Model reference self-tuning fractional order PID control based on for a power system stabilizer

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Abstract

This paper presents a novel approach of self-tuning for a Modified Fractional Order PID (MFOPID) depends on the Model Reference Adaptive System (MRAS). The proposed self-tuning controller is applied to Power System Stabilizer (PSS). Takaji-Sugeno (TS) fuzzy logic technique is used to construct the MFOPID controller. The objective of MRAS is to update the five parameters of Takaji-Sugeno Modified FOPID (TSMFOPID) controller online. For different operating points of PSS, MRAS is applied to investigate the effectiveness of proposed controllers. The harmony optimization technique used to obtain the optimal parameters of TSMFOPID controllers and MRAS parameters. For different operating points with different disturbance under parameters variations the simulation results are obtained. This is to show that Self-Tuning of TSMFOPID based on (MRAS) have better performance than the fixed parameters TSMOFOPID controller. Keywords: Fractional order PID Harmony research (HS) Model reference adaptive control (MRAC) Power system stabilizer (PSS) Takaji-sugeno fuzzy This is an open access article under the CC BY-SA license. 1. INTRODUCTION Generator excitation control systems contain Automatic Voltage Regulators (AVR) for voltage regulation and conventional Power System Stabilizers (CPSS) for damping mechanical mode oscillations. The changes in operating conditions of PSS is challenge to update the controller parameters [1]. Therefore, the new studies seek to design advanced control techniques, which controllers adapt with the continuous change in operating points [2-4]. The conventional PID controller is common use in several of engineering applications. Due to the structure simplicity and easy parameter tuning, it is suitable for a certain operating point. In addition, its performance is good for linear and simple systems [5, 6]. Still, the behavior of PID control is linear and cannot deal with the high disturbance and high nonlinearity in complicated systems [5, 7, 8]. The current research directed to use the Fractional Order PID (FOPID) control where it presents the nonlinear face of PID control [9-11]. In FOPID controller, two additional parameters (the fractional integral and derivative gains) will be supplementary to increase the flexibility and reliability of controller [12-14]. Therefore, the dynamic performance of FOPID controller is enhanced compared to the conventional PID controller [15-17]. At different operating points for a certain system, adaptation online was used self-tuning using for the system. In this case, the fuzzy logic calculations need a long time and addition efforts by try and error is performed to obtain normalizing gains selection [18]. So, this study resort to the MRAS to self-tuning the TSMFOPID online where it has simple structure, easy to implement and fast calculations [19, 20].

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