

SEMINAR ANNOUNCEMENT

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
COLLEGE OF DESIGN AND ENGINEERING
Website: <https://cde.nus.edu.sg/ece>

Area: Control, Intelligent Systems & Robotics (CISR) and Signal Analysis & Machine Intelligence (SAMI)

Host: Asst Prof Shi Fan & Dr Alexander Lin

TOPIC	:	Contact-Rich Robotic Manipulation in Construction Under Uncertainty
SPEAKER	:	Dr Arash Adel Assistant Professor, School of Architecture, Princeton University
DATE	:	Friday, 26 June 2026
TIME	:	10:00AM-11:00AM
VENUE	:	E5-03-20

ABSTRACT

Robotic systems are increasingly deployed in complex real-world settings where uncertainty is unavoidable. In construction, uncertainty arises from variability in material geometry and properties, fabrication and assembly tolerances, deviations between as-designed and as-built states, and incomplete observability due to occlusion and clutter. These challenges are particularly pronounced in contact-rich manipulation, where small deviations in geometry, pose, or force can lead to failure during assembly. As a result, robust robotic manipulation in construction requires closed-loop systems capable of perceiving, adapting, and acting under uncertainty.

This lecture presents a framework for contact-rich robotic manipulation in construction that integrates perception, planning, and control. Within this framework, three complementary approaches are examined: adaptive control to compensate for quantifiable uncertainties; learned sensorimotor policies to handle complex, tight-tolerance interactions that are difficult to specify analytically; and a hybrid approach that combines learned policies with adaptive control to improve robustness and enable zero-shot policy transfer.

Through building-scale case studies, the lecture highlights key methods, experimental findings, and current limitations across these approaches. It concludes by discussing open challenges and future directions in developing scalable and generalizable robotic systems for construction, with particular emphasis on robust contact-rich manipulation under uncertainty.

BIOGRAPHY

Dr. Arash Adel is an Assistant Professor at the School of Architecture, a Core Faculty of Princeton Robotics, and an Associated Faculty of the Department of Computer Science at Princeton University. He is the founder and director of Adel Research Group (ARG). ARG conducts interdisciplinary research at the intersection of robotics, artificial intelligence, and computational design; the research contributes to resilient, sustainable, and low-carbon construction outlooks and achievements. At the core of ARG's comprehensive research is investigating human-robot collaborative processes, which tackle fundamental questions related to the future of the design and construction industries and their potential to have a broader impact on inclusive and equitable building culture. Prior to joining Princeton University in 2023, Adel was an Assistant Professor of Architecture at the University of Michigan's Taubman College of Architecture and Urban Planning. Adel received his Doctorate in Architecture from the Swiss Federal Institute of Technology (ETH) and his Master's in Architecture from Harvard University.

