Modeling, Monitoring and Control of a Plant-wide Industrial Process Control Benchmark: 
Tennessee Eastman Challenge Problem

Background and Problem

The Tennessee Eastman (TE) Plant-wide Industrial Process Control Problem was proposed by Downs and Vogel (1993) as a challenge test problem for a number of control related topics, including multivariable controller design, optimization, adaptive and predictive control, nonlinear control, estimation and identification, process monitoring and diagnostics, and education. Since the publication of the TE process benchmark, over 60 studies have used this case study for alternative plant-wide control, process monitoring, fault detection, and identification. The TE process is a realistic simulation environment of a real chemical process. As shown in Figure 1, the TE process includes following units: an exothermic, a two-phase reactor, a flash separator, and a reboiled striper. There are a total of 41 measured output variables and 12 manipulated variables. The original benchmark coded by FORTRAN, it has also been implemented in the Matlab/Simulink environment. The main control objective is to maintain measurements of product rate and composition at setpoints, while keeping other variables within specified “shutdown limits”.

Objective

The objective of this project is to develop certain techniques for the purpose of monitoring and control of the TE process benchmark. Following tasks need be investigated in the project:

- Study on the TE process benchmark as well as its Matlab/Simulink implementation environment
- Necessary modifications of the available Matlab/Simulink code based on the original benchmark for the purpose of monitoring and control
- Modeling of the TE process for monitoring and control design
- State estimation of the TE process using extended Kalman filter (EKF) techniques
- State estimation based monitoring and fault detection in the presence of sensor or actuator faults in the TE process
• Control design based on nonlinear MPC (Model Predictive Control) technique on the benchmark (if possible)

**Key words:** Tennessee Eastman (TE) process, process monitoring, state estimation, extended Kalman filter (EKF), MPC (Model Predictive Control)

**References:** (available once the project is selected)

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