5th Annual AIChE Midwest Regional Conference

January 31st – February 1st, 2013
Organized by the Chicago Local Section of the AIChE
Hosted by the Illinois Institute of Technology, Chicago, IL

Session Th3B: 3:00pm -4:30pm, Thursday January 31, 2013 (Room 007)
Agent-based systems in chemical engineering applications
Session Organizer: Ali Cinar, Illinois Institute of Technology
Session Chair: Hamidreza Mehdizadeh, Illinois Institute of Technology and Eric Tatara, Argonne National Laboratory

3:00pm **Applying Agent-based Modeling and Simulation to Engineering Problems – A Review of Recent ABMS Research Program Activities at Argonne National Laboratory**
Eric Tatara. Argonne National Laboratory
A general overview of agent-related research programs ANL which would demonstrate the breadth of agent-based modeling and systems in chemical engineering, energy systems, modeling of ecologies and environment, and business processes.

3:30pm **Real-Time Scheduling of Batch Chemical Processes Via Multi-Agent Systems**
Yunfei Chu and Fengqi You, Northwestern University
Scheduling is a crucial decision-making activity in batch processes. Optimization methods provide a systematic approach to the scheduling problem and the optimality of the solution is guaranteed. However, due to the combinatorial nature of the resulting mixed-integer programming (MIP) problems, the computational complexity is still a main challenge in spite of the significant advances in the optimization theories and algorithms as well as computational power in recent years. To circumvent the computational complexity in the MIP based approach, multi-agent based modeling provides a powerful option. A major difference between the agent-based approach and others is that it models a process from the bottom up and decisions in the system are distributed across many intelligent agents. This feature equips the agent-based approach with the power of providing a fast and efficient solution that is applicable to real time rescheduling and thus responds to unanticipated events and uncertain processing times. A novel scheduling algorithm that provides a good balance between computational efficiency and solution quality will be presented.

4:00pm **Multi-Agent Systems for Modeling Vascularization and Tissue Growth within Porous Biodegradable Scaffolds**
Hamidreza Mehdizadeh, Elif S. Bayrak, Sami Somo, Eric M. Brey and Ali Cinar, Illinois Institute of Technology
Agent-based models (ABM) are naturally suitable for modeling biological systems as they are comprised of individual discrete micro-scale constituents (cells) that interact with each other and their environment (extracellular microstructure) to form non-homogeneous macro-scale bodies (tissues and organs). A multi-layer ABM is developed to model the process of tissue growth within biodegradable non-vascularized porous scaffolds. As scaffolds have dimensions in the order of hundred micrometers, tissue cells require functional blood vessel networks to provide them with required nutrients and hence it is necessary to consider vascularization of the scaffold at the same time as tissue growth. As a result, the model includes separate layers to simulate the scaffold structure, the developing blood vessel network (that invades inside the scaffold), and the tissue cells that grow, migrate, and increase in number.
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