Optimal tuning of sigmoid PID controller using nonlinear sine cosine algorithm for the automatic voltage regulator system

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ABSTRACT
Automatic Voltage Regulator (AVR) is fabricated to sustain the voltage level of a synchronous generator spontaneously. Several control strategies have been introduced into the AVR system with the aim of gaining a better dynamic response. One of the most universally utilized controllers is the Proportional–Integral–Derivative (PID) controller. Despite the PID controller having a relatively high dynamic response, there are still further possibilities to improve in order to obtain more appropriate responses. This paper designed a sigmoid-based PID (SPID) controller for the AVR system in order to allow for an accelerated settling to rated voltage, as well as increasing the control accuracy. In addition, the parameters of the proposed SPID controller are obtained using an enhanced self-tuning heuristic optimization method called Nonlinear Sine Cosine Algorithm (NSCA), for achieving a better dynamic response, particularly with regards to the steady-state errors and overshoot of the system. A time-response specifications index is used to validate the proposed SPID controller. The obtained simulation results revealed that the proposed method was not only highly effective but also greatly improved the AVR system transient response in comparison to those with the modern heuristic optimization based PID controllers.

KEYWORDS
Automatic Voltage Regulator (AVR); Optimization; Nonlinear Sine Cosine Algorithm (NSCA); Sigmoid PID controller

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