520g Blind Identification for the Detection and Estimation of Valve Stiction

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Control valve problems are common in industry and can lead to process oscillations which negatively impact efficiency and profitability. Valve problems are caused by nonlinearities such as stiction, backlash, and deadband. This work presents a non invasive method of detecting and quantifying valve stiction using blind identification techniques. Valve stiction is characterized by a period of time when the actuator attempts to move the valve but the valve does not move, followed by the valve jumping open and then moving smoothly. This behavior is captured by an empirical model with two parameters. The actuator output is the input to the model and the valve position is the output. The model can be represented by a flow chart. The blind identification algorithm determines values for the two model parameters that are used to indicate if stiction is occurring and how severely. The blind identification algorithm was developed to estimate the parameters of a nonlinear system coupled with a linear system when the intermediate signal between the two systems is not available. The algorithm requires input and output data for the coupled system, the order of the linear system, and the structure of the nonlinear system. The algorithm outputs estimates for the parameters of the linear and nonlinear systems. Identification is accomplished by using separable least squares to turn the parameter estimation problem into a one or two dimensional optimization problem. This algorithm is ideal for estimating the two parameters in the valve stiction model because most valve data comes from a coupled linear and nonlinear system. The nonlinear system is the valve dynamics followed by the linear flow dynamics. A flow control system and a level control system were simulated and the blind identification algorithm was used to estimate the valve stiction parameters. The algorithm does a good job at estimating the stiction model parameters with answers within ± 5% of the actual values. Noise affects the accuracy of the predictions and the larger the actual valve stiction values the less impact noise has on the estimates. This work presents a useful method for determining if stiction is occurring in a valve. The proposed method is advantageous because it is non invasive and uses existing process data so there is no need to run special tests.