CourseNo: ARCHA4748_001_2013_3

Meeting Location: AVERY HALL 115

Meeting Time: T 07:00P-09:00P

Instructor Information: Joshua William Hugo Draper

Special Topics in Fabrication: Formworks

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. 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 facade tiling 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 with material constraints.

NOTE: Students are strongly encouraged to attend both sessions.

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

Schedule

Classes met Tuesdays in Avery 115 from 7pm to 9pm

Class 1 // Tuesday, September 10

Class Overview
Dynamic Formworks
Physical Computing
Hands On: Arduino “Hello World” - The blinking LED
Assignment : Research and present a project that uses Physical computing (computational mechanisms) in its construction and/or operation

Class 2 // Tuesday, September 17

Hands On: Wiring a stepper motor, and a sensor w/Arduino & Firefly
Assignment : Choreography with 4 stepper motors

Class 3 // Tuesday, September 24

RhinoCAM 2d milling introduction towards linear actuator design
Formwork Construction and Anatomy
Assignment : Linear actuator - Prototype 1

Class 4 // Tuesday, October 1

Hands On: Casting plaster
Hands On: Casting concrete
Assignment : Linear actuator - Prototype 2 - Attach to formwork membrane

Class 5 // Tuesday, October 8

"Science Fair" (Deskcrit in the Round) - Present Design Machine work thus far

Midterm // Tuesday, October 15th

Show operational Design Machine using atleast one linear actuator working with Firely
4 Prototype castings using Design Machine

References:

Firefly page on the Grasshopper site

Fireflyexperiments.com - Firefly homepage

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

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