Faculty of Engineering and Applied Science

David W. Bacon Distinguished Speaker Series

Translating Control Technology for Personalized Medicine

Dr.** Francis J. Doyle III**/Harvard University

Thursday, September 15, 2022, 2:30pm

Dupuis Hall, Room 215

The future of healthcare will involve personalized medical therapies for individuals. In applications involving the delivery of a drug (for example, insulin), such personalization can be achieved using tailored feedback control strategies. For close to 30 years, our research group has collaborated with medical experts on the design of algorithms for safe and effective insulin delivery for individuals with Type 1 diabetes mellitus (T1DM). T1DM is a chronic autoimmune disease affecting approximately 35 million individuals world-wide, with associated annual healthcare costs in the US estimated to be approximately $15 billion. Over the years, there have been remarkable innovations in glucose measurement technology, insulin pump design, and personalized control algorithms. Over the last 5 years, multiple commercial closed-loop devices have entered the market, thus delivering the so-called “artificial pancreas” to individuals with T1DM. In this talk, I will outline the difficulties inherent in controlling physiological variables, the challenges with regulatory approval of such devices, and will describe several control systems engineering algorithms we have tested in clinical and outpatient settings for the artificial pancreas. I will describe our work in creating an embedded version of our MPC algorithm to enable a portable implementation in a medical IoT framework and will highlight some of the open challenges for automated insulin delivery. I’ll close by sharing other medical examples where feedback algorithms could provide transformational advances in personalized medicine, including chronotherapy.