

CourseNo: ARCHA4753_001_2014_1

Meeting Time: T 07:00P-09:00P Meeting Location: [BUELL HALL 200](#)

Instructor Information:

[Joshua William Hugo Draper](#)

Special Topics in Fabrication: Formworks

Blog of current course: www.allianceresearch.net

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 foundationSal 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 B: Field Fabrications

Building on Session A's "[Design Machine](#)" work, Session B begins with a review of mechatronics techniques and Firefly operations. Using the vocabulary of servo rotations and translations, we further develop the pre-cast facade tiling design visualizing the full field pattern of a panel. Quantities, sizes and edge transitions are scoped and designed. The output of this process feeds back in to the second prototype of the *Design Machine*. We choose a manageable number of servos which, aggregated in a single device, can produce a satisfying portion of our *Field Fabrication*, our pre-cast tile wall. In turn, we will realize the full *Design Machine*.

We will simulate and visualize the field of castings using the Grasshopper plugins Kangaroo and Diva. We then devote the necessary time to refining the *Field Fabrication*, mastering material and mechatronic processes and producing a sufficient quantity of panels to physically demonstrate the project. We end with a presentation of the synchronized Firefly/Grasshopper interface and the

mechatronic *Design Machine*, a visual presentation of the pre-cast tile wall, and the *Field Fabrication* castings.

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

[Click here](#) to register for the Session A course, "Design Machine"

Course Workflow:

Schedule:

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

Class 1

Working in concert: Fabrication; Simulation; Visualization

5 kinds of field fabrications; 10 important non-repetitive facades

Design Machine as a parametric module - Field design with Grasshopper

Introduction to Formfinding with Mesh Relaxation

Introduction to Kangaroo

Assignment : Field design Version 1; Site Selection

Class 2

Connecting Kangaroo, Grasshopper and Firefly

Multiple Arduino kits in Firefly

Techniques of Attachment - Building and Installing the Field

Assignment : Field design V2

Class 3

Introduction to Diva

Timelapse and Stop motion - Camera tricks and After effects

Assignment : Refine Design machine

Class 4

Casting Review

Assignment : Refine Design machine

Class 5

Progress Review

Assignment : Refine Design machine

Class 6

“Science Fair” (Deskrit in the Round) - Present Design Machine and Field Fabrications

Final

Formworks system working live with Firefly

9 to 25 Concrete ornamental tiles - 36" to 144" sq in plan ea.

Video: Stop motion of tile sequence

Film strip of tile sequence

Elevation Drawing of tile system

Composited tile system in site

References:

[Field Conditions](#), Stan Allen, 1985

[Physical Computing](#), Dan O’Sullivan 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>