Geometric Constructs in Digital Space | ARCH 4505
M | W | F : 12.05-12.55 **|** Arch West: 359
Spring 2015

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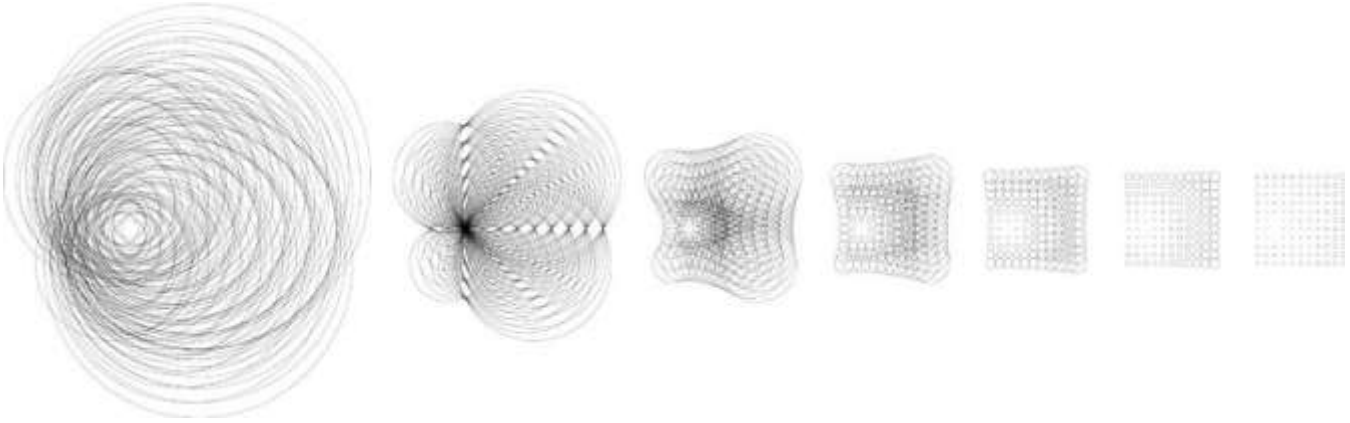
Office Location: Hinman - Room 358e
Office Hours: By Appointment



In the past, treatises on architecture began with a discussion of origin; as such, all aspiring architects were obliged to learn geometry. Triangles, circles, ovals, the calculation of areas, and the tracing of tangents – such were the geometrical figures that, from the early Renaissance until the nineteenth century, were used to initiate architects in the study of Euclidean geometry.

Rafael Moneo in Contested Symmetries

The laws of nature are but the mathematical thoughts of God.

Euclid

Course Description and Objectives

This course covers the fundamental concepts of geometric elements and operations used by designers in both Architecture and Industrial Design as formal vocabularies, spatial concepts, and constructive techniques. These concepts are taught through the lens of 3D modeling as explicitly constructed geometrical relationships and as a modality in contemporary representation. The course is a survey of architectural descriptive geometry, drawing systems, normative and complex geometry, 3D modeling, parametric structures, and digital fabrication.

After successful completion of this course students will have a foundation in applying precise geometrical principles to the design of objects and buildings through digital means in their design studio projects. In addition the course serves as a foundation for advanced study in computational geometry, parametric design, and digital fabrication.

Course Content

- Overview of geometric principles with underlying logic – From 0D to 3D
- Introduction to 3D surface and solid modeling for design and fabrication [Rhinoceros]
- Introduction to parametric thinking and structures [Grasshopper plugin for Rhinoceros]
- Introduction to rapid prototyping and digital fabrication [Laser Cutter and 3D Printer]

Grading and Evaluation

Attendance, participation, timely completion of work, the depth of engagement in course issues, and demonstration of progress in your work provides the foundation for your grade. Conceptual clarity, creativity, project development and refinement, drawing requirements, and craftsmanship are critical and factor equally in the evaluation of your performance. Remember, grades are earned by you –not given by your instructor. More than three absences from class will constitute an automatic letter grade reduction. The following grading scale has been established by Georgia Tech and may be reviewed at the following link: **www.catalog.gatech.edu/rules/5a.php**

- A = Excellent
- B = Good
- C = Satisfactory
- D = Passing
- F = Failure

Grading Distribution

- Attendance + Participation: 20%
- Research Report and Presentation: 10%
- Quizzes: 20%
- Exercises: 40%
- Final Exam: 10%

Primary Text

The primary text for the course is the following:

- Pottman, Helmut, A. Asperl, M. Hofer, and A. Kilian. Architectural Geometry. Exton, PA : Bentley Institute Press, 2007.

Prerequisites

There are no prerequisites for the course. Although the course presents a general exposition of geometrical principles no advanced mathematical background is assumed on the part of the student beyond basic high school mathematics.

Instructional Methodology

The class meets three times per week, Monday, Wednesday, and Friday. The course is structured around a series of lectures, readings, discussions, technology tutorials, design exercises, design reviews, and written examinations.

Technology

The course will be taught using Rhinoceros 3D [McNeel & Associates] along with the Grasshopper Parametric Plugin as the primary CAD environment for inquiry. Students are not required to have this software on their personal laptops though it is advisable. The CoA computer labs are all equipped with the appropriate software. Room 359a will be used as the primary instructional lab for technology tutorials. Students have remote access to a virtualized version of Rhinoceros through the CoA Vlab portal. **vlab.coa.gatech.edu**

Typical Bi-Weekly Schedule

- **Monday:**
  - Quiz to cover assigned readings
  - Lecture on fundamental concepts

- **Wednesdays:**
  - Technology/Representation lecture and Discussion

- **Friday:**
  - Technology/Representation lecture and Discussion
  - or:
  - Unconventional Practice Forum

- **Monday:**
  - Technology/Representation lecture and Discussion

- **Wednesdays:**
  - Exercise review and discussion

- **Friday:**
  - Exercise review and discussion
  - or:
  - Unconventional Practice Forum

Calendar

- **Week 1-2: January 5-16**
  - Introduction
  - Exercise One Assigned
  - Lecture and Discussion: Creating Digital Models, Architectural Projections, & Polyhedra.
  - Lab: Rhinoceros: Introduction, Views, Coordinate Systems, Construction Planes, Curves + Curve Editing, Isometric Transformations, File management, Plotting.
  - Reading | *Architectural Geometry* | Chapters 1-3

- **Week 3-4: January 19-30**
  - Review Exercise One
  - Exercise Two Assigned
  - Lecture and Discussion: Booleans & Transformations
  - Lab: Rhinoceros: Solids, Booleans, Modifications, Transformations, Annotations, Dimensions, Introduction to Grasshopper I [Parametric Modeling]
  - Reading | *Architectural Geometry* | Chapters 4-6

- **Week 5-6: February 2-13**
  - Review Exercise Two
  - Exercise Three Assigned
  - Lecture and Discussion: Curves, Conics, & Surfaces
  - Lab: Rhinoceros: Surfaces I, Projection Tools, Extraction Tools + Grasshopper II
  - Reading | *Architectural Geometry* | Chapters 7-8

- **Week 7-8: February 16-27**
  - Review Exercise Three
  - Exercise Four Assigned
  - Lecture and Discussion: Traditional Surfaces & Offsets
  - Lab: Rhinoceros: Surfaces II, Fabrication Tools, Analysis Tools + Grasshopper III
  - Reading | *Architectural Geometry* | Chapters 9-10

- **Week 9-10: March 2-13**
  - Lecture and Discussion: Freeform Surfaces & Deformations
  - Lab: Rhinoceros: Rendering, Cameras, 2D Drawing Extraction + Grasshopper IV

- Reading | *Architectural Geometry* | Chapters 11 & 13 [Skip chapter 12]

- **Week 11-12: March 16-27 (Spring Break)**
  - Review Exercise Four
  - Research Reports Assigned

  - Lecture and Discussion: Visualization and Analysis & Developability
  - Lab: Rhinoceros: Grasshopper V

  - Reading | *Architectural Geometry* | Chapters 14-15

- **Week 13-14: March 30-April 10**
  - Lecture and Discussion: Digital Fabrication & Reconstruction
  - Lab: Open for Review

  - Reading | *Architectural Geometry* | Chapters 16-17

- **Week 15-16: April 13-24**
  - Review Research Reports
  - Lecture and Discussion: Open for makeup lectures

  - Reading | *Architectural Geometry* | Chapters 18-19
  - ** Content from Chapters 18-19 on the final examination will only count towards extra credit.

  - NO CLASS DURING FINAL REVIEW WEEK: APRIL 20-24

  - **FINAL EXAMINATION**: See Oscar Schedule

** Schedule is subject to change. Any significant changes will be made with appropriate notice by email and/or in class.

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ADDITIONAL NOTES:

1) Students with disabilities requiring special accommodations must obtain an accommodations letter from the ADAPTS Office [www.adapts.gatech.edu] to ensure appropriate arrangements. Students with Disabilities who need to request classroom accommodations should contact:

Dan Carlson, Assistant Dean / Coordinator for Students with Disabilities
Smithgall Student Services Building, Suite 221, Telephone: 404 894 2564
E-mail: dan.carlson@vpss.gatech.edu

2) Georgia Tech aims to cultivate a community based on trust, academic integrity and honor. Students are expected to act according to the highest ethical standards. For policy information on Georgia Tech's Academic Honor Code, please see [http://www.catalog.gatech.edu/rules/1.php].

3) All cell phones should be turned off during class and when entering the classroom.

4) In case of emergency (i.e. fire, accident, criminal act), please call the Georgia Tech Police at 894-2500. Please note that Perry Minyard, IT Support Administrator is also a firefighter and an Emergency Medical Technician (EMT) certified in performing CPR.

5) The work produced in course is the property of Georgia Tech and may be collected for archival purposes or for representation in the accrediting process. The faculty strongly recommends that each student document his/her work upon completion (electronically or with slides) and that they submit a copy of work to their instructor at the end of the semester.

: http://www.coa.gatech.edu/AWPL/COA_interface/awpl_academic_use_policy.php