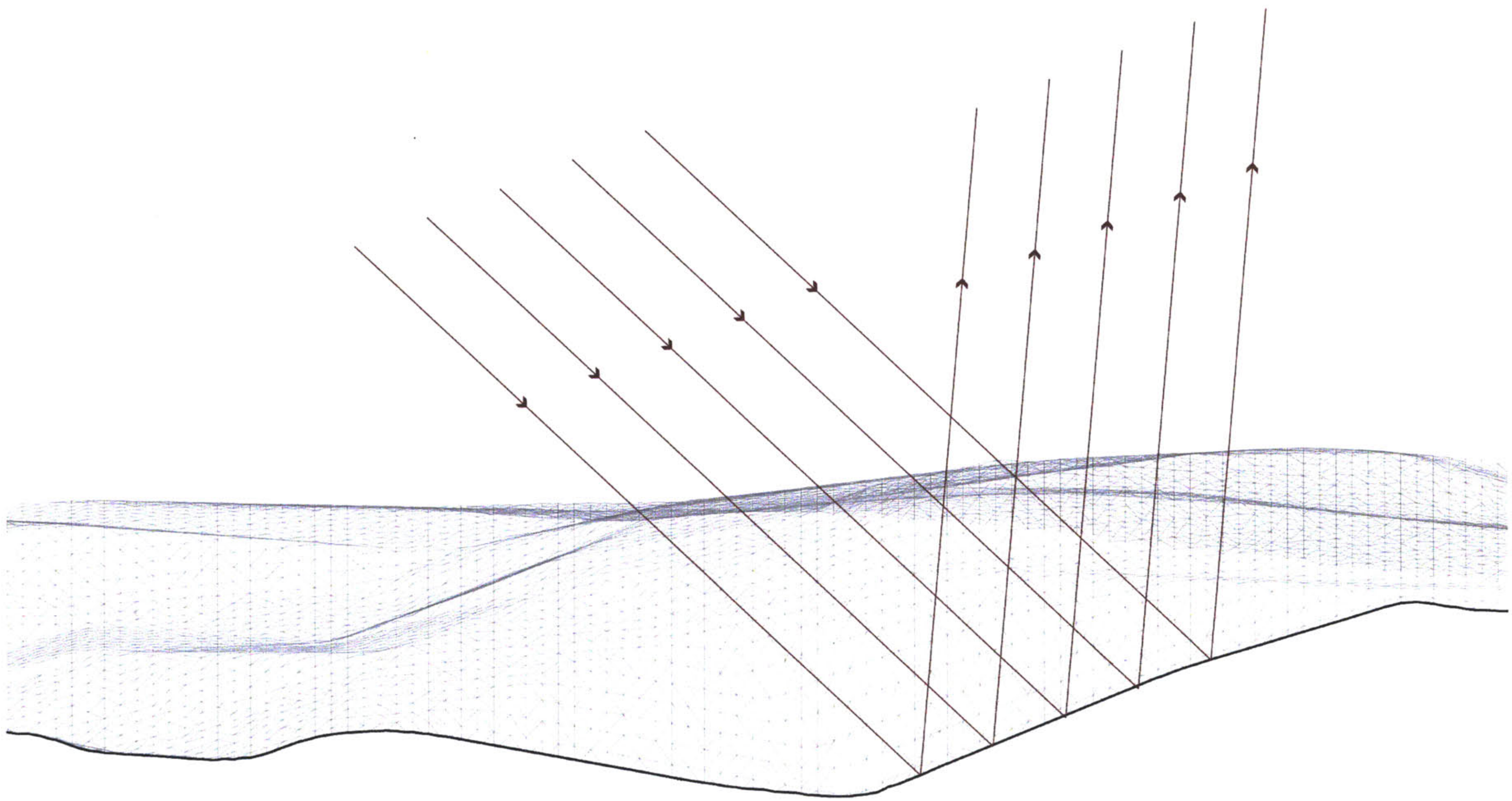
OPTICAL TEXTURES

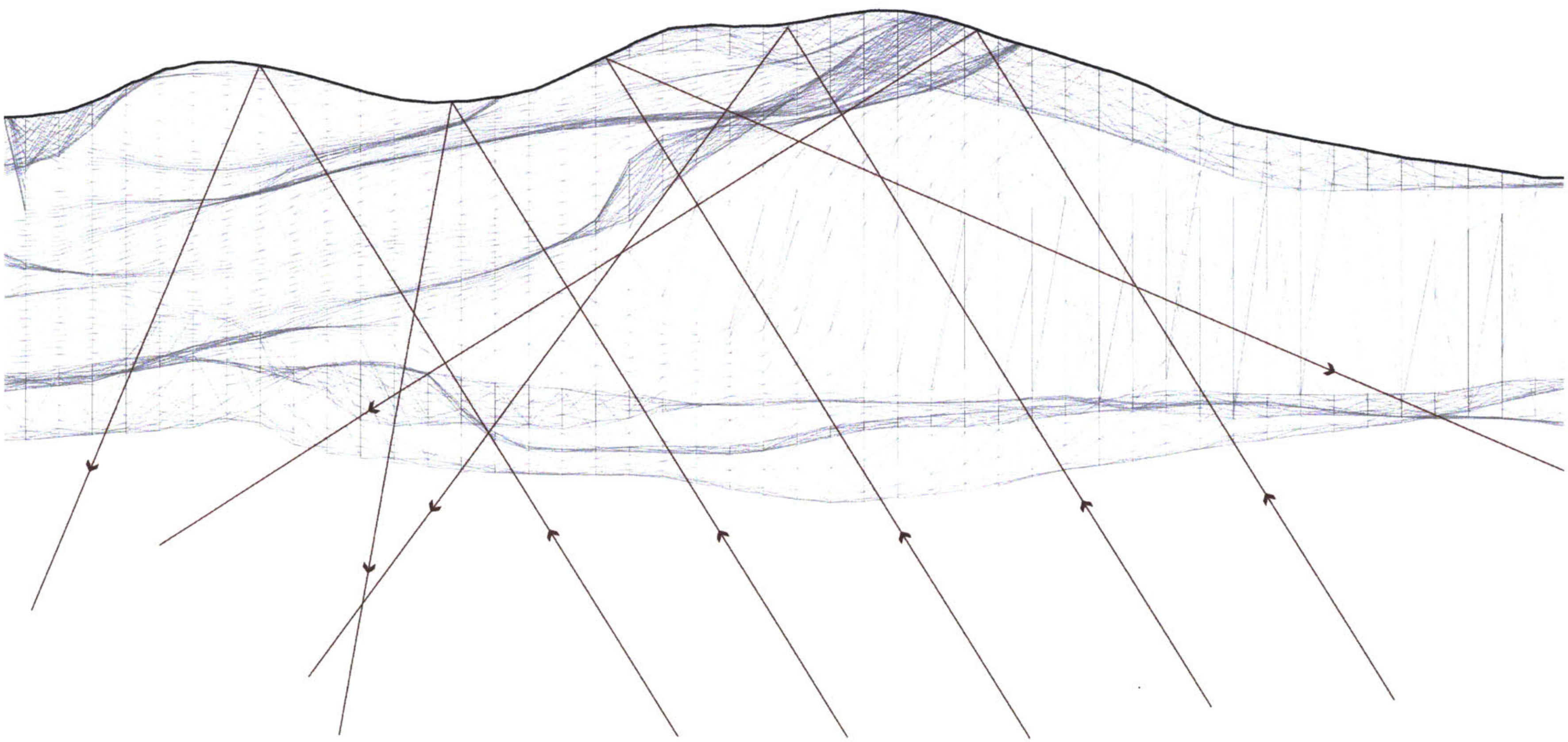
The third case study explored the use of the tool, to generate performance at the scale of the building skin. Here we tested how material qualities such as opacity, transparency, reflectivity manipulated to control how light is transmitted through and accross a surface. In particular we are interested how a single surface might produce diffuse, and directed lighting effects. We observed filtering a sample produces greater transparency We observed filtering a sample produces greater diffusion and specular noise. While the smooth un altered geometry, create lighting effects that create a transition between these conditions.

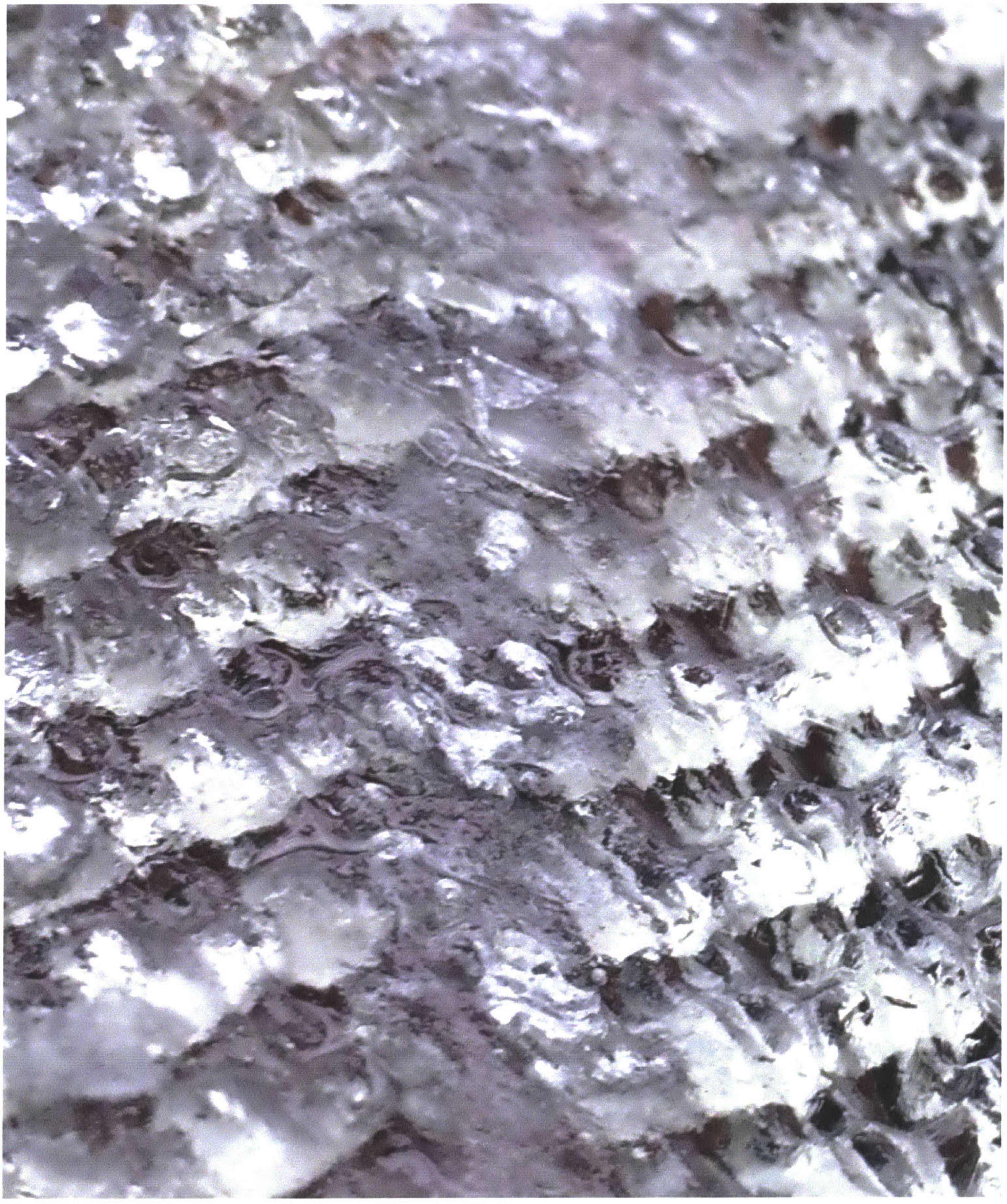


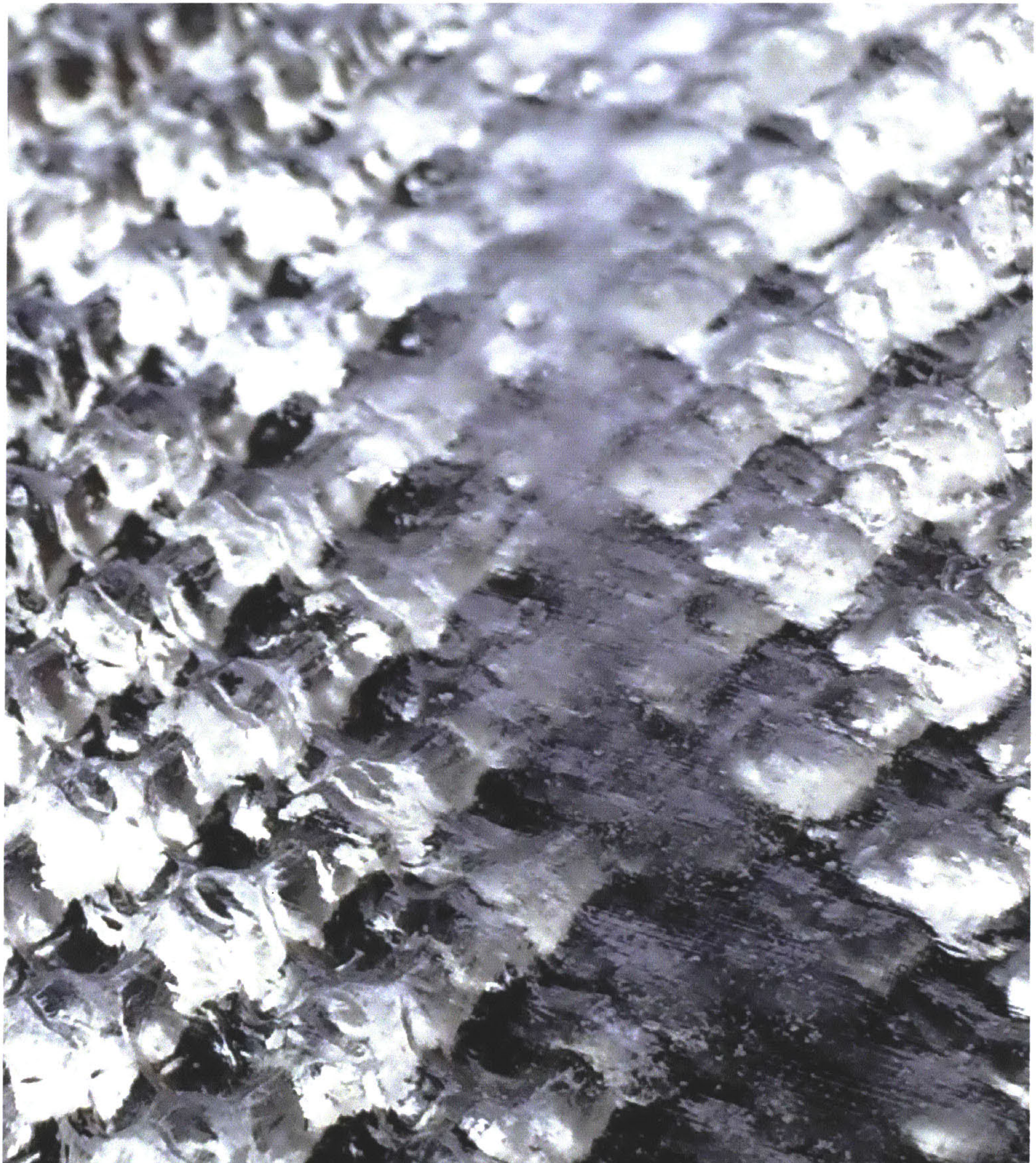




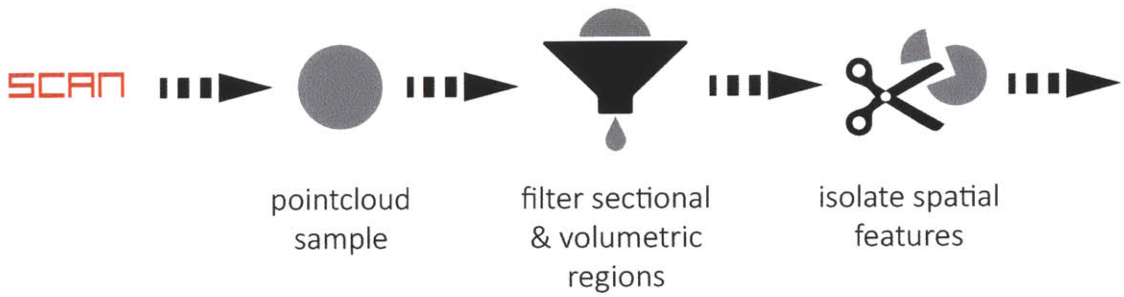




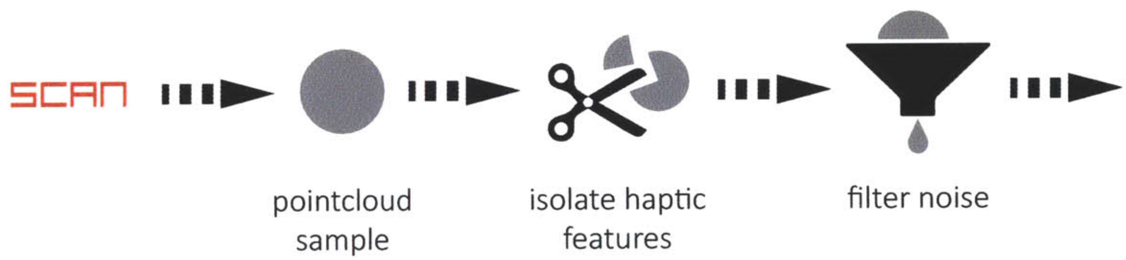




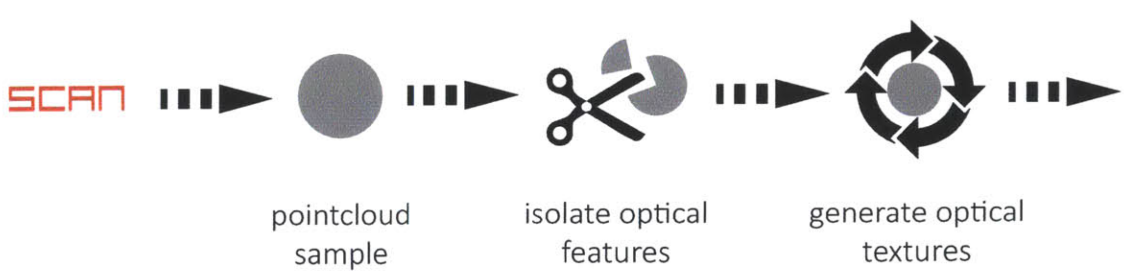
SPATIAL

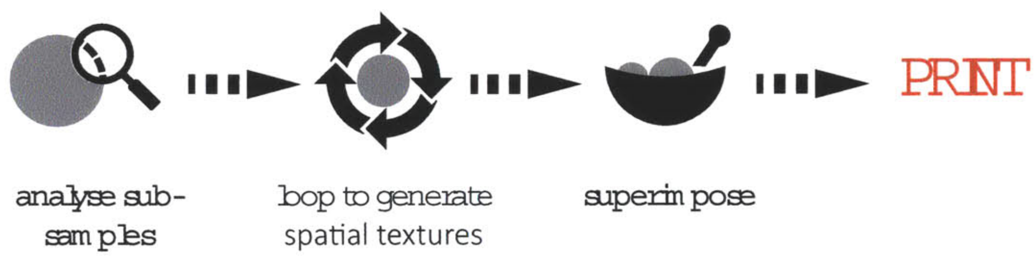


TACTILE

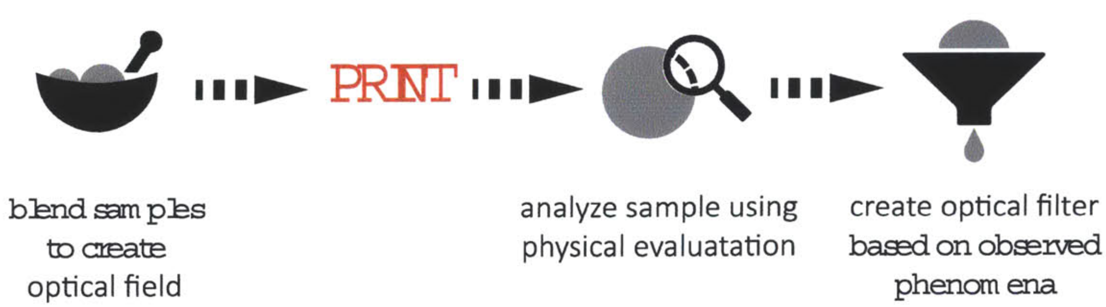


OPTICAL

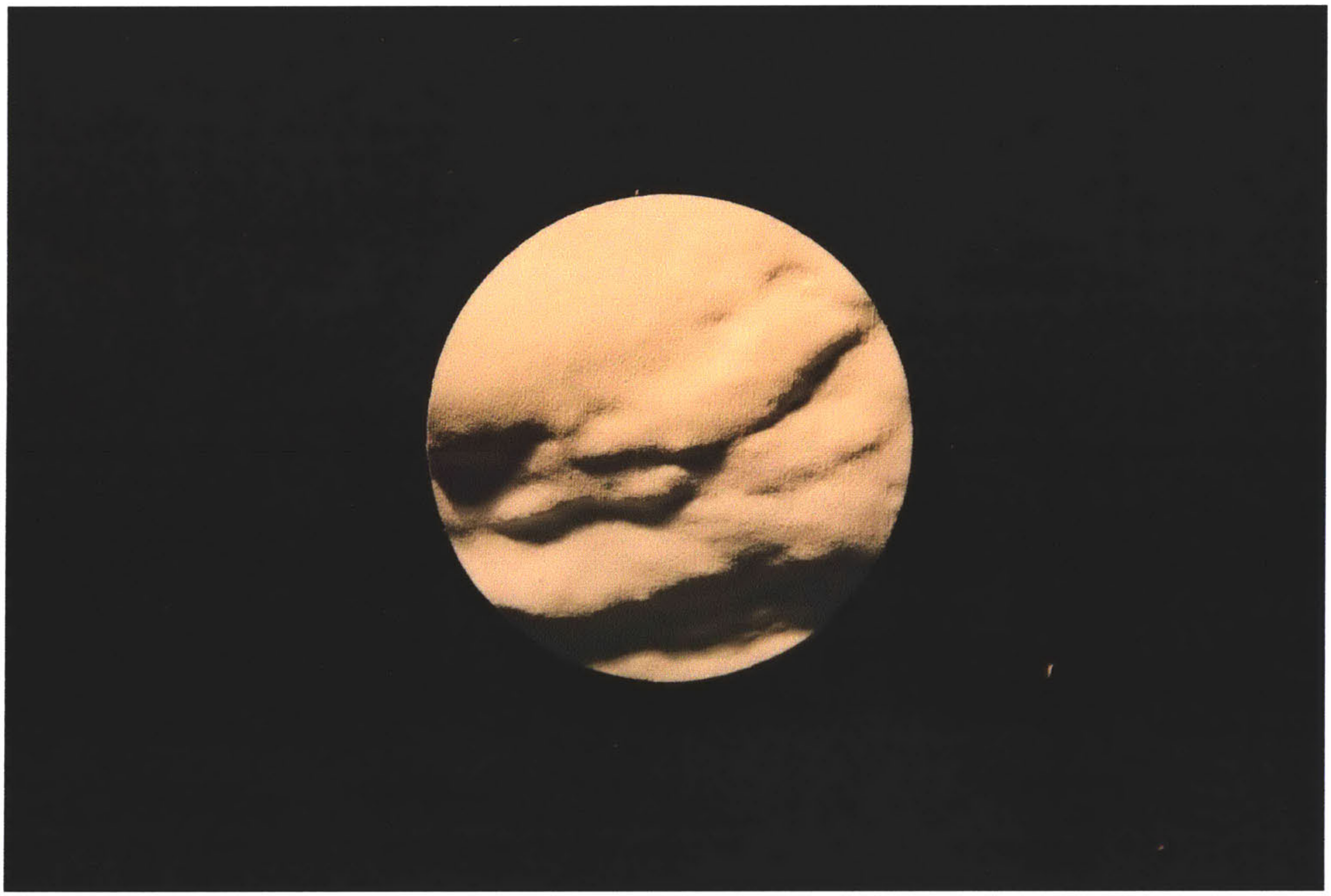



PRINT
analyse sub-samples
loop to generate spatial textures
superimpose

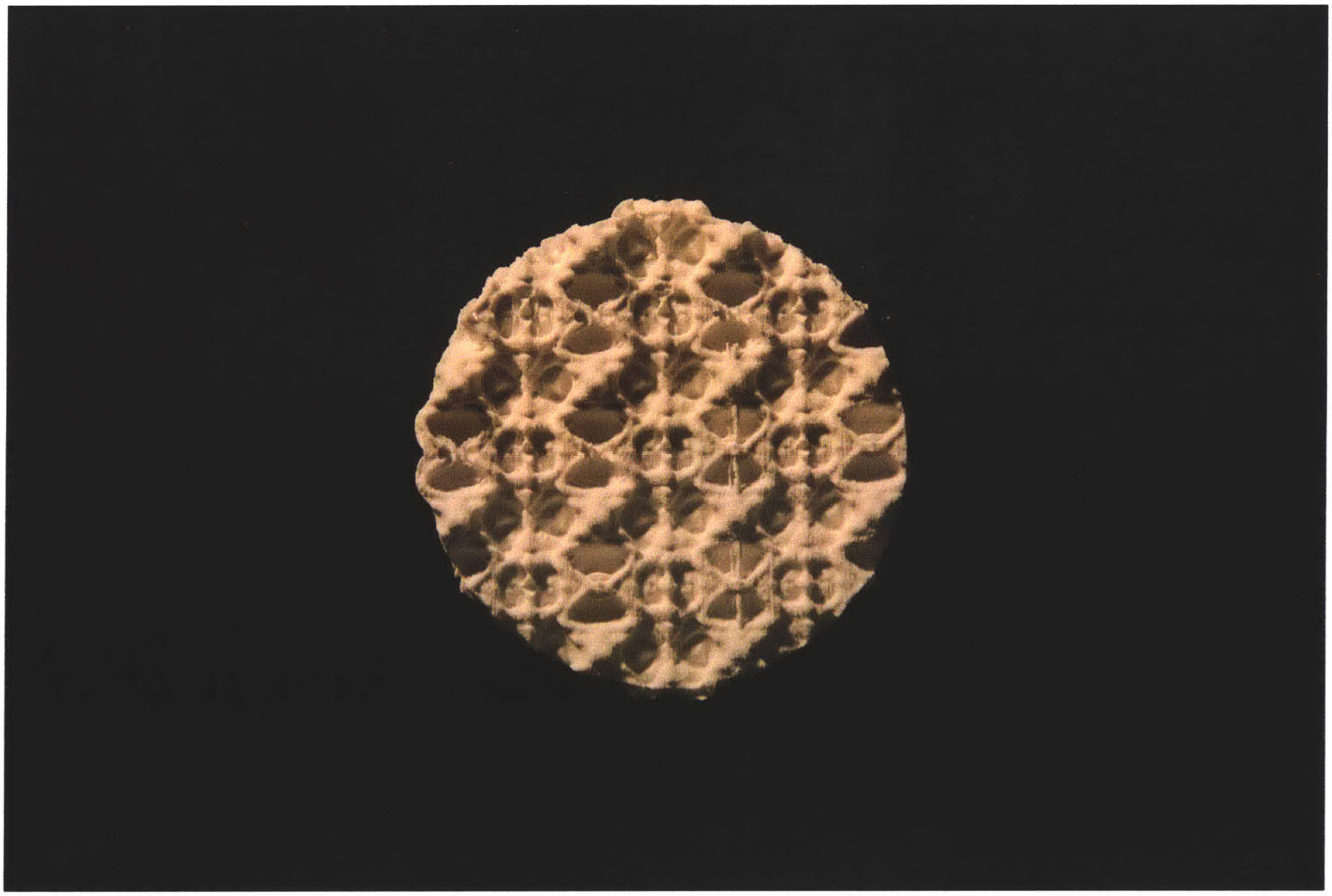

PRINT
generate haptic textures
juxtapose creating a haptic field
analyze using physical evaluatation of tactile features


PRINT
blend samples to create optical field
analyze sample using physical evaluatation
create optical filter based on observed phenomena

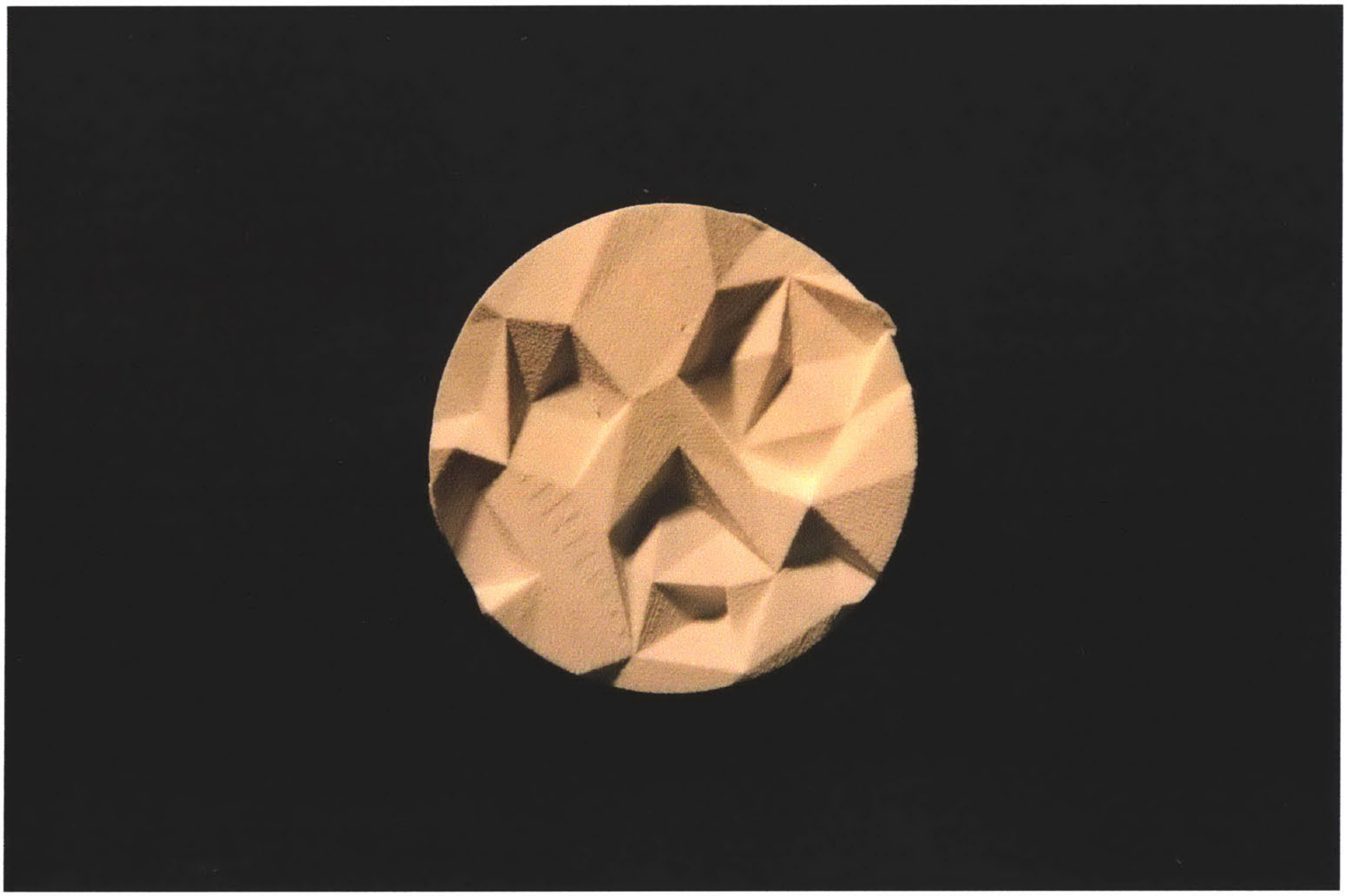
S P E
C I M
E N S



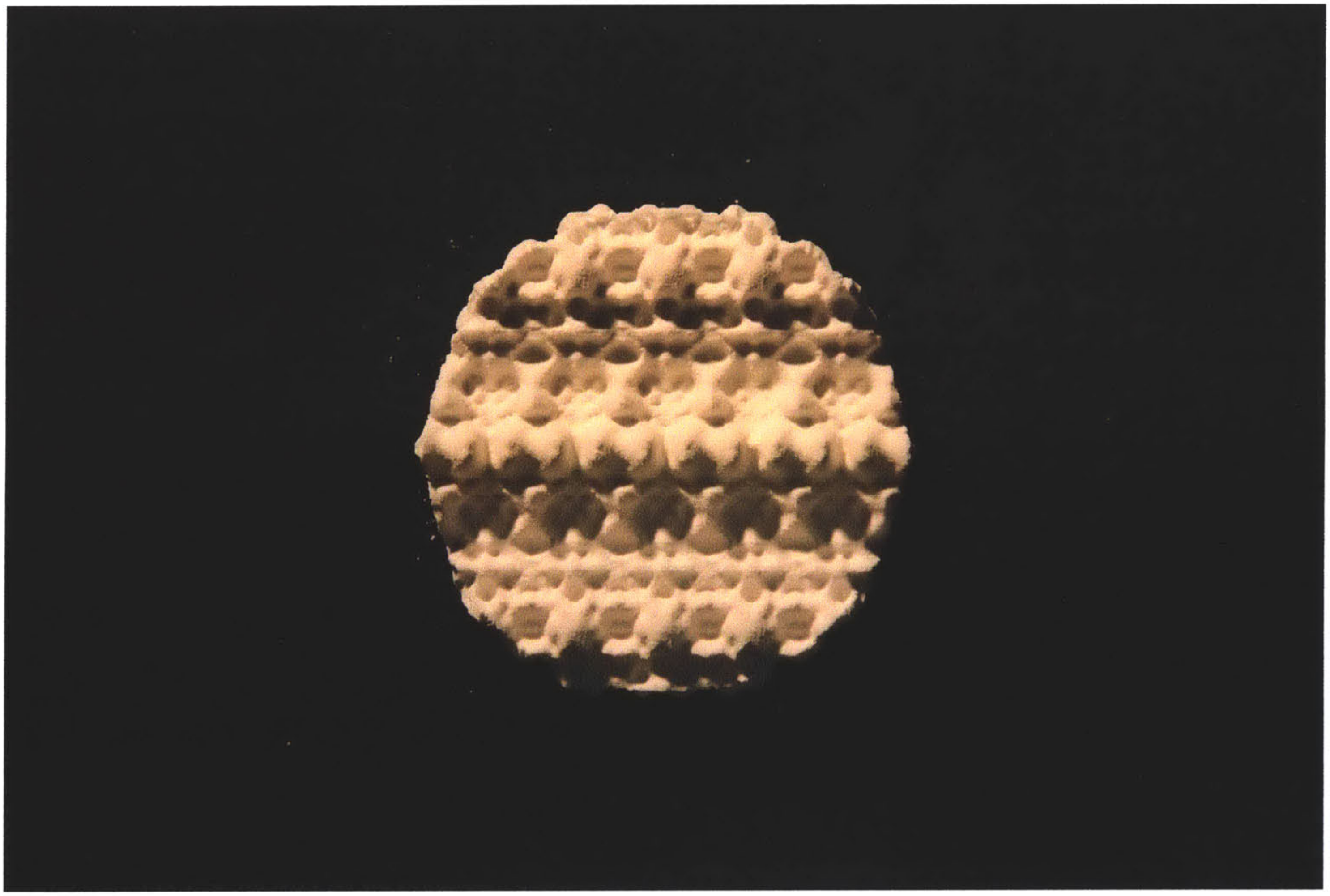
Oyster --> Sample -->
Cut --> Print



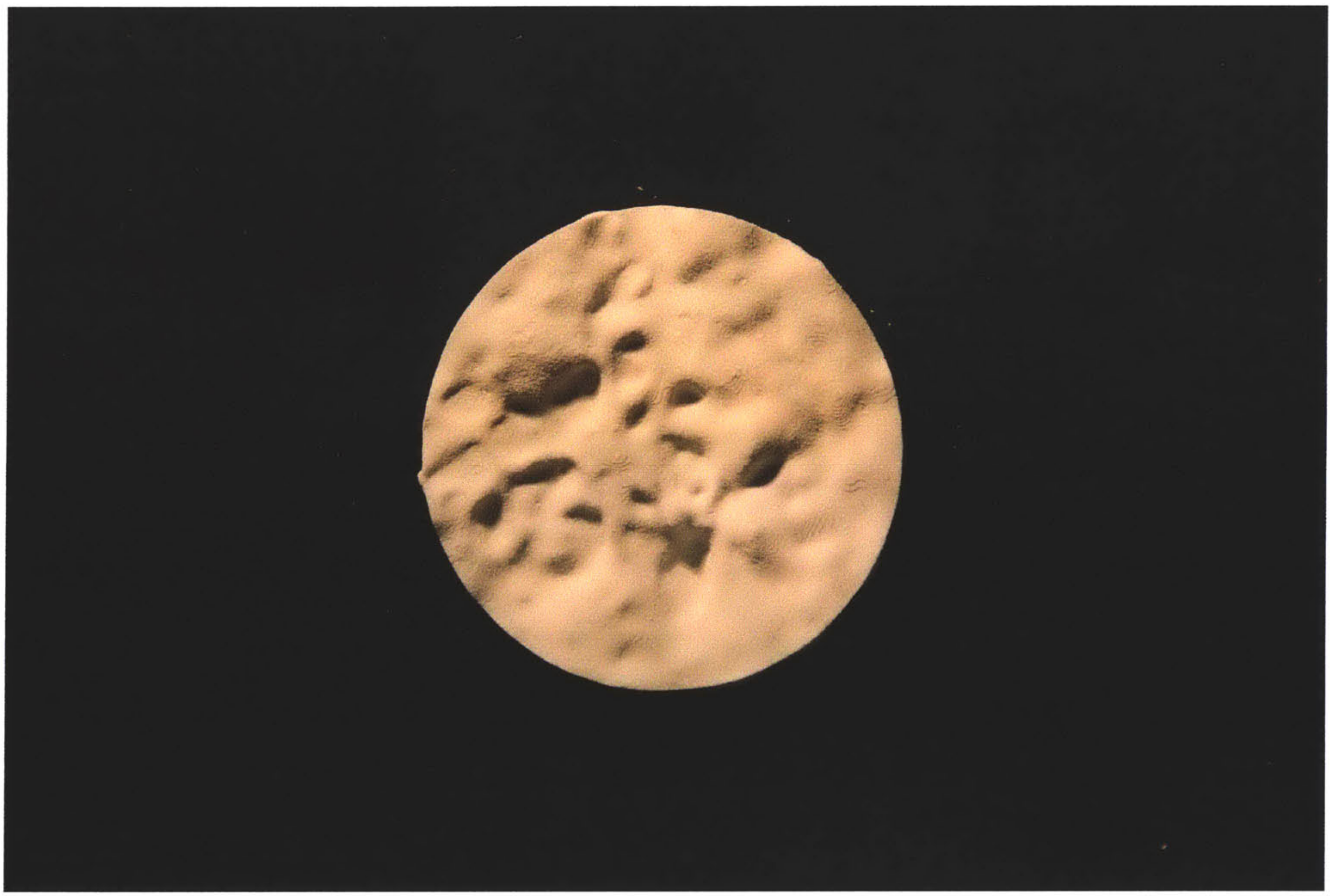
Rock --> Sample -->
Cut --> Loop --> Print



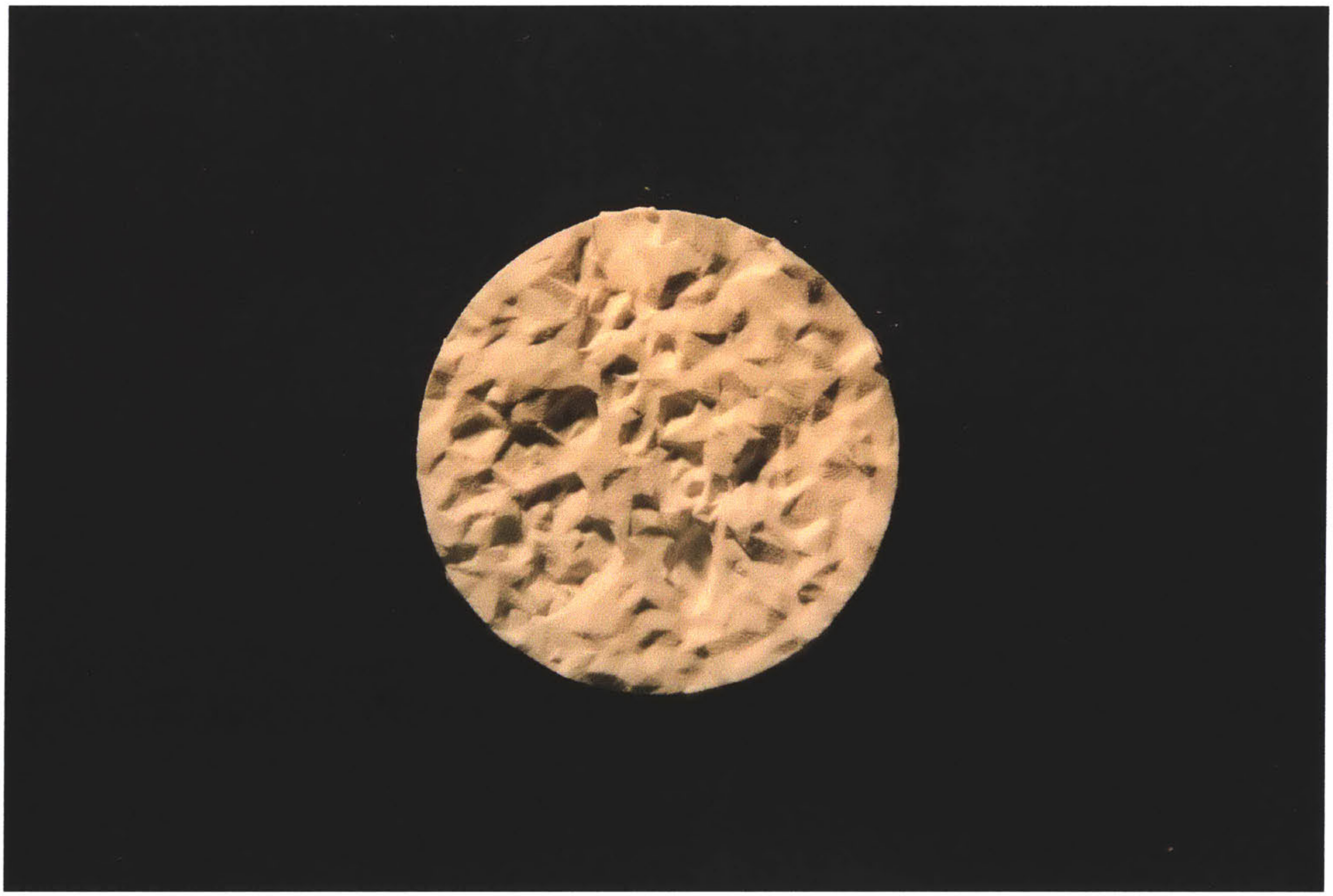
Rock --> Sample -->
Cut --> Filter --> Print



Rock --> Sample -->
Cut --> Loop --> Print



Rock --> Sample -->
Cut --> Filter --> Print

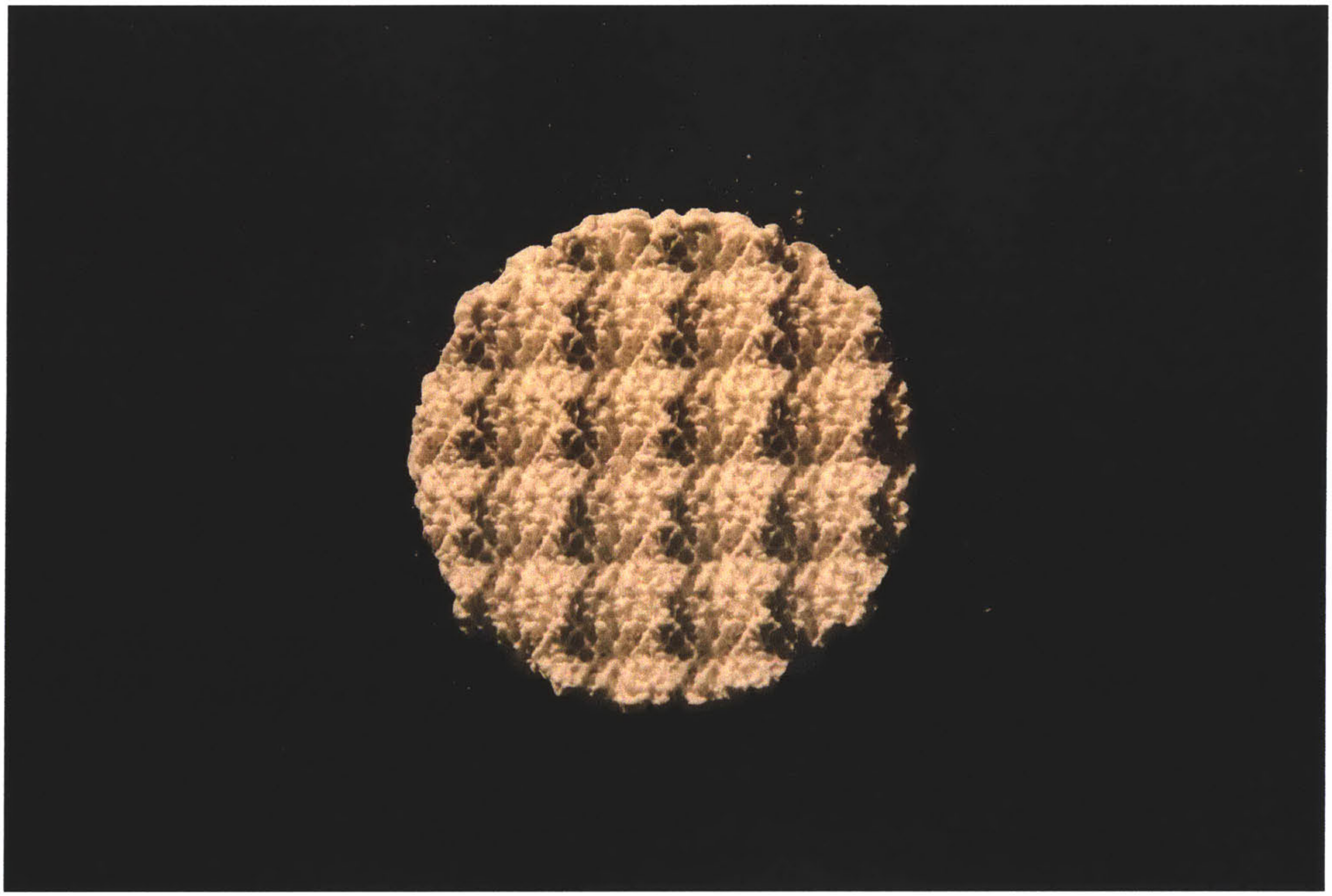


Rock --> Sample -->
Cut --> Filter --> Print

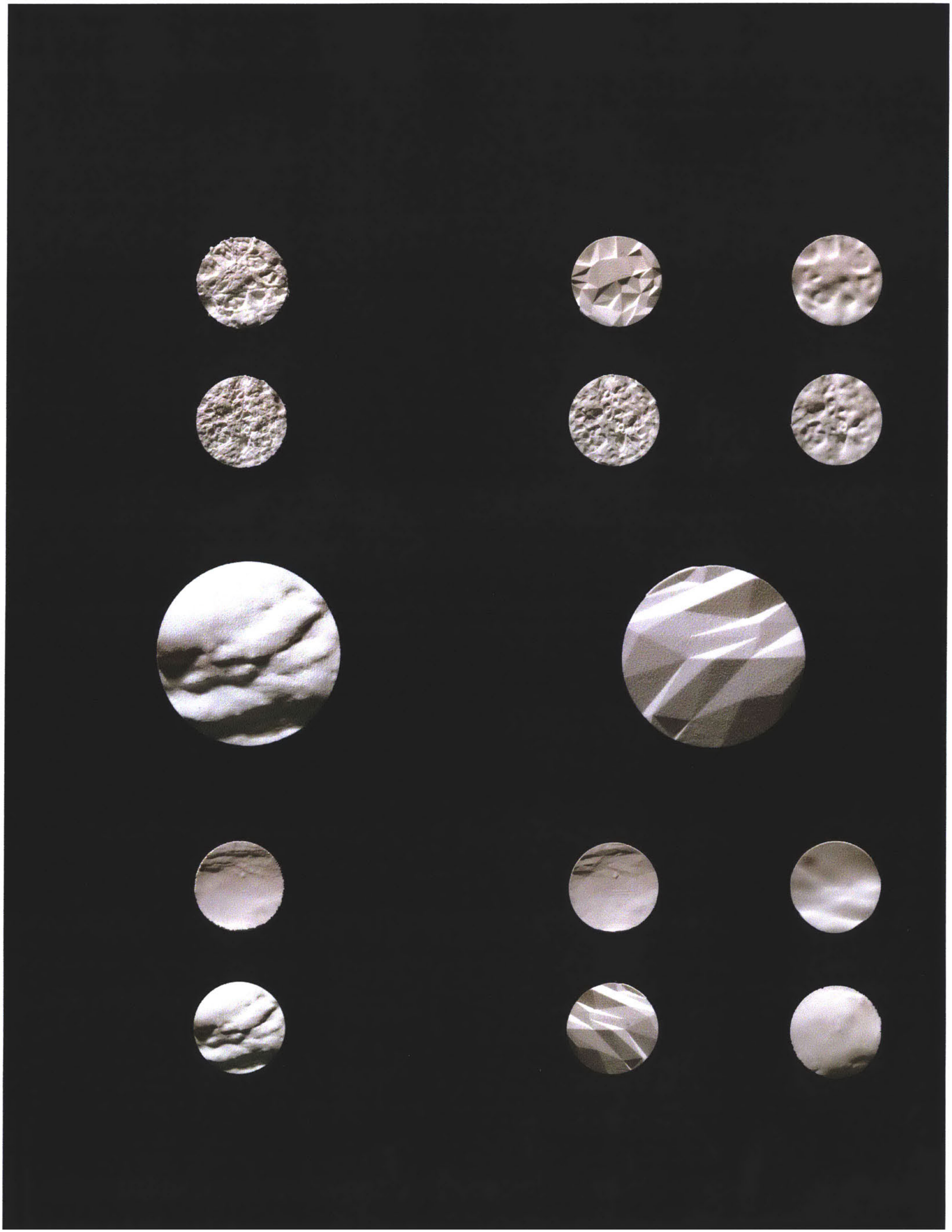
Rock --> Sample -->
Cut --> Filter -->
Loop --> Print

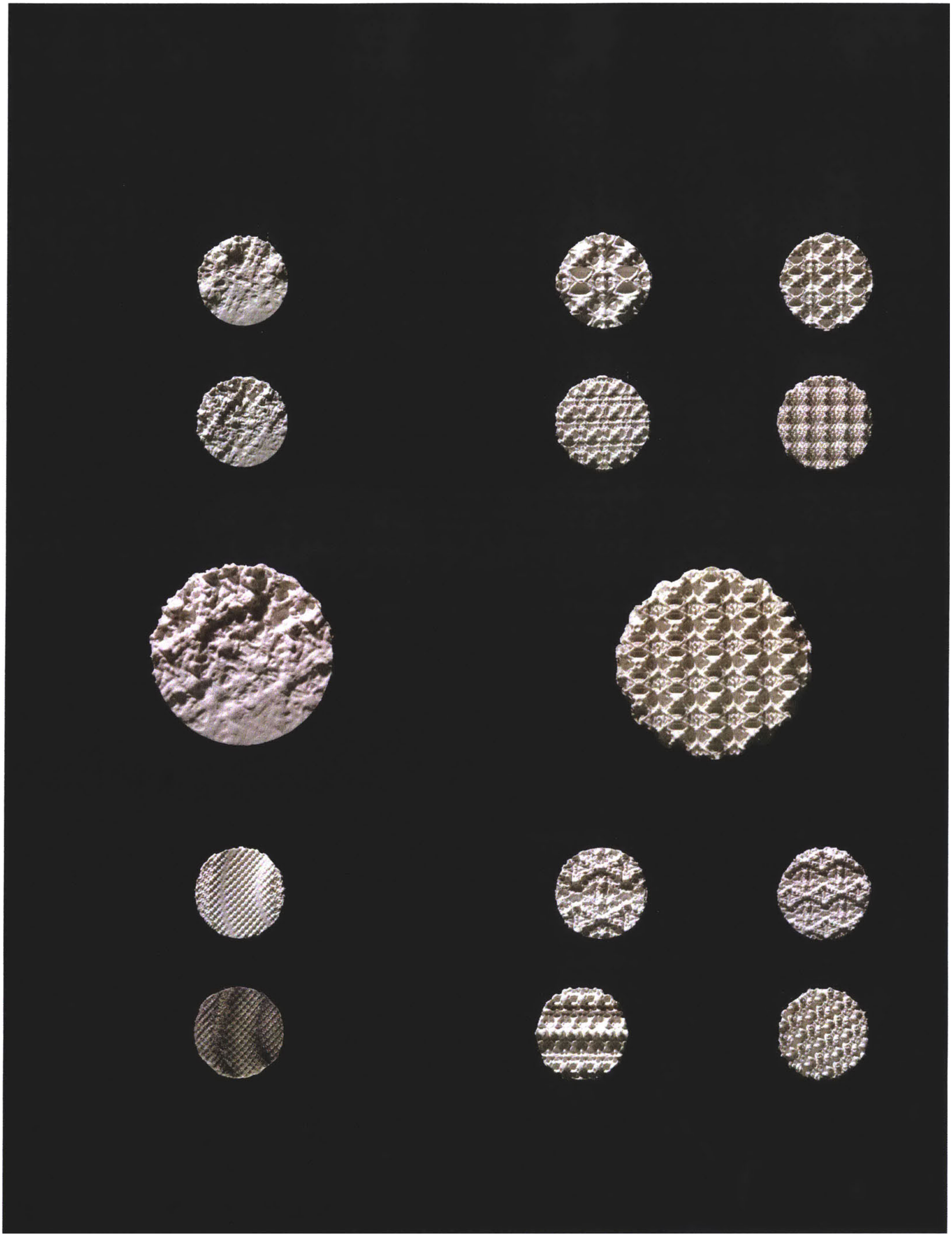
Rock --> Sample -->
Cut --> Loop --> Print

Rock --> Sample -->
Cut --> Filter -->
Loop --> Print

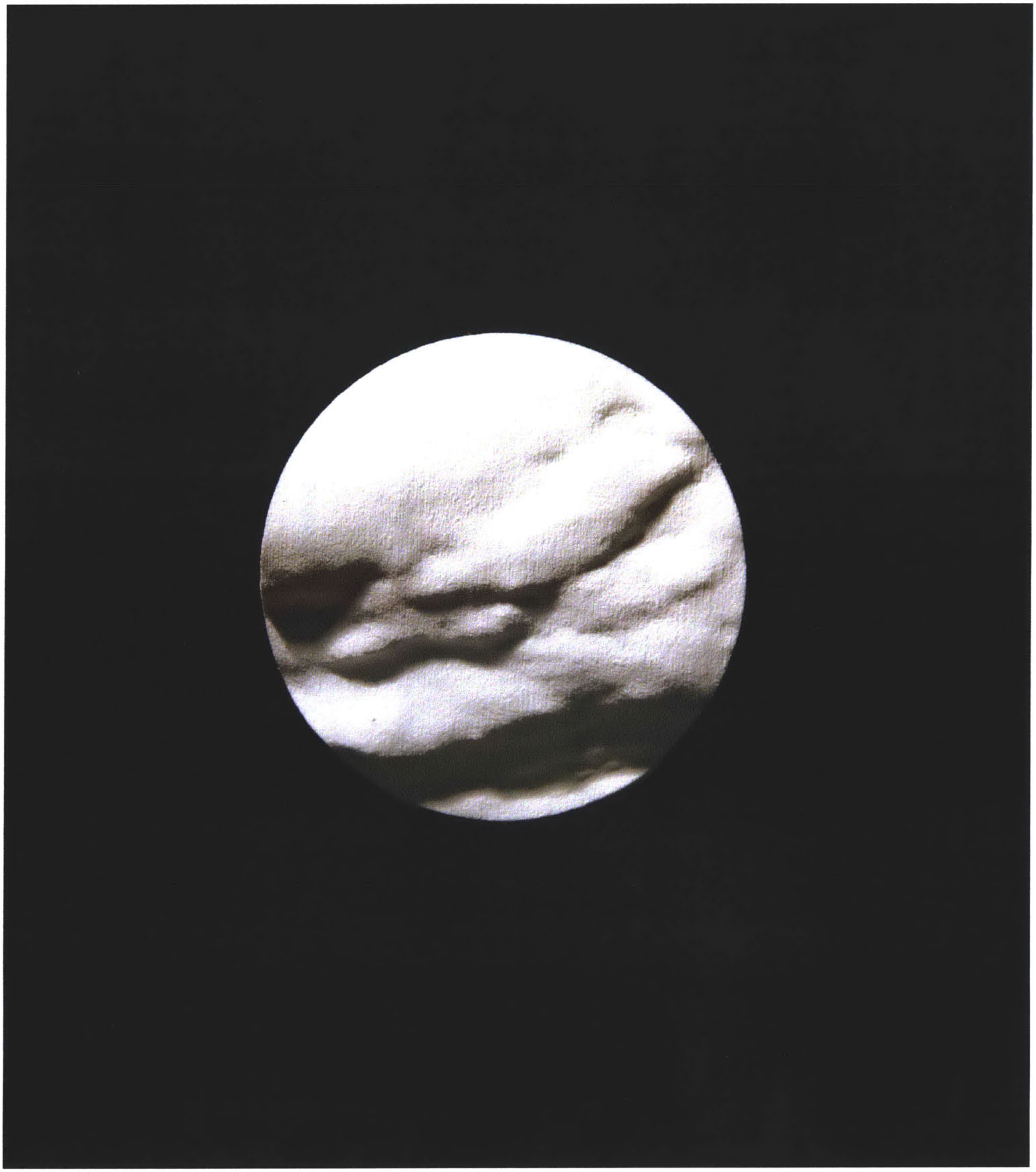


Rock --> Sample -->
Cut --> Loop --> Print





CONCLUSIONS -



CONCLUSION & FUTURE WORK

3-D scanning generates a wealth of new digital data for architects and design. This data represent not only a mine a materials that can be used not to produce form, but also new material, spatial, and even cultural qualities, properties, and effects drawn from the geometry of 3-D subjects. Re-framing 3-D scanning as a mode of creative production, the method and tools concieved within his thesis contribute a new way of designing around subjective or experiential qualties of objects or environments.

While the solutions developed within the three case studies - spatial, haptic, and optical, were framed within an architectural discourse, the implications of this work reach far outside the discipline :

Product Design

Enables the development of ergonomic, tactile, qualites such as grip, defense, water shedding, wind dispersal design around sense of touch.

Urban Design

A new medium for documenting and applying structures and buildings that would typically be over looked given convential drawing mediums as first hand research.

Landscape

Sampling of natural elements, that can be applied to facilitate blending into a landscape, fitting within the context ect.

Engineering / Structural Design

Allows textures (ie. gecko's feet, crumpled) with diserable properties found nature, but with poorly understood principles in order to applied and tested empirically vs parametric modeling processes which require a well understood model in order to be applied.

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TECHNICAL RESOURCES

Geometry

CGAL *(Very dependable, but C++-template-heavy computational geometry library, I personally stick to local modifications of the example code):* https://www.cgal.org/

Geometry Compression

http://www.siggraph.org/s99/conference/courses/course_22.html

Mesh Lab

A flakey, but interactive implementation of many meshing algorithms and mesh cleanup operations, including powercrust and MLS which are real pains to implement yourself. Reads and writes .ply files and various other formats: http://meshlab.sourceforge.net/

Poisson Reconstruction

For pointclouds - implementation in CGAL: http://doc.cgal.org/latest/Surface_reconstruction_points_3/

Projective Texture Mapping

An introduction to the math for projective texture mapping:
http://cgm.technion.ac.il/Computer-Graphics-Multimedia/Undergraduate-Projects/archive/2006/RAFAEL_fast_shadows/FastShadowProject/Project%20Book/Papers/Report.pdf

Photogrammetry

Yields meshes and camera projection transforms.
http://ccwu.me/vsfm/changelist.html is a,
http://www.cs.cornell.edu/~snavely/bundler/

Point Clouds

PCL http://pointclouds.org/ *is a good library for cloud comparison, RANSAC shape fitting and cleanup. But my favorite algorithm for estimating surface normals, tangents and binormals of unstructured point clouds is tensor voting. Window's executable here:* http://iris.usc.edu/people/medioni/ndtensorvoting.html

Texture Synthesis

Texture synthesis is a vast subject. One place to start for synthesis that's directable in a nice way is Aaron Hertzmann's work: http://www.mrl.nyu.edu/projects/image-analogies/tbn.html