**Optimized Behavioral Interventions:
What Does Control Systems Engineering Have to Offer?**

Daniel E. Rivera

Control Systems Engineering Laboratory

School for Engineering of Matter, Transport, and Energy

Arizona State University

Tempe, Arizona

The last decade has witnessed an increasing interest in the application of systems science methodologies for examining problems in behavioral health, and using these to inform the design, analysis, and implementation of more efficacious behavioral interventions. Among these approaches is control systems engineering, which is the field that considers how to adjust system variables over time to improve important process outcomes. How can the technology that is responsible for cruise control in automobiles, the home thermostat, and the insulin pump be useful in behavioral intervention settings? This presentation examines this question by focusing on the problem of *adaptive, time-varying interventions*. In an adaptive intervention, dosages of intervention components are assigned based on the values of tailoring variables that reflect some measure of outcome or adherence. We describe how control systems engineering concepts originating from the chemical process industries can be contextualized to serve as optimal decision policies for adaptive interventions in behavioral health. Control engineering (in general) and Model Predictive Control (in particular) are shown to provide a number of advantages; these include the ability to highly personalize dosages over time in multi-component interventions, to recognize lagged effects between intervention components and outcomes, and to enforce logical constraints that reflect clinical guidelines. The usefulness of the approach will be illustrated using examples drawn from interventions for promoting weight loss, smoking cessation, and managing chronic pain. Some opportunities and challenges presented by the field, such as how behavioral theories can inform the development of dynamical models useful for control design, will be discussed. The talk concludes with a discussion of what adopting control engineering principles for optimizing a behavioral intervention represents for behavioral scientists, methodologists, and engineers.