A Numerical Comparison of Three State Estimation Schemes Applied to a Nonlinear Stochastic System.

Nonlinearity and stochasticity are common attributes of chemical systems. This paper focuses on a gasoline blending process, in which the quality of the final product is a nonlinear function of the proportions and qualities of five blend components. Stochasticity arises from the measurement process, and, more significantly, from variations in the component qualities [2].

This work investigates the predictive power of three state estimation schemes applied to the “true” gasoline blending process as simulated in Matlab. This process is a stochastic discrete-time state-space model with a linear state equation and a nonlinear output equation. The first two schemes are derived by simplifying the original model to a time invariant or time-varying linear system and applying a Kalman filter. The third scheme uses the full nonlinear model and an unscented Kalman filter [1]. This work also addresses the estimation of model covariances directly from product quality and component proportion data.