

The form of sound through hybrid materials

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Figure 1: 3D models manipulated by sound, by MA students Danila Luppino (Left) and Kotaro Abe (Right).

Abstract

We describe a digital design process that interfaces real-time data with 3D modeling and 3D printing techniques. Digital Impressionism (DI) is a platform that explores new material possibilities, by 3D modeling physical and digital objects, as affected by invisible forces that act upon them in real time. Using a 3D pointcloud as a medium, we describe an experimental project run with students in our programme, incorporating real-time audio data to manipulate 3D physical forms, resulting in new static and dynamic shapes with what we call a hybrid materiality. The modeling platform of DI treats materials as composites, through which substance becomes physical via the digital interference the environment applies to digital forms. We describe dynamic modeling processes through which data enables a new hybrid tectonic made of composite shapes and materials. This abstract introduces the project and describes our methodology and results so far.

Keywords: 3D printing, data, hybrid materiality, pointcloud

Concepts: •Cross-computing tools and techniques; Design; performance; Experimentation;

1 The tectonic of digital 3D modeling with environmental data

Big data now constitutes the intangible landscape many of us dwell in every day. Like many other fields, design employs data as to help shape digital forms. In addition, sensors convert physical behavior to digital space, to then implement the physical

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environment of digital information [1]. One thing linking the physical and digital is the pointcloud, for its capability to transform intangible information into tangible forms through 3D coordinates. Digital Impressionism employs pointclouds to give intangible data digital materiality, through which substance takes form via the process of 3D scanning, digital modeling and 3D printing. In this abstract we describe the process through which environmental data can affect, and infect, digital forms. The process of design and making creates hybrid tectonics, i.e. the architecture of hybrid materials and forms. In the example illustrated in this abstract we applied ambient sound to 3D pointclouds. Through a 3D digital design process, we thereby interfaced natural entropic systems with digital simulations. Under the supervision of human creativity, we aim to enable responsive and interactive tectonics that read ambient data – sound in this case – in digital space.

2 Digital Impressionism

The DI project began in 2015 with the aims to return the artist's hand back to 3D modeling, and to integrate the design process with a continuous flow of live data to inform the creation of form, by focusing on materials and the tectonic of making. The DI platform aims to form hybrid materials via the human perception of materiality, extended into digital space. The existing literature on digital design mainly employs the keyboard and mouse or similar device as interface, and engineering software such as Autodesk Ecotect, which integrates environmental analysis but does not allow any direct interaction with it.

Within the context of the Information Experience Design programme, launched in 2012 with the intention to integrate information with experience through design [2], we set up an experimental project to test how the physical world can be interfaced in real time with the digital. Human creativity and perception of materiality drives this process; an interactive pointcloud is the medium, as it enables “entropic collaboration” between human and machine [5] and translates and extends human tactile perception of material in digital form. In order to translate hybrid materiality in physical form we are investigating multiple materials and voxel 3D printing. Similarly, by considering data as voxels, DI enables new (hybrid) materials, which are assembled between the physical and the real under the

human perception of physical materiality. We consider the relation between humans and machines as an oxymoron, which juxtaposes the contradictory processes of flattening (digital physicality) versus depth (physical materiality) [6].

2.2 Methods

In a previous project [7] we used the Microsoft Kinect depth camera to 3D scan a terracotta vase; the resulting pointcloud was imported into 3D modelling program Rhinoceros via its algorithmic editing plug-in Grasshopper. Real-time data of the ambient lighting conditions was used to distort the model, which was then exported as triangulated mesh, and imported into ZBrush software. There it underwent manual sculpting, texturing and colouring, before 3D printing and spray painting the resulting transformed vase as a new, hybrid object.

Grasshopper does not deal with real-time 3D pointcloud data well. For the current project we thus switched to Processing. This phase of work took place over three months, involving five MA students and one MPhil student, all from different backgrounds, to experiment with the system. The previously scanned vase was used as a dataset, and the pointcloud was modified by real-time audio from the computer microphone via the audio Minim library. Models were exported in .OBJ format, along with a .CSV file of 3D locations, which was then imported into CloudCompare software to be turned into a mesh for 3D printing.

3 Results

The process was kept open as a way of thinking through making. Danila Luppino, for example, worked only with the pointcloud of the scanned vase and no sound data. Figure 1 shows this pointcloud with individual voxels each rendered as a sphere. She manipulated the scale and position of the spheres to re-assemble them into a new form.

Virna Koutla took the opposite approach, experimenting only with staccato, percussive sounds versus sustained vocal sounds, then manipulating the resulting waveforms. MA student Francisco Norris scanned a banana for its simple shape and flat colour.

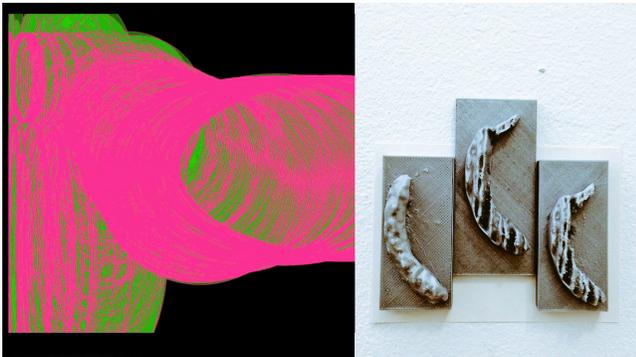


Figure 2: Virna Koutla's sound waves captured and distorted by environmental sound (Left); 3D printed banana distorted by sound waves, by Francisco Norris (Right).

He then 3D printed a version of it distorted by audio of single-frequency tones. Ker Siang Yeo used the sound of hummingbirds distort a pointcloud of a hummingbird nest.

Joanne Harik began with the pointcloud data of the vase, imported the sound of breaking glass into Processing, and applied this to

the vase. The result was a sonic shattering of the form, mirroring the real-world phenomenon of sound waves shattering glass, but in a surreal, impossible way only possible within the digital world, in which the vase is rendered in individual triangles, intended to allude to sharp fragments of real shattered glass, yet each perfect in its own form. She displayed the result as a printed flipbook of images.

4 Conclusion & next steps

As this is an experimental project, we are testing and evaluating the process and results. Processing is not a comprehensive 3D modeling program, although libraries gave us the flexibility of incorporating different kinds of data through different input devices. The Kinect, with a pair of low-resolution infrared depth cameras, results in messy pointcloud data.

The project can expand in many directions: environmental data can be incorporated in creative and artistic practice that employs sound and moving image interfaces (AR headsets, drones, etc). We are looking at new multi-material 3D printers and 3D bio-printers, which can work dynamically through digital reality headsets.

Forms are dynamic, composite systems that perform in relation to the surrounding conditions. Through DI we aim to challenge existing notions of 'intelligent behaviour' through sensors and smart materials. DI incorporates traditional artistic methods with a critical perspective, hacking current machines, algorithms and data in order to improve our collective knowledge. Through it we recognise that a key aspect of what makes us human is the ability to make.

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