The 8th ACM/EG Expressive Symposium - Posters, Demos, and Artworks
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SURFACE: Xbox Controlled Hot-wire Foam Cutter

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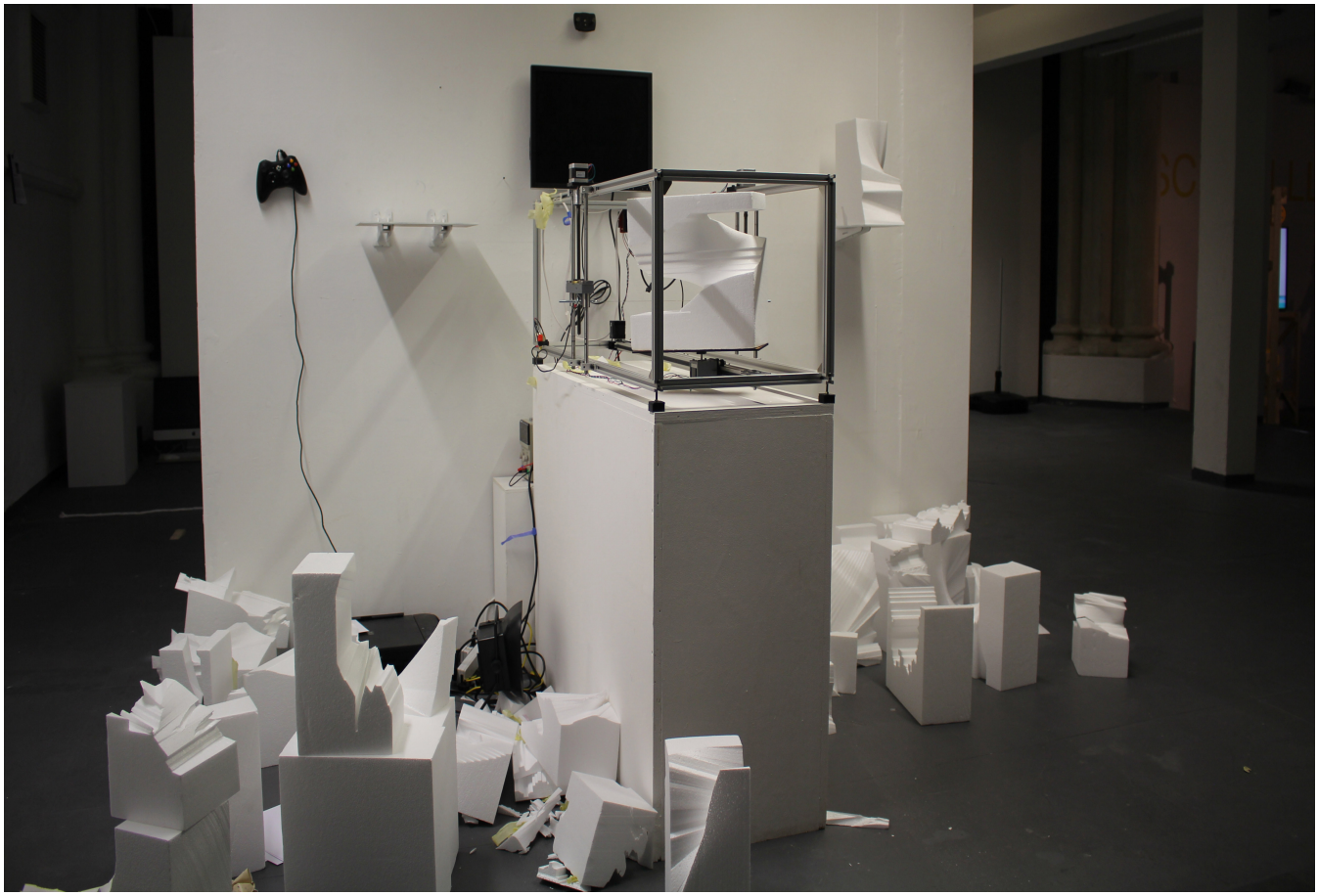

Figure 1: *Surface instrument setup*

Abstract

This artwork is a 3-axis sculpting instrument controlled by an Xbox controller, which allows anyone to intuitively apply one's creativity in a real-time flow without the aid of pre-drawn digital geometry. Surface runs purely on user instinct rather than on any digital geometry. The artwork explores the ambiguous boundary between the analogue and digital; it also challenges conventional methods of digital fabrication, which rely vitally on CAD software.

CCS Concepts

• ***Applied Computing*** → *Media Arts; Visual Arts;* • ***Hardware*** → *Tactile and hand-based interfaces; Haptic Devices;*

DOI: 10.2312/exp.20191093

1. Artist Statement

With recent technological advancements in digital modelling software, students and designers in the architectural field can now utilise a modelling software's prewritten algorithmic functions to achieve parametric complex geometries without necessarily understanding the mathematical theories behind them. As Kostas Terzidis mentions,"it may be argued here that the long awaited paradigm shift in style occurred not in the designer's mind but in the programmer's mind" "CAD software developers are meta-designers, designers of design-system" [Ter06]. Although this claim may not be entirely true, it is arguably correct that in recent years more students are adopting computer-aided drawing functions as their design cognitive in their architectural education. In addition, with easily usable desktop-sized additive fabrication tools such as 3D printers, designers can now effortlessly produce complex geometries directly as physical prototypes. However, this type of workflow prevents designers from experiencing the haptic aspects of model making, thus eliminating the human-to-material relationship in design and construction. In contrast, pioneers in computational modelling such as Antoni Gaudi used cartographic drawings and plaster models to rationalise hyperbolic geometries [Bur16]. This artwork was therefore developed as a challenge to the growing trend of accepting computer parametricism as a design intent[Sch10]. This artwork aims to reintroduce the joy in the human act of creating art in a playful manner involving both the digital and physical.

2. Construction

The Surface uses the traditional method of hot-wire cutters, consisting of Nichrome wire and an adjustable DC power supply, but moves the Styrofoam block using 4 stepper motors (3-axis) connected to the Xbox game controller instead of by hand. The surface machine was exhibited at Goldsmiths University as a workshop for people to actively participate in its making process. It was surprising to see how quickly audience members grasped the Surface's technique, quickly becoming playful with the instrument, although this is likely due to their prior familiarity with the Xbox controller. A key focus of this Xbox-controlled hot-wire CNC is to showcase the concept and the experience of constructing a ruled-surface geometry. Simply by controlling the speed and the rotation of three different motors, participants witness the sculpting process of curvelinear surfaces generated from a single straight hot wire. It was also vital that the audience receives clear and effective visual feedback of the sculpting process; the temperature of the hot wire had to be adjusted to ensure that the wire cuts through the foam at an appropriate speed. Surface uses the Arduino mega and Ramps board 1.4 to control all the motors and an Xbox 360 controller connected to a Windows PC to write commands to the Arduino board.

3. Musical score or G-code

In addition, as participants use the cutting instruments, the computer records user commands on the game controller and produces graphical notations on screen similar to a musical score. At the end of the sculptural process, this notation is saved as a PDF, which can be viewed and studied. As shown in Figure 4, this notation better describes the output geometry than conventional descriptors such as dimensions, angles or G-code. While the cut artwork cannot be duplicated perfectly, users can consistently produce accurate models through their mastery of the required technique, just like playing a musical instrument.

Figure 2: *Picture of an audience member playing with the Surface exhibited as a workshop at Goldsmiths University, 2017* https://youtu.be/NUXkQs2yhhE

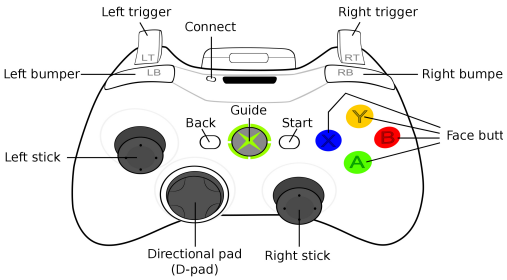

Figure 3: *The Surface uses 4 keys on the Xbox360 controller: left trigger (rotates the base to the left), right trigger (rotates the base to the right), left stick (moves base in Y-axis) right stick (moves base in Z-axis)*

4. Application

Figure 5 shows a Styrofoam sculpture constructed with the Surface. This column consists of 12 Styrofoam geometries sculpted from 6 rectangular Styrofoam blocks. The geometries on the left side of the column are an exact void of the geometries on the right side; put together, both sides form a column of perfectly rectangular blocks. This installation showcases a Boolean splitting method of making a sculpture: one neither additive nor subtractive, the two most common ways to sculpt raw materials.

References

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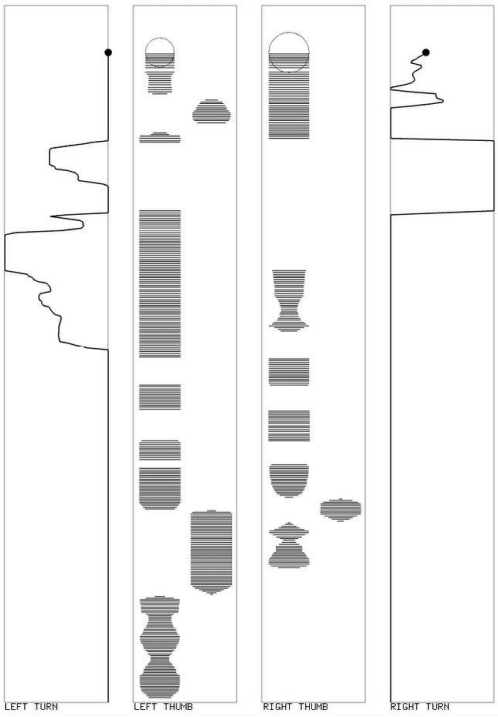

Figure 4: *Notation showing controller history in a vertical timeline*

Figure 5: *Butterfly Effect Exhibition at OXO Tower Wharf, May 2018*