

# ECSE 500 Spring 2023 Colloquium

11:30 AM to 12:30 PM  
Tuesday, February 7, 2023  
White 411

## Modeling and Control of Smart Material-based Actuators

**Abstract:** Smart actuators featuring high energy densities, large strokes and fast responses are playing an increasingly important role in micro/nano-positioning applications. However, hysteresis nonlinearities are very common in smart material-based actuators. For decades, the existence of such nonlinearities has provided one of the most difficult challenges to control design engineers since the entire Laplace domain and most state space control design techniques were developed exclusively for differentiable linear or nonlinear systems. Hence, the controllers were designed where the existence of hysteresis nonlinearities in practical systems were neglected. When the actuators are considered with hysteresis nonlinearities, these methods encountered substantial difficulties in the analysis, model fitting and control design stages. It was extremely difficult, if not impossible, to design or prove stability of such systems. The development of techniques for the identification of such nonlinearities in smart material-based actuators has emerged as a significant problem. This talk is intended to discuss state-of-the-art solutions for modeling and control techniques of hysteresis effects in smart actuators. The presentation and discussion will range from modeling of hysteresis to the design of corresponding control schemes, especially in the absence of complete information concerning the system model and state.



**Chun-Yi Su**  
Concordia University

**Bio:** Dr. Chun-Yi Su is currently a professor and holder of Concordia University Research Chair's position. His research covers control theory and its applications to various mechanical systems, with a focus on control of systems involving hysteresis nonlinearities. He is the author or co-author of over 200 journal publications. He has been identified Highly Cited Researcher by Clarivate since 2019. Dr. Su has served as Associate Editor for several journals, including IEEE Transactions on Automatic Control, IEEE Transactions on Control Systems Technology, IEEE Transactions on Cybernetics. He is a Distinguished Lecturer of IEEE RA Society. He served for many conferences as an Organizing Committee Member, including the General Chairs and Program Chairs.

---

This is to certify that \_\_\_\_\_ attended this seminar. Certified by \_\_\_\_\_.  
Certificates of attendance and other evidence of CPD activity should be retained by the attendee for auditing purposes.



CASE SCHOOL  
OF ENGINEERING

CASE WESTERN RESERVE  
UNIVERSITY