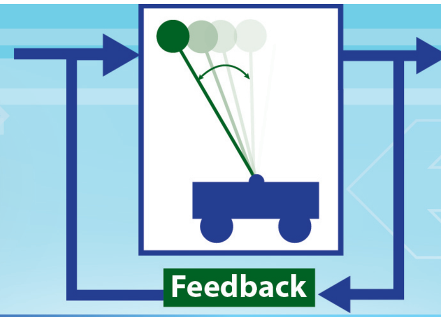
COLLEGE OF ENGINEERING

Control Seminar



Sponsored by: Bosch, Ford, and Toyota

Numerical Synthesis of Pontryagin Optimal Control Minimizers Using Sampling-Based Methods

Humberto Gonzales

Washington University at St. Louis
Department of Electrical and Systems Engineering

Friday, April 7, 2017

3:30 – 4:30 pm • 1500 EECS

ABSTRACT: Optimal control remains as one of the most versatile frameworks in systems theory, enabling applications ranging from classical robust control to real-time safe operation of fleets of vehicles. While some optimal control problems can be efficiently solved using algebraic or convex methods, most general forms of optimal control must be solved using memory-expensive numerical methods. In this talk we will present a theoretical formulation, and a corresponding numerical algorithm, capable of finding Pontryagin-optimal inputs for general dynamical systems using a direct method. Pontryagin-optimal inputs, those satisfying the Minimum Principle, can be found for many classes of problems using indirect methods. But convergent numerical methods to solve indirect problems are hard to find, and often converge slowly. On the other hand, convergent direct optimal control methods are fast and built upon solid theory, but their limit points are usually Banach-optimal inputs, which are a weaker form of optimality condition. Our result employs the theory of relaxed inputs, as defined by J. Warga in the 1960s, to establish an equivalence between Pontryagin-optimal inputs and optimal relaxed inputs. Then, we formulate a sampling-based numerical method to approximate the Pontryagin-optimal relaxed inputs using an iterative method. Finally, we synthesize approximations of the Pontryagin-optimal inputs from the sampled relaxed inputs using a provably-convergent numerical method.

BIO: Dr. Gonzalez received the B.S. and M.S. degrees in Electrical Engineering from Universidad de Chile, Santiago, Chile, in 2005, and the Ph.D. degree in Electrical Engineering and Computer Sciences from the University of California at Berkeley, CA, USA, in 2012. He is currently an Assistant Professor in the Department of Electrical & Systems Engineering at Washington University in St. Louis. His research focuses on the theory and implementation of control algorithms for cyber-physical systems, with an emphasis on optimal control and numerical algorithms.

ELECTRICAL & COMPUTER ENGINEERING
UNIVERSITY OF MICHIGAN

Questions? Contact: Judi Jones asap@umich.edu