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A FICTITIOUS REFERENCE ITERATIVE TUNING METHOD WITH SIMULTANEOUS DELAY PARAMETER TUNING OF THE REFERENCE MODEL

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Abstract. *Fictitious reference iterative tuning (FRIT) is a direct control parameter tuning method using one-shot experimental input-output data with no need for help from a plant model. FRIT searches control parameters so that the plant output follows the reference model output, which specifies an ideal response for the reference signal. However, if an inappropriate reference model is selected, FRIT might possibly derive improper control parameters. In particular, the reference model which requires too fast a response from a controlled plant often makes the closed loop system unstable. This paper, therefore, proposes a modified FRIT method, which, while optimizing the plant's control parameters, simultaneously tunes the delay parameter of the reference model. Since the proposed method adjusts the rise time of the reference model output by tuning the delay parameter, it can avoid the problem of selecting an inappropriate reference model. The paper also extends the analytical pre-filter for the one-shot experimental input-output data in the conventional FRIT, to the case for the proposed FRIT with simultaneous delay parameter tuning of the reference model. Finally, a numerical example is shown to demonstrate the effectiveness of the proposed method.*

Keywords: Fictitious reference iterative tuning (FRIT), Control parameter tuning, Direct control, Data-based tuning

1. **Introduction.** Most theoretical control system design methods are based on mathematical models. However, it is often difficult to collect input-output data for the identification of a controlled plant that has already been set up and is in full operation. Therefore, direct design approaches based on input-output measurements with no need for help from a plant model have attracted attention from several researchers. Hjalmarsson et al. [4], developed iterative feedback tuning (IFT), Campi et al. [1], proposed virtual reference feedback tuning (VRFT), and Kaneko et al. [9, 10, 11], proposed fictitious reference iterative tuning (FRIT). Furthermore, several solutions based on IFT, VRFT, and FRIT approaches have been proposed by researchers. Lequin et al. [7], compared IFT with classical tuning methods. Graham et al. [3], reported an application of IFT to a mechanical process. Lecchini et al. [6], proposed VRFT for controllers with two degrees of freedom. Campi et al. [2], introduced the VRFT approach for controller tuning in a nonlinear environment. Kansha et al. [5], proposed an adaptive VRFT method for non-linear systems.