Imperial College London

# Centre for Process Systems Engineering
## 2016 Seminar Series: The Next Generation

UCL

# Parallel Algorithms and Applications in Structured, Large-scale Optimization


## Prof. Carl Laird
## Purdue University



**Abstract:**

Mathematical programming has proven to be an efficient tool for design and operation of chemical processes. However, engineering and scientific needs continue to push the boundaries of existing mathematical programming tools, often outstripping the capabilities of a single CPU workstation. Furthermore, computer chip manufacturers are no longer focusing on increasing clock speeds, and the "free" performance improvements that we have historically enjoyed will no longer be available, unless we develop algorithms that are capable of utilizing modern parallel architectures. This presentation discusses advances in parallel algorithms for structured nonlinear mathematical programming problems, along with a few applications of large-scale optimization.

Large-scale optimization formulations arise from a number of different problem classes, including design and operations under uncertainty, optimization of complex networks, and optimization of discretized systems. In this presentation, I will outline applications in each of these areas. In design of process safety systems, we have developed advanced stochastic programming formulations for the optimal placement of gas detectors in chemical process facilities based on data from CFD simulations of leak dispersion. As well, we have partnered with both industry and federal agencies to develop a suite of tools for protecting drinking water distribution systems in the event of accidental or intentional contamination. Our research has focused on improved simulation capabilities, optimal placement of booster response units, real-time determination of contamination sources, and response optimization. Finally, we have been working with epidemiologists at Johns Hopkins University to develop improved models of infectious disease spread. These dynamic optimization formulations find seasonal patterns in inputs by solving inverse problems based on observed case counts. In particular, these results help quantify the importance of school-term holiday schedules on the spread of childhood infectious diseases.


**Bio:**

Carl Laird is an associate professor in the School of Chemical Engineering at Purdue University. Dr. Laird's research interests include large-scale nonlinear optimization and parallel scientific computing. Focus areas include chemical process systems, homeland security applications, and large-scale infectious disease spread. Dr. Laird is the recipient of several research and teaching awards, including the CAST Division Outstanding Young Researcher Award, National Science Foundation Faculty Early Development (CAREER) Award and the Montague Center for Teaching Excellence Award. He is also a recipient of the prestigious Wilkinson Prize for Numerical Software and the IBM Bravo award for his work on IPOPT, a software library for solving nonlinear, nonconvex, large-scale continuous optimization problems. Dr. Laird earned his Ph.D. in Chemical Engineering from Carnegie Mellon in 2006 and his Bachelor of Science in Chemical Engineering from the University of Alberta.

27 April 2016, 4PM
ACEX Building, Lecture Theatre 2

**Lecture Theatre 2, ACEX Building, Chemical Engineering department, Imperial College London, London SW7 2AZ**
**This event is free and open to the public. No registration is required.**
**Tea & Coffee before the seminar, and for PhDs & Post Docs reception drinks after the seminar in the Chemical Engineering main Entrance Hall.**

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computational optimisation group

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