CONTROL OF AVR SYSTEM USING PID CONTROLLER

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Abstract

The current work presents particle swarm optimization (PSO) calculation as an improvement strategy in the territory of tuning of the exemplary regulator introduced in automatic voltage regulator (AVR). The proposed PSO technique is applied with a mean to discover the ideal estimation of relative essential subsidiary (PID)controller gains with first request low pass channel introduced in the AVR. The voltage reaction of the AVR framework, as acquired by utilizing the proposed PSO based PID regulator with first request low pass channel, is contrasted with those offered by different calculations announced in the new cutting edge written works. The pith of the current work means that the proposed PSO procedure might be, effectively, applied for the AVR of force framework.

Introduction

In power generation system, automatic voltage controller (AVR) is used to keep up the terminal voltage of an alternator at a predefined level. The AVR controls the consistency of the terminal voltage by shifting the exciter voltage of the generator [1]. Because of the high inductance of the generator field windings and load variety, steady and quick reaction of the controller is hard to accomplish. In this manner, it is imperative to improve the AVR execution also, guarantee steady and proficient reaction to transient changes in terminal voltage. Different control structures have been proposed for the AVR framework, notwithstanding, among these controllers the relative besides necessary in addition to subordinate (PID) was the best controller. The PID controller is recognized by its strong exhibition over a wide scope of working conditions and straightforwardness of structure plan [2]. The plan of the PID controller includes the assurance of three boundaries which are the proportional, integral and derivation gains. As of late, numerous canny advancement calculations were proposed to tune the PID gains of the AVR framework. Such calculations incorporate Particle Swarm Optimization (PSO) [3], Genetic calculation (GA) [3,4], Craziness based molecule swarm streamlining (CRPSO) [5], Reinforcement Learning Automata (RLA) [6], Artificial Bee Colony (ABC) [7], Differential Evolution Calculation (DEA) [8], Many Optimizing Liaisons (MOL) [9], Local Unimodal Sampling (LUS) [10], and Chaotic Ant Swarm (CAS) [11]. CAS is a new search calculation enlivened by the organic conduct of ants in nature proposed by Li et al. [12]. Nonetheless, it is a deterministic measure unique in relation to the customary subterranean ant calculation [13]. It joins the confused conduct of individual ants with the insightful enhancement activity of an ant state and subsequently it incorporates the points of interest of confused hunt and the incredible capacity of multitude collection. In view of CAS calculation, Li et al. built up a model which can be utilized to depict how an insect state sorts out itself to locate the ideal way between a food source and the home [14]. The CAS calculation shows an incredible potential in tackling troublesome advancement issues experienced in different fields, for example, boundary ID of dynamic frameworks [13], fluffy framework distinguishing proof [15], and boundaries tuning of PID regulator [11].

AVR System

The AVR system contains four parts: Amplifier, Exciter, Generator and Sensor. The transfer block diagram has been shown in Fig 1.

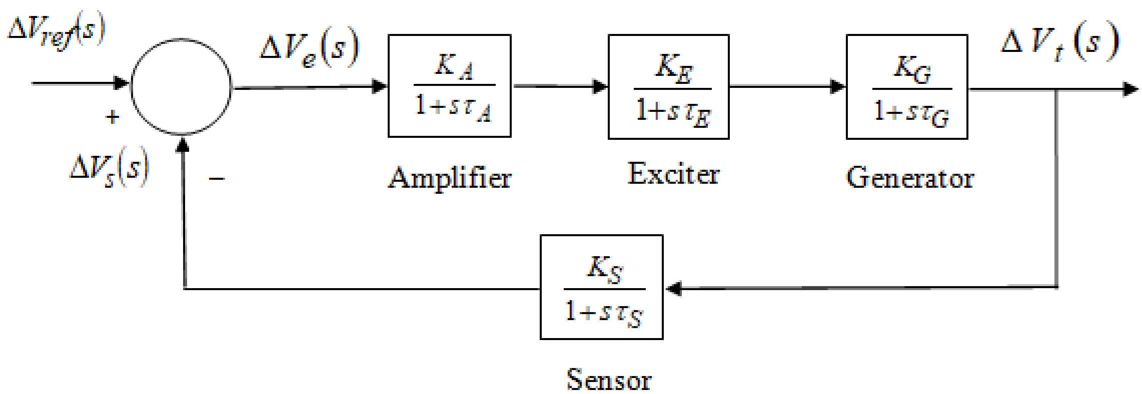

Fig. 1. AVR system

The transfer functions of the AVR system parts have been reported in the Table 1.

Table 1:

Transfer functions of the AVR system components.

AVR component	Transfer function	Range of the gain K	Range of the time constant T (s)
Amplifier	$G_a = \frac{K_a}{T_a s+1}$	10–40	0.02–0.1
Exciter	$G_e = \frac{K_e}{T_e s+1}$	1–10	0.4–1.0
Generator	$G_g = \frac{K_g}{T_g s+1}$	0.7–1	1.0–2.0
Sensor	$H_s = \frac{K_s}{T_s s+1}$	0.9–1.1	0.001–0.06

The exchange capacity of the AVR framework have one zero at 100, two real poles at 98.82 and 12.63, and two complex posts at 0.53 ± 4.66i. The AVR can be approximated by dropping the zero at 100 with the poles at 98.82 to acquire AVR. The unit step response of AVR is appeared in Fig. 2. It very well may be seen from Fig. 2 that the AVR framework has the steady state amplitude value of 0.909, 1.5 (Mp 65.43%) at tp - 0.75s, tr - 0.42s, ts - 6.97s at which the reaction has settled to 98% of the consistent state esteem.

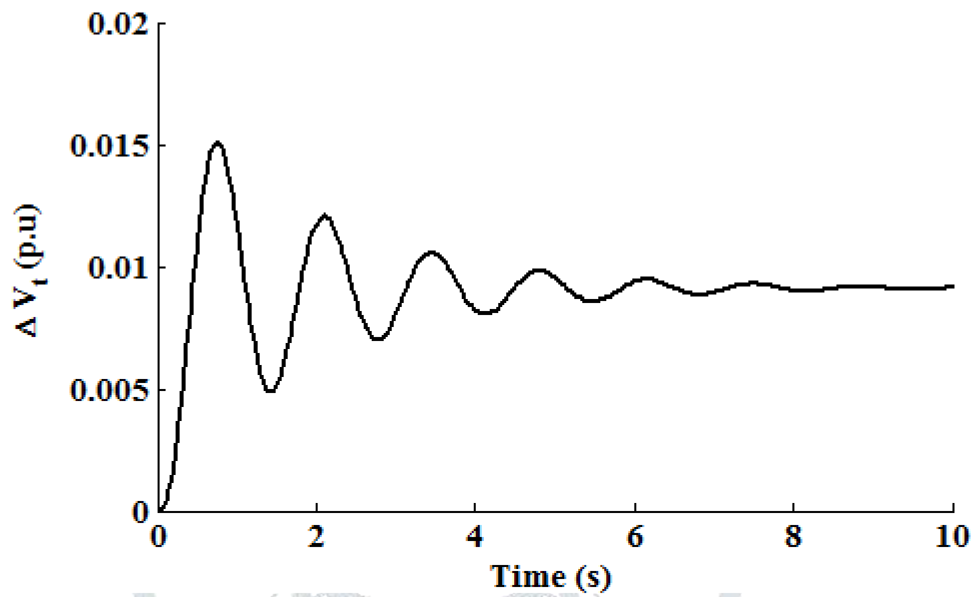

Fig 2. Output of AVR without controller

PID Controller

The proportional-integral-derivative controller is widely used controller comprises of three gains, proportional, integral and derivative. In this controller, a low pass filter has also being installed with the derivative gain to achieve better response as shown in Fig. 3.

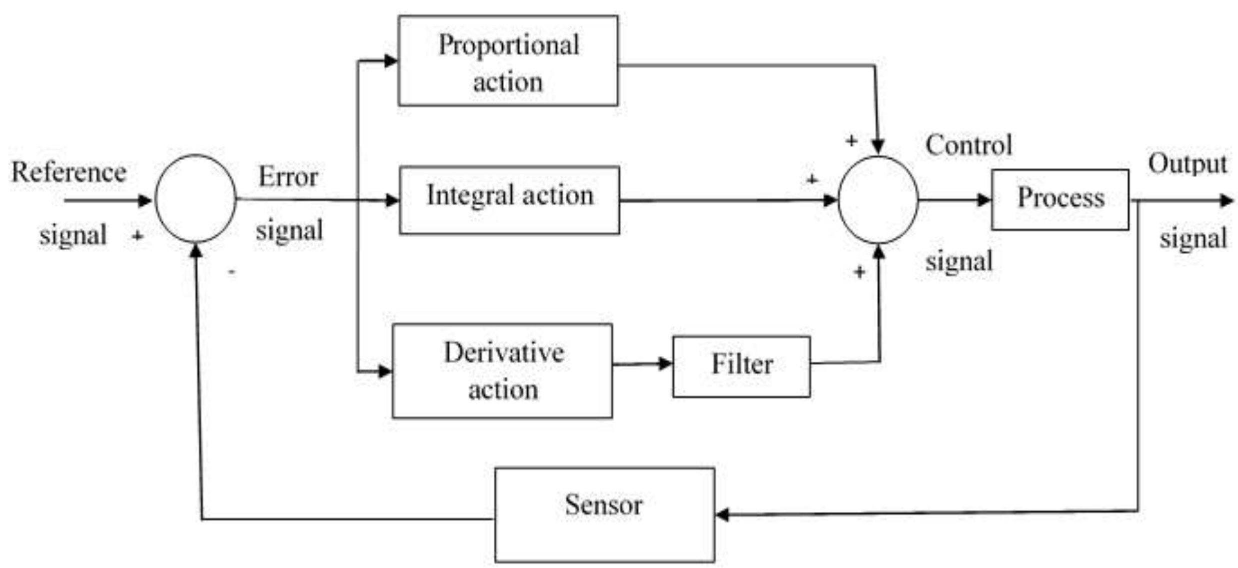

Fig.3. PID Controller

Result and Analysis

As the output of AVR is not as per the desired response, hence the PID controller has been inserted in the system (as shown in Fig. 4) to achieve a better response.

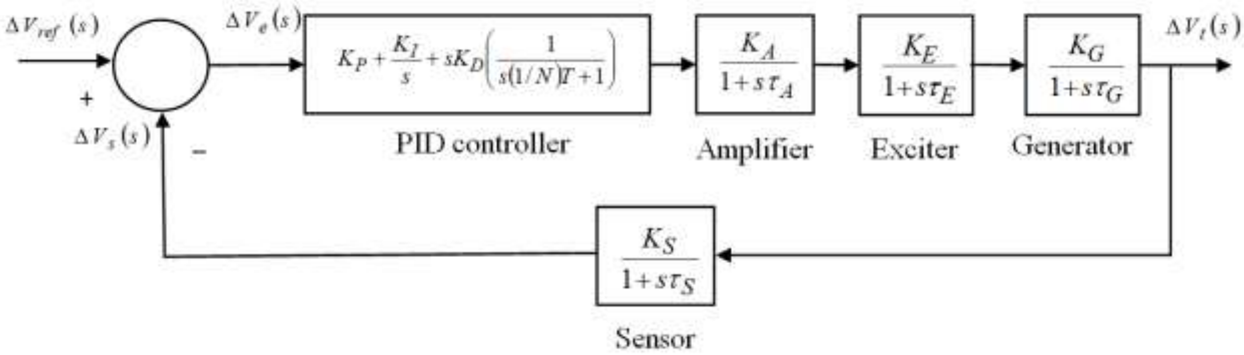

Fig. 4. AVR with controller

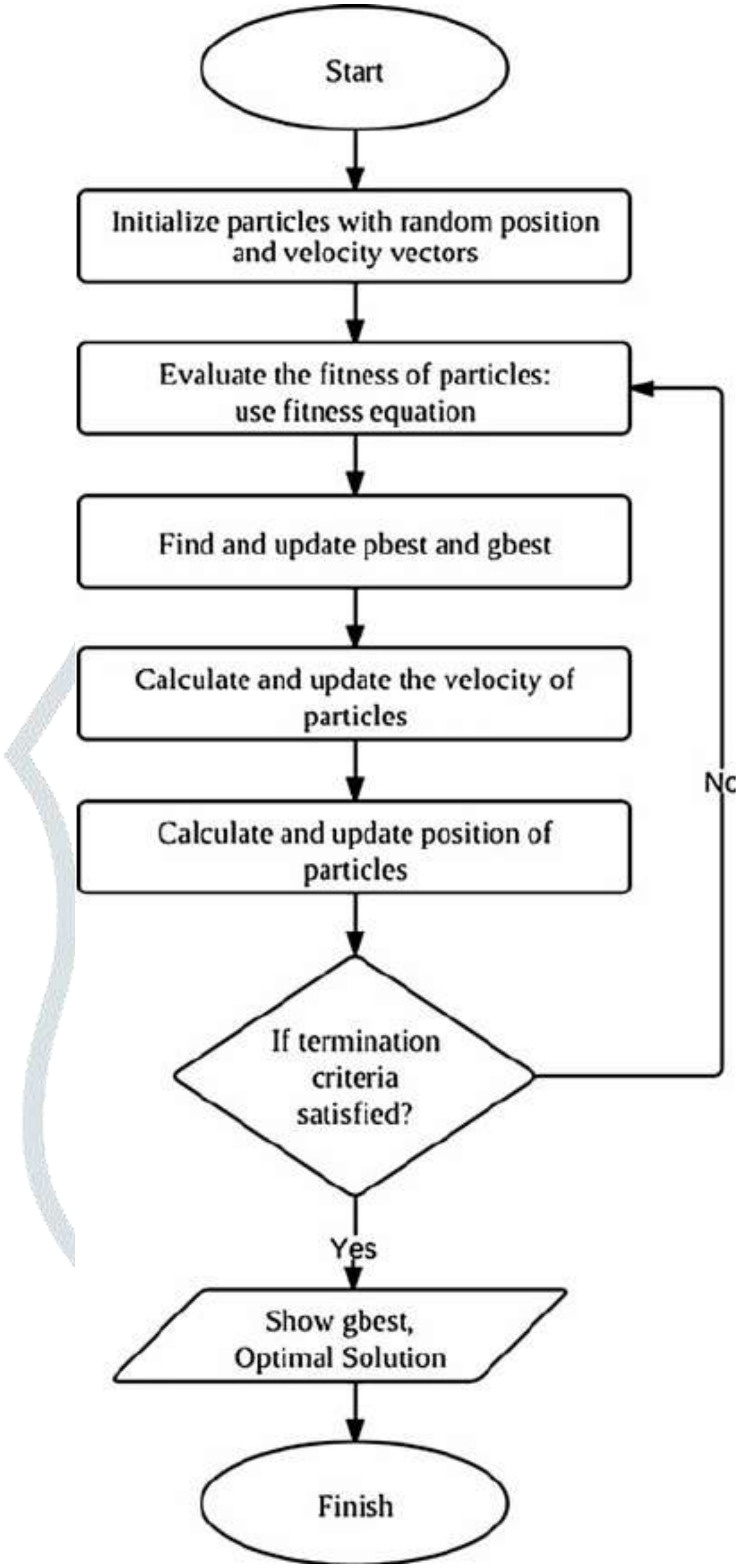

Fig. 5. PSO's Fowchart

The controller gains of the PID controller has been tuned by using the evolutionary optimization technique i.e. PSO whose flowchart has been shown in Fig. 5. On tuning the parameters with PSO, the output of the AVR response is as per the desired one as shown in Fig. 6.

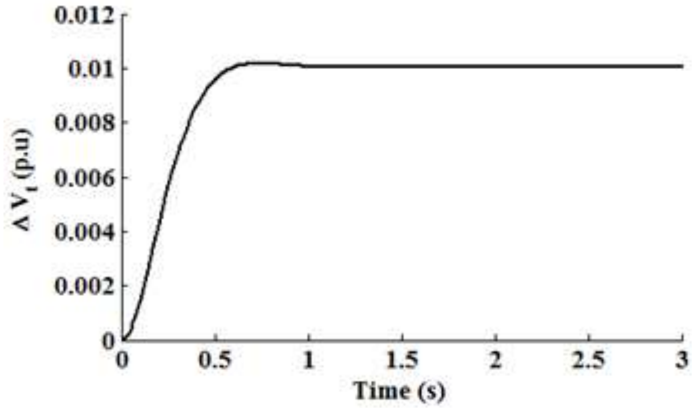

Fig. 6 AVR's Output

Conclusion

The output of the AVR shows that the proposed PSO based PID controller is very good in application to this particular system and it will work very efficiently in the system while sustaining the output voltage of the generator. The filter also works very well on the output of the system. Thus, the propounded controller can be installed in this type of system.

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