411e Dynamic Optimization of Hybrid Discrete/Continuous Particulate Processes

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The majority of processes to produce nano-particles and micron-size particulate are operated in transient manner. In this work a new optimization methodology is utilized to find the optimal conditions for size control in nano-particle synthesis. The nucleation profile and the induction of mechanism switches during the synthesis are used as control variables with the globally optimal conditions found by the proposed method. This is a challenging task because in addition to time dependence and nonlinearities, the mechanism switches superimpose discontinuities or discrete events on the continuous state dynamics. The LARES-PR algorithm [1] is extended to solve this hybrid system. This algorithm uses a new paradigm called artificial chemical process [2]. The population balance equation (PBE) and multivariate PBE are used to describe the dynamics of the nano-particle production. The PBE is solved by moment or discretization methods while the multivariate PBE is solved by Monte Carlo method. Results show that the extended LARES-PR for hybrid systems can handle both situations (PBE and multivariable PBE) effectively.

[1] Irizarry, R. (2005), A Generalized Framework for Solving Dynamic Optimization Problems using the Artificial Chemical Process Paradigm: Applications to Particulate Processes and Discrete Dynamic Systems, Accepted in Chemical Engineering Science, April 2005.

[2] Irizarry, R. (2004), LARES: An Artificial Chemical Process Approach for Optimization, Evolutionary Computation Journal, 12 (4), 435-460.