Robust Feedback Control based on Low Order Models with Uncertainty Estimation for a class of Biomedical Problems

Héctor Puebla, Miguel A. Gutiérrez-Limón

División de Ciencias Básicas e Ingeniería, Universidad Autónoma Metropolitana Azcapotzalco

Eliseo Hernández-Martínez, Alejandra Velasco-Pérez

Facultad de Ciencias Químicas, Universidad Veracruzana

Abstract

In the last two decades, considerable effort has been directed toward the development of control schemes for biomedical applications aimed to provide physicians with a reliable and practical polices for drug dose. The development of mathematical models for biomedical problems has impulse model-based control designs. However, model-based control for biomedical applications is a challenging problem due significant model uncertainties as well intra and inter-patient variability. In this work, we are addressing a model-based robust feedback control approach for a class of biomedical applications. Our control design is based on a low-order step response model enhanced with estimation of model uncertainties due model reduction and uncertainties in model parameters. The control design is addressed using a simple robust control approach that has two features for practical application of the resulting controller: (i) a systematic consideration of uncertainty that leads to a controller with a good robustness properties, (ii) an equivalent linear control structure with simple tuning rules that could be implemented in practice. Numerical simulations on two case studies, glucose regulation in diabetes type 1 and the regulation of virion particles in HIV.

Keywords: Biomedical processes, drug delivery, glucose control, HIV.