GSAPP Fall 2014 - VISUAL STUDIES WORKSHOPS

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Session A: A4753 - Special Topics in Fabrication: Design Machine

Josh Draper and Eric Hagan Tuesdays 7-9pm 115 Avery

Overview

Digital Fabrication has revitalized the idea of the Architect as Maker. While new software and workflows have made digital fabrication accessible, its potential to intervene in practice is only fully realized at the level of the CNC machine. What might become possible if Architects designed and built their own machines? Agendas involving material, performance and computation could be embedded instead of inherited. New architectures could become possible when control extends to this foundational level.

Formworks is a Visual Studies Digital Fabrication course which combines casting with computational techniques through the production of a *Design Machine* - an original and specific CNC machine. Using the Firefly plug-in for Grasshopper, the Arduino microcontroller and servo devices such as stepper motors and linear actuators, students will make their own CNC machine from the ground up to produce a system of non-repetitive castings.

Formworks will be staged in two sessions over the semester. Students are strongly encouraged but not required to attend both sessions. The first session, *Design Machine,* introduces students to mechatronics techniques using Firefly, Arduino and two basic servo devices - stepper motors and linear actuators. Students will make a prototype servo device, which forms the basis of a larger system, to mechanically and computationally demonstrate a system of non-repetitive but parametrically related castings. In parallel, students will be introduced to various casting techniques. The second session, *Field Fabrications*, will iterate the prototypes, producing a larger array of robust servo devices. Full castings will be made using the system. The course will focus on pre-cast curtain walls to maximize the graphic qualities of the process.

Session A: Design Machine

Beginning with an introduction to the machine in Architecture and Design, students will research and present projects that deployed, or actively employ, computational mechanisms in their design and/or operation. We proceed with an introduction to Physical Computing and Mechatronics, using the Firefly Grasshopper plugin to control a stepper motor and develop a vocabulary of rotational moves and states which are simultaneously represented by and controlled through Firefly and Grasshopper. Linear actuators, which use embedded stepper motors, are introduced. Translation is added to rotation in the kit of moves. The prototype *Design Machine* emerges, using a propagated array of rotations and translations to manipulate a formwork membrane. Students propose a system of castings which each maps a different state of the formwork membrane. In parallel, we investigate physical casting techniques and materials and inform the *Design Machine* process

Blog of current course: www.allianceresearch.net

Session A - Design Machine is a prerequisite for Session B -Field Fabrications

Click here to register for the Session B course, "Field Fabrications"

Course Workflow:

Schedule

Classes meet Tuesdays in Avery 114 from 7pm to 9pm

Class 1

Class Overview

Lecture "Fabric Formwork and Digital Fabrication"
Formwork Construction and Anatomy

Hands On: How to cast in plaster and concrete

Assignment: Using a standard casting footprint, produce 10 effects exploring fabric material, cast surface, volume, curing, and cast material.

Class 2

RhinoCAM 2d milling introduction - Digital Joinery using the CNC Mill
Grasshopper and Kangaroo for formwork simulation

Assignment: continue production of 10 effects using fabric formwork

Class 3

Pin up: Present 10 effects

Grasshopper and Kangaroo for field design - part 2
Using Diva for sun simulations

Assignment : Choose an effect and develop it as physical animation in 5 castings. Isolate and animate the parameters that make the effect. Prototype and draw a "design machine" using digital fabrication that produces the effect. Extrapolate the effect to a field design using Grasshopper and Kangaroo

Class 4

Designing the machine - Electricity, circuitry and mechatronics
Grasshopper/Kangaroo working Session

Present progress of "Physical Animation" of 5 castings, field design and design machine prototype

Class 5

Designing the machine - Arduino and Firefly
Grasshopper/Kangaroo working Session

Present progress of "Physical Animation" of 5 castings, field design and design machine prototype

Midterm

Present "Physical Animation" of 5 castings, field desgin and design machine prototype

References:

Field Conditions, Stan Allen, 1985

Physical Computing, Dan O'Sullian and Tom Igoe, 2004

Studies in Tectonic Culture, Kenneth Frampton, 2001

Tangible Bits, Hiroshi Ishii and Brygg Ullmer, 1997

The Computer for the 21st Century, Mark Weiser, 1991

Firefly

Grasshopper group: www.grasshopper3d.com/profile/firefly

Firefly homepage: www.fireflyexperiments.com/

Firefly users guide: fireflyexperiments.com/s/Firefly_Users_Guide.pdf

Kangaroo:

Grasshopper group: http://www.grasshopper3d.com/group/kangaroo

Diva:

Homepage: http://diva4rhino.com/

User Guide: http://diva4rhino.com/user-guide