Can We Design an Artificial Pancreas?

- Closed-loop control requires:
  - Actuator: Insulin pump
  - Sensor: Blood glucose sensor technology
  - Control Validation (low tolerance for mistakes):
    - Sensor validation
    - Robustness under uncertainty
    - Insulin / blood glucose dynamic model
Diabetes Mellitus

- 2004 - CDC Statistics
Diabetes Mellitus

- 2005 - CDC Statistics
Diabetes Mellitus

- 2006 - CDC Statistics

[Map of the United States with color-coded regions indicating diabetes prevalence]
Diabetes Mellitus

- 2007 - CDC Statistics
Diabetes Mellitus

• 2008 - CDC Statistics
Diabetes Mellitus

• 26 million Americans (8.3%)
• 79 million with pre-diabetes (25%)
• 33% with diabetes by 2050 if trend continues
Fit FOPDT Model & Obtain PID Tuning Parameters

Blood Glucose

Insulin Injection Rate

mg/dL

micro-U/min
Artificial Pancreas Design Considerations

Optimal Insulin Injection to Achieve Desired Glucose Profile