LSU | College of Engineering

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LSU | College of Art + Design

ME 4933 & LA 7504 & ART 7255 & DART 7020 | Ecological Robotics

Marcio de Queiroz, Hunter Gilbert, Brendan Harmon, Hye Yeon Nam, & Corina Barbalata
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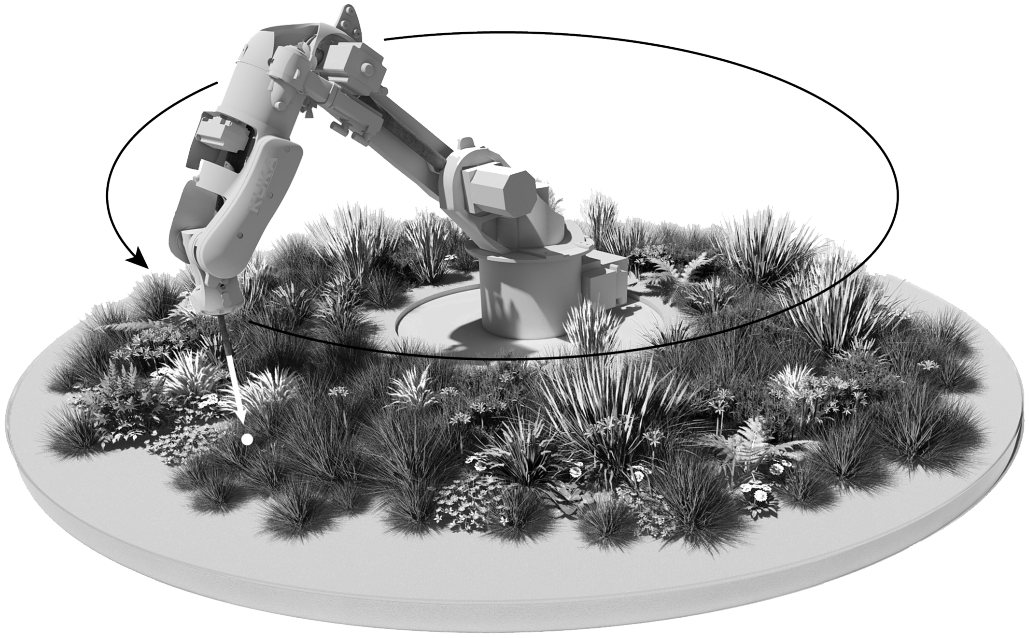
Robotics Lab, Patrick Taylor Hall
Tuesday & Thursday 4:30pm–6:00pm
Spring 2020



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Course Description

Ecological robotics is an introduction to environmental applications for robots. In this course you will learn how to build DIY robots, program industrial robots, and design custom end effectors. Through a series of projects you will design, prototype, and program a robotic process for planting. This interdisciplinary course is open to students in the College of Art & Design and the College of Engineering.

Keywords

- Digital fabrication
- Generative design
- Visual programming
- Soft robotics
- DIY robotics
- Robotic gardening
- 3D modeling & rendering
- Machine vision
- Image classification

Topics

Robotics in Art, Design, & Engineering

1 Robotics in A, D, & E
2 Our robots
3 Intro to robotics
4 Visual programming
5 Pick & place project

Ecological Robots in the Lab

6 Horticulture for robots
7 Delivery system
8 Digital fabrication
9 Prototyping
10 Lab planting project

Ecological Robots in the Field

11 Environmental apps.
12 Prototyping
13 Prototyping
14 Prototyping
15 Applied project

Course Schedule

Robotics in Art, Design, & Engineering

Week 1	Lecture |	Robotics in art, design, & eng.	
	Workshop |	DIY robotics	
Week 2	Tour |	Robots & fabrication facilities	
	Demo |	Industrial robotic operations	
Week 3	Lecture |	Intro to robotics I	
	Lecture |	Intro to robotics II	
Week 4	Workshop |	Installation party	
	Tutorial |	Visual programming	
Week 5	Workshop |	Prototyping	
	Review |	Project demonstrations	**Project:** Pick & place

Ecological Robotics in the Lab

Week 6	Lecture |	Horticulture for robots	
	Tutorial |	Modeling plants in 3D	
Week 7	Lecture |	Soft robotics	
	Workshop |	Delivery system ideation	
Week 8	Tutorial |	Digital fabrication	
	Workshop |	Delivery system prototyping	
Week 9	Workshop |	Prototyping I	
	Workshop |	Prototyping II	
Week 10	Workshop |	Documentation	
	Review |	Project demonstrations	**Project:** Laboratory planting

Ecological Robotics in the Field

Week 11	Lecture |	Environmental applications	
	Workshop |	Ideation	
Week 12	Tutorial |	Generative design	
	Workshop |	Prototyping I	
Week 13	Workshop |	Prototyping II	
	Workshop |	Prototyping III	
Week 14	Workshop |	Prototyping IV	
	Workshop |	Prototyping V	
Week 15	Workshop |	Documentation	
	Review |	Project presentations	**Project:** Applied planting

Projects

As interdisciplinary teams you will develop novel environmental applications for robots.

Pick & place Program an industrial robotic arm to pick and place potted plants in a procedurally defined pattern. Record a video of your robot in action.

Laboratory planting Design, fabricate, and test a robotic process for planting. Use a collaborative, industrial robotic arm to deploy and test your prototype. Focus on an aspect of planting like seed delivery, sapling delivery, water and nutrient delivery, or grading topography. Record a video of your robotic system in action.

Applied planting Design, illustrate, and document a robotic system for planting a green wall. Deliverables include a poster illustrating your design, 3D models and CAD drawings of your design, a CNC milled greenwall module, and a 3D printed scale model of your design.

Software

SolidWorks | https://www.solidworks.com/
Rhinoceros | https://www.rhino3d.com/
Grasshopper | http://grasshopper3d.com/
HAL Robotics Framework | https://hal-robotics.com/
Thea Render | https://www.thearender.com
Xfrog | https://xfrog.com/

Resources

Grasshopper Primer | http://grasshopperprimer.com
Intro to HAL Playlist | http://bit.ly/hal-playlist

Grading

Pick & place	20%
Laboratory planting	40%
Applied planting	40%

Readings

Birrell, Simon, Josie Hughes, Julia Y. Cai, and Fumiya Iida. "A field-tested robotic harvesting system for iceberg lettuce." *Journal of Field Robotics*: 1–21. doi:10.1002/rob.21888.

Gross, B, H Bohnacker, J Laub, C Lazzeroni, J Lee, N Poldervaart, and M Frohling. 2018. *Generative Design: Visualize, Program, and Create with JavaScript in p5.js*. Princeton Architectural Press.

Robinson, A. 2018. *The Spoils of Dust: Reinventing the Lake that Made Los Angeles*. ORO Editions.

Willmann, J. 2018. *Robotic Fabrication in Architecture, Art and Design 2018*. Springer. doi:10.1007/978-3-319-92294-2.

Giftthaler, Markus, Timothy Sandy, Kathrin Dörfler, Ian Brooks, Mark Buckingham, Gonzalo Rey, Matthias Kohler, Fabio Gramazio, and Jonas Buchli. 2017. "Mobile robotic fabrication at 1: 1 scale: the in situ fabricator." *Construction Robotics* 1 (1-4): 3–14. doi:10.1007/s41693-017-0003-5.

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Stevens, J., and R. Nelson. 2015. *Digital Vernacular: Architectural Principles, Tools, and Processes*. EBL-Schweitzer. Taylor & Francis.

Gramazio, F, and M Kohler. 2014. *Made by Robots: Challenging Architecture at a Larger Scale*. Architectural Design. Wiley.

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

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

Dunn, Nick. 2012. *Digital Fabrication in Architecture*. Laurence King Publishing.

Carpo, Mario. 2011. *The Alphabet and the Algorithm*. Cambridge, MA: MIT Press.

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

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.