

Graduate School of Architecture, Planning + Preservation
Columbia University

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APPROACHING CONVERGENCE 2011: ADVANCING EXCHANGE IN GRASSHOPPER

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OVERVIEW

Have we reached a *stasis* in the long-heralded potential of the parametric?

We as architects have certainly acknowledged, and arguably accepted as hard and fast truths, the limitations of the performance-based paradigm, challenges both *human*—the inescapability of embedded presuppositions + subjective determinations of fitness—and technological—perhaps most concerning, the lack of a universal computational language for modeling + analytics. Along the way, our ambitions for performative design have shifted to generative + nonlinear potentials, while exploiting our controls over the efficiency, fluidity + substantive analyses of the parametric system to close the gap in the exchange of information has remained largely unexplored.

Dexterity across digital platforms, meanwhile, underscores the designer's ability to both explore options across an expansive design space and achieve depth + speed of analysis. The agile designer traverses a broad spectrum of generation, testing, + evaluation methodologies in orchestrating the complex intricacies + collaborations of the process of design. Imagine if we could teach our machines to think the same!

The architect has always operated across a multitude of domains at once. This course emerges from the assertion that the architect of the very near future will design workflow + software as integrally as projects + buildings. We aim to establish sizable research + progress toward this end, first developing then employing an encyclopedic catalogue of dynamic computational operations and systems, grounded in robust, performative evaluation + time-tested mechanisms and techniques. Navigating through, between, + within modeling applications as an initial and continual platform for exploration, students will launch into a variety of opportunities for advanced + fluid interoperations: events control + subroutine scripting, user datagram protocol, physics + agent-based modeling, systems + environmental analytics, and further interests presented by course participants. The ultimate goal is to begin to approach a convergence of varied + disparate computational platforms of design, with a specific focus on integrating techniques of digital craft + analysis into a near-seamless and active coexistence.

Software Explorations: Toolsets + Workflow

Base modeling: Rhino, Grasshopper (beta 0.7 or current)

Workflow automation + customization: VB.NET-based scripting, Java, MEL, Python, Lua, Rhinoscript

Cross-platform communication: Text file I/O, Excel events + subroutines, User Datagram Protocol (UDP)

The primary explorations of this course will focus on advancing techniques within the Grasshopper plug-in for Rhinoceros toward expansion of the base GH toolset via add-on GHA plug-ins and custom Visual Basic dotNET scripting. We will swiftly build a robust foundation of operational moves within Grasshopper as means to establish information/logics + geometric manipulations of external data. Grasshopper will serve as our primary engine for both *interoperative* control of various platforms + *intraoperative* drivers of systems built within GH itself (see Research Focii below).

Additionally, participants will be expected to post work + images throughout the semester to the course website, <http://www.thediscontinuum.net> (*rebuild in progress*). The online component of the course is key to fueling collaborative exchange and will form the basis for research documentation + internal resources.

Software Explorations: Research Focii

Participants will work collaboratively under a specified topic of investigation distributed during the first week of the semester based on student interest + background. Anticipated areas of research/exploration include:

intraOperative Toolsets:

Workflow Tools

Image Mapping + Production [vRay + render engines, ModeTools, Illustrator]

Force-based Simulations [Kangaroo]

Mesh/NURBS Topology [Weaverbird]

Evolutionary Solvers [Galapagos]

interOperative Datasets:

Agents + Behaviors [processing]

Physics + Dynamics [Autodesk Maya]

Sensory + Physical Inputs [Arduino]

XML + Streaming Data [web-based sourcing, GIS, Excel]

Environmental [Autodesk EcoTect Analysis]

Students are encouraged to bring their own software interests to the course in terms of development of the interoperable workflow; the list above is intended as a resource of opportunities for dynamic software communication.

Laboratory Approach: Collaborative Workshop

As Grasshopper is currently a software in beta form, a primary intent of this course is to make a significant contribution to the current efforts of an ever-growing community of users, through the creation and development of an online catalogue + forum devoted specifically to the topic of automated workflow strategies (@ www.thediscontinuum.net). Fueled by several modes of internal collaboration, we will work systematically to develop a diverse library of customized tools in and ultimately for an open-source environment. The schedule will incorporate laboratory sessions specific to this collaborative goal.

Tools + components collaboratively developed in Grasshopper will merge to generate complex super-operations, comprising a collective virtual workshop. Students will construct mechanisms within Grasshopper to gain real-time access to operations + plug-in functionalities of Rhino beyond the standard Grasshopper toolset, then build advanced scripts to dynamically weave these super-operations into + out of our other primary software platforms, in an effort to develop truly intricate + efficient digital constructs for synchronized generation + analysis.

Assignments

OPERATION #0: *Concept Sketching + Warmup Tutorials*

Students are expected to complete a series of base tutorials (available online) as the primary mode of introduction to the Grasshopper toolset (augmenting week01 discussion). Additionally, students are asked to sketch an initial design problem for study through various methodologies throughout the course term. The design problem will consist of a parametrically derived architectural component + an agenda for design + a devised automated workflow.

DELIVERABLES: Sketches, diagrams, + posted description of the proposed design problem.

OPERATION #1A: *inSourced Operations (Accessing Rhino + Plug-ins)*

Students are expected to integrate custom VB.NET script modules within Grasshopper to access Rhino operations beyond the base Grasshopper toolset as well as plug-ins and rendering/animation software, thereby expanding the generation and visualization functionality of the tool. The scripts will be applied to the design problem proposed by the student in Operation #0.

DELIVERABLES: Initial workflow diagram; matrix of initial possibilities; operational pseudocode; GH definitions posted to course website.

OPERATION #1B: *outsourced Operations (Cross-Platform Scripts + Data Streams)*

Students are expected to build custom, cross-platform workflows (using provided scripts as groundwork) to dynamically connect Rhino+Grasshopper as a modeling platform with generative and/or evaluation software for testing of component designs. Workflow connections will be based in VB.NET scripting, and students are encouraged to explore various methodologies for intercommunication such as automated text file writing/reading and Excel events + subroutines. Additionally, students will be asked to produce an animation/video of dynamic processes in action (via CamStudio or similar recording software) and final renderings of output.

DELIVERABLES: Workflow diagram of dynamic system; matrix of final interoperable designs; animation/video of dynamic processes + rendering; GH definitions + associated software files posted to course website.

Attendance/Participation + Grading

As we aim for a richly interactive workshop, participants will be required to both present both progress + final work (per assignment) to the workshop group at large at periods throughout the semester, via web documentation + in-class review. As such, consistent + interactive attendance is required. Attendance + participation will be reflected in final grades.

Course assignments will be graded according to quality, clarity, intricacy + depth of operations, and creativity. On-time posting of deliverables is key to the progression of the research as a whole and will be reflected as such in individual grades.

PROPOSED SCHEDULE (REVISED 01.11)

Note: Final submittal of projects will occur the week following Spring Break + Kinne Travel.

Week01	<u>ORIENTATION / NAVIGATION</u> Course Overview: Thinking Explicitly Introduction to Online Resources and Course Website + Catalogue http://www.thediscontinuum.net Grasshopper Demo: Download/Plug-in, Interface Overview http://www.grasshopper3d.com Operation #0 Assigned: Concept Sketching + Warmup Tutorials
Week02	<u>GH OPERATIONS</u> Operation #0 Due (Student Documentation) Components + Operations: Math, Vector, Curve, Surface, Intersect, Xform
Week03	<u>GH LOGICS</u> Data Management: Data Matching, Data Trees, Logics Conditional Statements: Functions / Expressions / Booleans / Dispatches Operation #1A Assigned: inSourced Operations (Accessing Rhino + Building Custom Modules)
Week04	<u>GH WORKFLOW + EXTENSIONS: intraOPERATIONS</u> Scripted IntraOperations: Layer Control, AutoBakes, Rendering + Animation Introduction to Rhino SDK http://en.wiki.mcneel.com/default.aspx/McNeel/DotNetPluginEssentials.html http://en.wiki.mcneel.com/default.aspx/McNeel/Rhino4DotNetPlugIns.html Calling the Command Line Toolset Extensions: Accessing Plug-ins, Kangaroo + Weaverbird Overview
Week05	<u>DYNAMIC SYSTEMS: interOPERATIONS</u> Operation #1A Due (Student Documentation) Data Streaming: Read/write to Excel, .csv, VB Modules / Subroutines Dynamic Text File I/O: Processing + Maya Operation #1B Assigned: outSourced Operations (Cross-Platform Scripts + Evaluation/Analytics)
Week06	<u>WORK SESSION 1.0</u> Operation #1B Checkpoint
Week07	<u>RESEARCH REVIEW</u> Operation #1B Research Review (Student Presentations + Documentation) Collective Tool Library Assessment + Development
POST-BREAK	<u>FINAL SUBMITTALS</u> Posting + Submittal of Final Work