Faculty of Engineering and Applied Science
Chemical Engineering Seminar Series

Observer and Control Design for Cell Population Models of Yeast Fermentation Processes

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Dupuis Hall, Room 217

In bioreactors, the lack of available online process information is a common issue, due to physical limitations of the reactor or a lack of available sensors. Especially online measurements of the cell distribution with respect to process relevant properties remain to be a challenging task. From a control theory perspective, the lack of online measurements restricts the control strategy to feed forward control, which is sensitive to process disturbances or model inaccuracies, which are typically present in biological systems. This motivates the design of reliable observer schemes for the online estimation of process-relevant state variables based on classically available measurements during cultivation. This talk addresses the observer and control design for cell population models of yeast fermentation processes. Cell population models describe the time evolution of the cell distribution with respect to specific properties like cell mass, size, age, or chemical composition. Modeling of the cell division cycle by means of the population balance equation leads to a partial integro-differential equation, which is coupled to a set of ordinary differential equations due to the interaction with nutrient dynamics. Different methods to analyze the observability, detectability, and controllability of the considered class of systems are discussed and applied to the discretized model equations. Based on the results, observers and control schemes are designed and validated for the estimation and control of the cell mass distribution in a lab-scale reactor.