Implementation of Crow Search Algorithm based two degree of freedom combined fractional order PID controller for AGC of hydro-thermal power system with wind and small hydro power plants

Appala Naidu Karanam[1], Binod Shaw[1], and Jyoti Ranjan Nayak[2]

[1]National Institute of Technology Raipur Department of Electrical Engineering
[2]Vignan's Institute of Information Technology Department of Electrical and Electronics Engineering

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Abstract

The unceasing efforts to design an optimal controller for automatic generation control (AGC) in power systems motivate the design of a novel Two-Degree-of-Freedom-Combined Fractional Order PID (2-DOF-Combined FOPID) controller. Two-area interconnected power systems comprised of reheated thermal and hydro units with boiler dynamics, generator rate constraints and dead zone non-linearity in each area are tested using the designed controller. The performance of the proposed controller is studied with the conventional PID controller, the classical Two-Degree-of-Freedom PID (2-DOF-PID) controller, and the Two Degree-of-Freedom Fractional Order PID controller (2DOF FOPID). The elemental intension of designing supplementary controllers is to diminish the area of control error (ACE). The Crow search algorithm (CSA) is chosen to determine the optimal values of controller gain parameters in order to curtail the figure of demerit. The dynamic behavior of the system is investigated pertaining to a 0.01 p.u. load disturbance in area 1. The performance of the designed controller is explored using wind integration and an CSA optimized small hydro power plant. Investigations reveal that the transient response is superior using the 2-DOF-Combined FOPID concerning the stability indices viz. overshoot (Osh), undershoot (Ush), and settling time response of the power system.

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