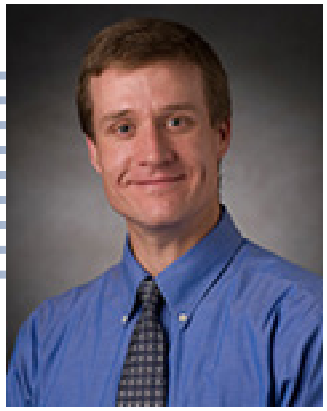
Department of Aerospace Engineering
Minta Martin Seminar Series



Dr. Sean Brennan

Associate Professor, Mechanical Engineering
Penn State University

HOW TRANSPORTATION APPLICATIONS TAUGHT ME TO LOVE DISTURBANCES, NOISE, AND UNMODELED DYNAMICS

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Aerospace Engineering Conference Room, 3164 Martin Hall

ABSTRACT: The purpose of feedback control, as it is generally taught, is to "achieve reference tracking in the presence of disturbances, noise, and unmodeled dynamics". This paradigm is so pervasive that – as a graduate student – this phrase was posted as the on-the-wall "motto" in the graduate student offices. But since then, a decade of implementation of control systems has taught me that the influences of disturbances, noise, and unmodeled dynamics are not as "evil" as classroom theory would imply. Rather, these signals contain tremendous amounts of information whose treatment offers great opportunities for new theory and novel, low-cost solutions to well-known transportation problems.

This talk presents examples of transportation applications in which disturbances, noise, and unmodeled dynamics have played central roles in the development of novel automation-enabling vehicle technologies. These applications include the study of how disturbances can be used to find a vehicle's position on the road without GPS, how noisy sensor data can be mitigated by inclusion of previewed map information and noise-resistant design of maps, and how unmodeled dynamics are of fundamental importance in predicting future congestion patterns of connected vehicles.

This talk concludes with a discussion of open challenges and theoretical opportunities in using "big data" and "big connectivity" to better analyze disturbances, noise, and unmodeled dynamics. Some recent work in neural-systems, which have remarkably similar dynamics to that of interconnected vehicular traffic, show that more information, connectivity, and feedback channels is not always better, and may indeed worsen performance of conventional algorithms.

BIO: Dr. Sean Brennan is an Associate Professor of Mechanical Engineering at Penn State University, where he leads the Intelligent Vehicles and Systems Group. He is also the director of the Vehicle Systems and Safety Program at Penn State's Larson Transportation Institute, an organization of about 40 staff members focused particularly on experimental vehicle and subsystem measurements. His research focuses on vehicle dynamics both at high speeds (highway vehicles) and low speeds (ground robotics), with particular expertise on the estimation of vehicle state using map-based data fusion approaches. He has published nearly 100 papers on applications including high-speed police pursuits, vehicle rollover prevention, HIL testing of hybrid vehicles, bomb disposal robots, and even the observability of brain seizure and traffic jam dynamics.

University of Maryland 1856
THE DEPARTMENT OF AEROSPACE ENGINEERING

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