The Department of Mechanical Engineering
College of Engineering and Applied Sciences
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Mechanical Engineering Seminar

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Machine Learning Meets Machine Design: Data-Driven Approach to
Kinematic Synthesis of Mechanisms and Robots
Friday, May 10, 2019 at 11:30 AM, Room 173 Light Engineering Building

Abstract

While humanity has endeavored to innovate tools and simple machines from an early age, it was Machine Design (MD) that truly transformed societies during industrial revolution time. More than 250 years later, Machine Learning (ML) is similarly having a transformative effect on our ability to understand and impact the world through advanced cognition. ML may be relatively new, but MD is a well-established research area where designing mechanisms that carry out specific motion tasks is an early stage design goal. Five decades of work in this area has revealed the gaps that exist at various levels of the machine design process, starting with capturing designers' intent to generating robust and practical mechanism design concepts. A major problem has been to create a unified approach to type and dimensional synthesis while fulfilling additional design constraints. In this talk, I will present some of our recent work in addressing these problems, namely 1) creating a unified computational framework for data-driven type and dimensional synthesis of mechanisms and robots and 2) leveraging ML for variational synthesis of mechanisms using Variational- and Conditional-Autoencoder (VAE/C-VAE) and generative deep neural network architectures. We have shown that by effectively situating ML models between the user and the traditional kinematic synthesis approaches, we can create a framework for the next generation of mechanism design synthesis. In the end, I will present an application to the design of a rehabilitation device, which is helping individuals suffering from neuromuscular disability and injuries overcome their motion-related difficulties.

Biography

Dr. Anurag Purwar is a Research Associate Professor and the SPIR Coordinator of the Department of Mechanical Engineering at Stony Brook University. He is an award-winning teacher, researcher, TEDx speaker, and inventor of several licensed technologies. He has received several best paper and research awards, excellence in teaching awards, and the top 100 design awards for his inventions. He received the SUNY FACT2 award, two SUNY Research Foundation Technology Accelerator Fund (TAF) awards, A.T. Yang award for Theoretical Kinematics, Innovator of the Year award from Innovate LI, and Presidential Award for Excellence in Teaching. Dr. Purwar has led more than 125 technical projects with cumulative in-cash funding of $4.4M supported by National Science Foundation, industry, NY-state SPIR, NY-state Center for Biotechnology, Sensor-CAT, SUNY Research Foundation, and SUNY Office of Provost. He has published 65 peer-reviewed papers in international journals and conferences. He is currently an Associate Editor of the American Society of Mechanical Engineer (ASME) Journal of Computing and Information Science in Engineering and of International Journal of Mechanics Based Design of Structures and Machines and has served as the Conference and Program chair for several ASME international conferences. He is an elected member of the ASME Mechanisms and Robotics Committee and of the National Academy of Inventors.