Keynote for
The First Australasian Workshop on Computation in Cyber-Physical Systems

Title: Massive Networked Decision Systems

Speaker: Professor David John Hill, The Australian National University and NICTA

Abstract:

Infrastructure networks such as power grids, information networks of various kinds, water distribution and traffic networks have all become complex beyond our ability to properly plan and operate them to achieve the levels of performance and security needed. The operation of such networks requires large distributed decision systems. The most complex systems built by people are actually large networks of this kind. The need to deal with new priorities, such as the impact of global warming, adds new complexity and challenges, e.g. power grids with more diverse generation and the need for more energy efficient transport systems.

In response to these challenges, we need progress in the study of networked decision systems. Naturally, the distributed decision and control processes are also networked. How do we construct algorithms for these processes which are sensitive to the system structure and can be scaled up to large and massive systems such as a national grid Further, these processes need to be robust to failures and attacks, i.e. include reconfigurability in the face of such disturbances.

The talk is based on the premise that progress in such problems is beyond areas like computer science, automatic control, communications and mathematical areas like algorithms acting alone. However, these areas working together have the tools to make major advances. A research program which addresses these challenges will be outlined in a framework which includes planning and various levels of distributed control of large networks. Particular emphasis will be given to the speaker's research on exploiting the graph structure of the network and (dynamic) learning from past experiences.

As a case study, the SmartGrid concept for power systems will be reviewed for the motivation and opportunities it presents for application of the ideas discussed.

About the Speaker

DAVID J HILL received the BE(Electrical) and BSc(Mathematics) degrees from the University of Queensland, Australia, in 1972 and 1974, respectively. He received the PhD degree in Electrical Engineering from the University of Newcastle, Australia, in 1976. He is currently a Professor in the School of Engineering at The Australian National University and the NICTA Canberra Research Laboratory. He is also a Chief Investigator of the Australian Research Council Centre of Excellence for Mathematics and Statistics of Complex Systems. During 2005-2010, he was an Australian Research Council Federation Fellow at ANU. He has held academic and substantial visiting positions at the universities of Melbourne, California (Berkeley), Newcastle (Australia), Lund (Sweden), Sydney and Hong Kong (City University). He holds honorary professorships at the University of Sydney (Australia), City University of Hong Kong, South China University of Technology, Wuhan University and Northeastern University (China). His research interests are in network systems, stability analysis, nonlinear and distributed control and applications, mainly to infrastructure type networks. He is a Fellow of the Institution of Engineers, Australia, the Institute of Electrical and Electronics Engineers, USA, the Society for Industrial and Applied Mathematics, USA, and the Australian Academy of Science; he is also a Foreign Member of the Royal Swedish Academy of Engineering Sciences.