University of Waterloo
Department of Chemical Engineering

Department of Chemical Engineering

Seminar

Thursday, May 2, 2013

3:00PM – E6 2024

"Computational and Process Systems Approaches to Resolving the TGF-β Paradox in Cancer"

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Transforming growth factor β (TGF-β) signaling regulates a wide range of cellular and physiologic processes including proliferation, apoptosis, differentiation, and immune surveillance. During the early stages of epithelial tumorigenesis, TGF-β functions as a potent tumor suppressor primarily by inhibiting cell proliferation and by inducing apoptosis. However, the level of TGF-β is often significantly elevated in malignant tissues and blood from cancer patients with poor prognosis. Accordingly, in the late phases of tumor progression, the role of TGF-β appears to become one of tumor promotion, apparently supporting growth, subverting the immune system, and also facilitating epithelial to mesenchymal transition (EMT), invasion and angiogenesis, thereby creating the widely held perception that TGF-β is simultaneously a tumor suppressor under one condition and a tumor promoter under another. But how does a single stimulus produce multiple contradictory results?

As a first step toward a quantitative explanation of such paradoxical roles of TGF-β in cancer, we have developed a dynamic model of the canonical TGF-β pathway via Smad transcription factors, an analysis of which motivated the subsequent development, from a control theory perspective, of a macroscopic computational model of TGF-β regulation of prostate cell population. We will discuss the most important results of these models and their potential implications for clinical practice.

Education:
University of Wisconsin-Madison, PhD - 1981
University of Wisconsin-Madison, MS (Statistics) - 1981
University of Lagos, Lagos, Nigeria, BS - 1976

Brief Biography:
The Ogunnaike group is interested in understanding the dynamic behavior of complex systems through mathematical modeling and analysis, and then exploiting this understanding for postulating novel designs and improved operation. Specific systems of interest range from polymer reactors, particulate processes and extruders, to biological processes at the cellular and physiological levels. Specific research topics include modeling and control of industrial processes (polymer reactors, extruders, distillation columns); the application of process analytical technology for control of pharmaceutical processes; modeling and control of hybrid renewable energy systems; biological control systems; and systems biology with application to neuronal responses and cancer.

Dr Ogunnaike is the author or co-author of four books including a widely used textbook, *Process Dynamics, Modeling and Control*, published in 1994 by Oxford University Press, and *Random Phenomena: Fundamentals of Probability and Statistics for Engineers*, published in 2009 by CRC Press. He is an Associate Editor of the journal *Industrial and Engineering Chemistry Research*. His awards include the American Institute of Chemical Engineers 1998 CAST Computing Practice Award, the 2004 University of Delaware's College of Engineering Excellence in Teaching award, the 2007 ISA Eckman Award, and the 2008 AACC Control Engineering Practice award. He was named a fellow of the American Institute of Chemical Engineers in 2009, and elected to fellowship of the Nigerian Academy of Engineering and elected to the US National Academy of Engineering both in 2012.