CS324045

Incorporation of BIM in autonomous construction

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Learning Objectives

- Learning Objective 1: Learn how to generate multiple building-design options parametrically
- Learning Objective 2: Learn how to optimize building design for constructability criteria (additive construction)
- Learning Objective 3: Learn how to generate a toolpath for a robot
- Learning Objective 4: Learn about the 4D simulation of an additive construction process

Description

Autonomous construction assembly and 3D printing of concrete are becoming promising technologies for building structures in the near future. However, such technologies require design professionals to optimize the building design for constructability constraints imposed by the robots and 3D-printed material parameters, in addition to traditional design criteria. Recent advances in generative design showcase promising potential to use BIM (Building Information Modeling) for optimizing the building design for multiple objectives. Pennsylvania State University participated in the NASA 3D-Printed Habitat challenge (for Mars), which had a virtual construction level focusing on using BIM for the design of a Martian habitat, and an actual construction level focusing on the autonomous construction of a subscaled version of the design. This class will demonstrate the underlying BIM process that our team developed to identify the optimal design and perform 4D simulation of the robotic construction process.

Speaker(s)

NaveenKumar Muthumanickam

Naveen is a Ph.D. candidate (Architecture) and concurrent M.Engg. candidate (Architectural Engineering) at Penn State specializing in multi-objective optimization using interoperability between BIM, analysis and simulation tools to enable data driven decision-making in the design and construction process. Building on top of his research, he worked as an Intern with the Cloud Integration Team and Generative Design Team at Autodesk during Summer 2018 and 2019. Prior to his doctoral research, he graduated with a MS degree in Architectural Science and Building Technology from University of Michigan, Ann Arbor and has research experience in the field of VR/AR, object detection and object classification in building design and construction. Naveen’s recent interests include methods to incorporate manufacturing constraints in building design optimization and autonomous construction and using reinforcement learning to increase optimization accuracy.

Dr. Jose Duarte

Dr. José P. Duarte is the Stuckeman Chair in Design Innovation and Director of the Stuckeman Center for Design Computing (SCDC). Duarte is also Professor of Architecture and Landscape Architecture, and Affiliate Professor of Architectural Engineering and Engineering Design at Penn State. After obtaining his doctoral degree from MIT, Duarte returned to Portugal where he helped launch technology-oriented architecture degrees and programs, as well as digital prototyping and fabrication labs. He was Dean of the University of Lisbon Faculty of Architecture and president of eCAADe. His research interests are in the use of computation to support context-sensitive design at different scales from urban design, to architecture and materials design. He recently co-edited with Branko Kolarevic the book "Mass Customization and Design Democracy" (Routledge, NY, 2019) and his team was awarded 2nd place in the finals of the "NASA 3D Printed Mars Habitat Challenge" for printing subscale habitat.

Link to Class Handout and Material(s):

Please find class handout and relevant materials here:
https://drive.google.com/drive/folders/13j5BA5pF9Z6AXenyYyY9SwNR5KreXfI0?usp=sharing