320c A Curve Fitting Method for Detecting Valve Stiction in Oscillating Control Loops

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Many control loops in process plants perform poorly due to valve stiction as one of the most common equipment problems. Valve stiction causes oscillations in control loops which increases variability in product quality, accelerates equipment wear, or leads to control system instability. Therefore, it is important to detect valve stiction early on so that appropriate action can be taken and major disruptions to the operation can be avoided.

To help understand the valve stiction phenomenon and simulate a sticky valve, several valve stiction models have been proposed in the literature. These models are either physical models which are not very practical to use, or empirical models with rather complex logic making them difficult to implement. In this current work, the validity of two empirical models is investigated, namely Choudhury's model and Kano's model. In addition, a new valve stiction model is proposed with a simple structure and straightforward logic.

Several methods have been developed to detect valve stiction in the last decade. However, most these methods require either detailed process knowledge or user interaction which is not desirable for automated monitoring systems. In particular, we examine a valve stiction detection method proposed by Horch. Its inconsistency is theoretically analyzed and demonstrated by a simple example.

A new valve stiction detection technique is developed in which the controller output and process variable are fitted piece-wise to both linear and sinusoidal curve segments using a least squares method. This method is fully automatic and does not require a process model. The new technique is applicable to both self-regulating and integrating processes. Superior performance of the proposed method is demonstrated using both simulated data sets based on the new valve stiction model and a number of industrial data sets.

Keywords: Valve stiction; Control valve; Oscillation diagnosis; Fault detection