Hybrid Simulation of Event Driven Continuous-Discrete Processes

Project Team: Vishal Bahl, Shantanu Chowdhry, and Andreas Linninger

Many of the operations in the process industries exhibit continuous-discrete dynamic behavior. In industrially relevant models these "continuous" conservation balances are interrupted by discrete actions. While the continuous behavior is described by mass, energy and momentum balances, discrete behavior may occur due to physico-chemical discontinuities, discrete or logical controller actions. Such systems with interaction between the continuous and discrete system dynamics are classified as Hybrid Systems. For these systems, standard numerical treatment via "continuous" integration methods breaks down. As an example consider the start-up of a plant whose transient production schedule is submitted to discrete operator interaction or commands from a Distributed Control System (DCS). In all the above processes there are control tasks or logical control functions interacting with the continuous process dynamics. Models for such realistic processes require a mathematical theory for both its continuous as well as discrete transitions.

Features of Hybrid Simulation

In this project we take a pragmatic approach for the solution of continuous-discrete process simulation in order to address the following questions:

- Development of new description language for the rapid formulation of the process operation and control policies involving multi-state transitions.
• Extensive consistency checks for the identification of impossible state sequences.
• Improvement of the methodology for industrial case studies should lead to new insight for optimal operation of dynamic systems.
• Improvement of plant operation performance through simulator training and undergraduate education in process dynamics and control.