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# Applying Joint and Dual State and Parameter Estimation Using Derivative-Free Kalman Filter for a Switched Nonlinear System

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## Abstract

In a hybrid system, the continuous and discrete modes are interaction with each other which results that the system states are operated in nonlinear dynamics and complexity of the system is increased. When the system dynamics are subjected to state and

measurement uncertainty with parametric uncertainty, online parameter estimation of such a hybrid system is a difficult problem. Estimation of hybrid system states and parameters is a critical aspect in fault classification and identification, as well as fault tolerant control and adaptive control applications. Dual unscented Kalman filter (DUKF) and joint unscented Kalman filter (JUKF) are used to estimate state and parameters of the system based on dual state and parameter estimation approaches. The simulations were carried out for the performance evaluation of JUKF and DUKF on benchmark system, namely switched mode continuous stirred tank reactor (CSTR). According to simulation data, DUKF outperforms JUKF for switched nonlinear systems, and choice of recommendation is DUKF for simultaneous state and parameter estimation of switched nonlinear hybrid systems.

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