LA 7032

Geospatial modeling and fabrication

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Fall 2017. Design 217.
Tuesday & Thursday 1:30am–5:20pm.

Course Description

This course is an introduction to digital design for landscape architects. In this course you will develop a creative digital design process seamlessly integrating research and design using geographic information systems (GIS), 3D modeling and rendering, and visual programming. You will learn how to use geospatial data to model and analyze landscapes and visual programming to parametrically model and transform new landforms. You will learn how to model plants – from trees to grasses – in 3D, automatically distribute them across your digital landscape, and render photorealistic scenes. Each week you will spend a day in a workshop learning new methods and a day developing your projects.

In preparation for this course please read:

Carpo, Mario. 2011. *The alphabet and the algorithm*. Cambridge, MA: MIT Press.

Course Schedule

1	Terrain modeling	
2	Digital fabrication	**Workshop:** Lost foam casting
3	Geospatial analysis	
4	Geospatial simulation	**Project:** Geospatial modeling
5	Surface modeling	
6	Visual programming	
7	Families of form	
8	Generative processes	**Project:** Generative design
9	Image classification	
10	3D plants	
11	Particle systems	
12	Rendering	
13	Physics	
14	Exhibition	**Project:** Ecosystem modeling

Projects

Through a series of 3D modeling projects you will study how to restore a highly eroded landscape with a deep gully. You will work in small teams and present an exhibition of your models and renderings at the end of the course.

Geospatial modeling Using lidar data you will model, analyze, and digitally fabricate the topography of the study landscape. Each group will CNC mill a physical model of the landscape in a different media – either medium density fiberboard, polystyrene foam, or urethane foam. Then each group will prepare a different set of – either topographic, hydrologic, or sedimentation – analyses and simulations.

Generative design Using visual programming you will generatively design erosion control features to restore your degraded study landscape. Through a series of algorithmically generated design interventions you will explore interactions between topographic form and hydrologic processes. Your goal is to catalyze topographic changes that will restore the landscape to a dynamic equilibrium. You will produce 3D printed models of your designs and augment these with projected water flow and sediment flux.

Ecosystem modeling After mapping the existing vegetation you will design, model, and render in 3D a planting plan to restore this degraded landscape. You will produce beautiful, photorealistic 3D renderings of the existing landscape and your design.

Sessions

Terrain modeling Model topography in 3D from lidar data.

Digital fabrication Use computer numerical control (CNC) machining to carve physical models of topography. Learn how to cast a topographic model in aluminum.

Beorkrem, C. 2013. *Material Strategies in Digital Fabrication*. Taylor & Francis.

Thompson, R. 2007. *Manufacturing Processes for Design Professionals*. Thames & Hudson.

Geospatial analysis Model and analyze topographic parameters including contours, slope, hillshading, and landforms and hydrologic parameters including watersheds and flow accumulation.

Geospatial simulation Simulate the physical processes that shape landscapes including water flow, sediment flux, erosion-deposition, and landscape evolution.

Surface modeling Model complex, continuous, 3D surfaces using non-uniform rational basis splines (NURBS).

Visual programming Use visual programming to automatically generate patterns and forms.

Tedeschi, A. 2014. *AAD Algorithms-aided Design: Parametric Strategies Using Grasshopper*. Le Penseur.

Terzidis, Kostas. 2006. *Algorithmic architecture*. Elsevier Architectural Press.

Families of form Use visual programming to procedurally generate families of form based on parametric variations.

Choma, J. 2015. *Morphing: A Guide to Mathematical Transformations for Architects and Designers*. Laurence King Publishing.

Cache, B, and C Barrett. 2011. *Projectiles*. AA words. Architectural Association.

Generative processes Procedurally generate dynamic forms using parametric equations and attractors.

Image classification Use aerial photography to automatically classify different types of landcover.

3D plants Procedurally model unique specimens of trees and other plants in 3D. Model an ecosystem in 3D using 3D plant libraries.

Deussen, Oliver, and Bernd Lintermann. 2010. *Digital Design of Nature: Computer Generated Plants and Organics*. Springer. doi:10.1007/b138606.

Particle systems Generate fields of plants using particle systems.

Rendering Setup lights, prepare materials and textures, and render 3D scenes with raytracing.

Physics Simulate processes like water flow and rock fall using a physics engine.

Exhibition Present your work in a gallery style exhibition.

Software

GRASS GIS | https://grass.osgeo.org/
Rhinoceros | https://www.rhino3d.com/
RhinoTerrain | http://www.rhinoterrain.com/
RhinoCAM | https://mecsoft.com/rhinocam-software/
Grasshopper | http://grasshopper3d.com/
Blender | https://www.blender.org/

Resources

Intro to GRASS GIS | https://ncsu-geoforall-lab.github.io/grass-intro-workshop/
Hydrology in GRASS GIS | https://grasswiki.osgeo.org/wiki/Hydrological_Sciences
Grasshopper Primer | http://grasshopperprimer.com
BlenderGIS tutorial | https://github.com/ptabriz/ICC_2017_Workshop

Readings

Choma, J. 2015. *Morphing: A Guide to Mathematical Transformations for Architects and Designers*. Laurence King Publishing.

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Deussen, Oliver, and Bernd Lintermann. 2010. *Digital Design of Nature: Computer Generated Plants and Organics*. Springer. doi:10.1007/b138606.

Picon, Antoine. 2010. *Digital culture in architecture: an introduction for the design professions*. 224. Boston, MA: Birkhaeuser.

Thompson, R. 2007. *Manufacturing Processes for Design Professionals*. Thames & Hudson.

Terzidis, Kostas. 2006. *Algorithmic architecture*. Elsevier Architectural Press.

Policies

Time Commitment Expectations LSU's general policy states that for each credit hour, you (the student) should plan to spend at least two hours working on course related activities outside of class. Since this course is for three credit hours, you should expect to spend a minimum of six hours outside of class each week working on assignments for this course. For more information see: http://catalog.lsu.edu/content.php?catoid=12&navoid=822.

LSU student code of conduct The LSU student code of conduct explains student rights, excused absences, and what is expected of student behavior. Students are expected to understand this code: http://students.lsu.edu/saa/students/code.

Disability Code The University is committed to making reasonable efforts to assist individuals with disabilities in their efforts to avail themselves of services and programs offered by the University. To this end, Louisiana State University will provide reasonable accommodations for persons with documented qualifying disabilities. If you have a disability and feel you need accommodations in this course, you must present a letter to me from Disability Services in 115 Johnston Hall, indicating the existence of a disability and the suggested accommodations.

Academic Integrity According to section 10.1 of the LSU Code of Student Conduct, "A student may be charged with Academic Misconduct" for a variety of offenses, including the following: unauthorized copying, collusion, or collaboration; "falsifying" data or citations; "assisting someone in the commission or attempted commission of an offense"; and plagiarism, which is defined in section 10.1.H as a "lack of appropriate citation, or the unacknowledged inclusion of someone else's words, structure, ideas, or data; failure to identify a source, or the submission of essentially the same work for two assignments without permission of the instructor(s)."

Plagiarism and Citation Method Plagiarism is the "lack of appropriate citation, or the unacknowledged inclusion of someone else's words, structure, ideas, or data; failure to identify a source, or the submission of essentially the same work for two assignments without permission of the instructor(s)" (Sec. 10.1.H of the LSU Code of Student Conduct). As a student at LSU, it is your responsibility to refrain from plagiarizing the academic property of another and to utilize appropriate citation method for all coursework. In this class, it is recommended that you use Chicago Style author-date citations. Ignorance of the citation method is not an excuse for academic misconduct.