UTC INSTITUTE FOR
ADVANCED SYSTEMS ENGINEERING

FACULTY CANDIDATE

Model-Based Control, Design and Resilience of Complex Systems

Traditional control and design of production machines have important limitations: (i) physical constraints and fast dynamics are not considered during design, (ii) inability to track complex and vaguely known dynamics that change with environmental conditions, (iii) not accounting for strong interactions amongst subsystems. These drawbacks necessitate new techniques of model-based design and control that can adapt by the introduction of learning behavior. Model predictive control is central to the realization of such 'intelligent machines' as it transcribes the control objective into a cost function which is optimized online by predictions over a system model with constraints, thereby leaving enough room for adaptations at every level. I shall construct novel distributed nonlinear MPC over systems with switching dynamics and those composed of interacting subsystems, that solves (i)-(iii) achieving speed by limited communication over low-fidelity models and adaptation by learning reference trajectories and model parameters. The superiority of these techniques will be demonstrated over benchmark systems like automatic transmission and hydrostatic drivetrains.

Consequently, as more and more critical infrastructures such as aerospace, power and agricultural systems are being embedded with sensing and control and linked to the internet, the resulting security vulnerability can be exploited to inflict systematic damage to the connected physical systems. Once again, it is imperative to have model-based anomaly detection and certification techniques that guarantee stability and resilience of the controlled systems to a class of attack models. In this concluding part, I shall construct set-membership based anomaly detectors and false-data injection attacks that remain stealthy by masquerading as disturbance subsequently hijacking the system. The principles of invariance are then used to obtain resilience and stability in terms of boundedness and will be demonstrated on the hijack of a Boeing 747 aircraft.

Abhishek Dutta

Abhishek Dutta is an aerospace postdoc at the University of Illinois at Urbana-Champaign with Cedric Langbort. He holds a PhD in electromechanical engineering (model predictive control) under the supervision of Robin De Keyser at Ghent University and under the advice of Jan Maciejowski as a junior member of Wolfson College Cambridge. He has a MSc with distinction from the University of Edinburgh including an informatics prize for outstanding thesis and an European masters from the University of Trento with final mark 110/110. He has held research positions at Technical University Munich (electrical engineering) and Nanyang Technological University (mechanical and aerospace).

Tuesday, May 24, 2016

11:30am – 12:30pm and 3:30pm – 4:30pm

UConn, Storrs Campus – ITE Building 336

To view live webcast at 11:30am click here

To view live webcast at 3:30pm please click here

Upcoming Distinguished Lectures

10/06/16 – Olivier de Weck
When is complex too complex? Graph energy, proactive complexity management and the first law of systems engineering

10/17/16 – Wei Chen
Design under uncertainty; multidisciplinary design optimization; simulation-based design

Upcoming Seminars

09/08/16– Chris Ha
Think Like a Customer, Act like a Startup in Analytics Space

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