An explicit tuning rule of PID controllers using a simple fractional order plus time delay model

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Fractional calculus describes real dynamic systems more accurately than usual calculus and also can be used to design powerful and flexible controller as it compromises positive and negative effects of the derivative and integral actions in classical control theory.

In this study, a model reduction method to a simple fractional order plus time delay model and an explicit tuning rule of PID controllers are present. The model reduction method fits the fractional model to frequency responses data using one-dimensional optimization method combined with the least squares method. It simultaneously estimates the model coefficients and fractional order with fairly good accuracy. In addition, a tuning rule for the fractional order plus time delay model is proposed. The tuning rule provides almost the same performance as the optimal tuning parameters which minimize the time weighted absolute value of the error (ITAE). The proposed method needs no complicated numerical techniques and shows good performances in several simulation results.