

SEMINAR

Estimating the Volatility of Wind Energy from High Frequency Data

Friday, September 23, 2011

1:30 – 2:30P

Carl A. Pollock Hall 4333 (CPH)

Complimentary Refreshments will be served

Presented by the Waterloo Institute for Sustainable Energy

University of Waterloo



Public Lecture with Prof. John Boland
Environmental Mathematics, Barbara Hardy Institute
University of South Australia

South Australia has the second largest penetration of wind energy into the electricity grid in the World, behind Denmark. Currently, 20% of SA's electricity is produced from wind. We work with the Australia Energy Market Operator (AEMO) in two Australian Research Council funded projects on various aspects of integration of renewable energy into the electricity grid.

The electricity market in Australia runs on a five minute time frame, with generators offering bids of volume and price every five minutes throughout the year. AEMO runs a linear program to select the volume from each generator and determine a pool price. The spot price is determined as an average of the six pool prices every half hour. The time scales of five minutes and half hour are crucial in the operation of the market since as well, peaking plants can often be asked to start up within a half hour to meet coming shortfalls. We have developed sophisticated forecasting techniques for wind and solar power on short time scales. I will focus on a method we have developed for estimating the volatility of wind farm output on a five minute time scale utilizing higher frequency (ten second) data. This is necessary for computing error bounds on forecasts, given that the wind farm output displays conditional volatility similar to that in energy markets. Co-Authors: Manju Agrawal and Barbara Ridley

John Boland (B.MATH Hons 1969, M.MATH, Waterloo, PhD 1996, Adelaide) is Associate Professor of Environmental Mathematics at the University of South Australia (UniSA). Professor Boland has since 2000 been awarded, in conjunction with colleagues, eight research grants from the principal research funding body in Australia – the Australian Research Council. These have been across the fields of integration of renewable energy into the electricity grid, water resource management, reduction of food waste, modeling the efficacy of permeable pavers, planning indigenous plant revegetation schemes. They, and numerous other nationally and state based competitive grants, encompass using rigorous mathematical techniques to solve environmental problems. He has published over seventy peer reviewed research papers and supervised or co-supervised eleven successful PhD students. Some other notable achievements include:

- Associate Editor for *Renewable Energy* journal where he has handled the review of ninety research articles since 2007

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- The Boland-Ridley-Lauret (BRL) diffuse radiation model adopted for use in solar resource estimation worldwide – it is the sole diffuse model used in the Renewable Energy Atlas for Australia constructed by the Australian Bureau of Meteorology, and is one of four options used in the *Meteonorm* software that is a key component used in solar installation planning worldwide
- He is the program coordinator at UniSA for the Industry Doctoral Training Centre in Mathematics and Statistics that will operate across five universities in Australia and take in its first PhD students in 2012
- He has led teams that have estimated the Ecological Footprint of the State of South Australia and various precincts within the state, including the Lochiel Park Green Village, an initiative in sustainable living of the state government of South Australia
- John has been plenary or invited speaker at five international conferences in the last two years, and as well has run one day workshops at Energy Storage Forums in Beijing and Barcelona in 2010
- He organises the resource assessment streams at the World Renewable Energy Congresses since 2008 and has recently performed a similar duty at the Solar World Congress, Aug, in Kassel, Germany
- He was the Co-Director of the Australia and New Zealand Industrial and Applied Mathematics Conference in 2010 and will be Convenor of the MODSIM 2013 Congress
- John and his wife Chris have 50 fruit and nut trees in their suburban garden, which, in conjunction with their vegetable garden, produces 25% of their food. They also own a private conservation park where they are custodians of one of Australia's rarest plant species



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