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Automatic Control & Systems Engineering.

You are invited to the:

3rd Harry Nicholson Distinguished Lecture in Control Engineering

From contaminant plume forecasting to firefighting with unmanned vehicles

Prof Tom Bewley

University of California, San Diego

Thursday 24th May 2012
SB LT01
Sir Henry Stephenson Building

Programme:
3.30 – 4.30 pm Lecture
4.30 – 5.30 pm Reception

FREE ADMISSION

To book a place please visit:
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Delivered by:
Professor Tom Bewley, Director, Flow Control & Coordianted Robotics Labs, UC San Diego

Prof. Thomas Bewley (BS/MS Caltech 1989, PhD Stanford 1998) works at the intersection of control theory, fluid mechanics, numerical methods, and applied math, and has a particular interest in the analysis, estimation, & forecasting of environmental flow systems. Related projects include in-situ hurricane and ocean current monitoring leveraging buoyancy-controlled balloons and drifters, and advanced work in simultaneous localization and mapping (SLAM) for coordinated deployments of robotic vehicles. His laboratory has been developing small mobile robotic systems such as iHop, ice Cube, Switchblade and iFling. Bewley is the sole author of the forthcoming textbook /Numerical Renaissance: simulation, optimization, & control/, as well as its extensive accompanying codebase.

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Abstract and background

The accurate real-time estimation of chemical, radioactive, and biological contaminant plumes (and BP oil, Icelandic ash, ...), leveraging targeted deployments of sensor-laden unmanned aerial/ground/surface/underwater vehicles, is a class of interdisciplinary grand challenge problems of both acute societal impact and intense scientific, mathematical, and technological interest. This talk will discuss the range of cutting-edge scientific, technological, and regulatory challenges involved in this class of problems, and introduce our recent efforts on the two main control-theoretic challenges at the core of them. The first challenge we address, which represents a significant advance in estimation theory for large-scale systems, is the development of a hybrid algorithm for data assimilation which combines the retrospective analyses inherent to variational methods (important for working with systems with significant nonlinearities) with the efficient characterization of uncertainty inherent to ensemble methods (important for applying measurement updates to state estimates in large-scale systems). Both of these classes of methods are already used widely in the Numerical Weather Prediction community; our work shows how the outstanding features of both may be used effectively in concert. The second challenge we address is the optimization of sensor vehicle trajectories to address the precise identification and forecasting problems for which these sensor vehicles are deployed, while complying with the dynamic constraints on the motions of the vehicles themselves; our hybrid algorithm for accomplishing this, which explores possible vehicle trajectories in the near future, is essentially dual to our hybrid algorithm for data assimilation, which explores possible state trajectories in the recent past. Experimental testing of both algorithms, leveraging high-performance computing resources communicating over a low-bandwidth cellular data link with a dozen unmanned ground vehicles deployed in large heavy smoke plume released in a parking lot, is also discussed, as well as the potential extension of these techniques to both wildland and structural firefighting applications.

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