European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)

International Conference on Renewable Energies and Power Quality (ICREPQ'10)
Granada (Spain), 23rd to 25th March, 2010

Optimization of PI Controller Gains in Nonlinear Controller of STATCOM Using PSO and GA

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***Abstract*— According to nonlinear operation of STATCOM, nonlinear controller has a better performance in comparison with linear controller. Regulating the DC capacitor voltage in STATCOM is a common task and can improve the system dynamic. The nonlinear control is based on exact linearization via feedback. A PI controller exists in this control system to regulate the capacitor voltage. In conventional scheme, the trial and error method has been used to determine PI controller coefficients. In this paper, the effect of PI gains on responses of V_{dc}, I_d and Modulation Index (M) is presented. The exact calculation of optimized PI coefficients can be carried out to reduce disturbances and steady state error in DC link voltage. Therefore, in this paper, Particle Swarm Optimization (PSO) approach is used. It is shown that capacitor voltage tracks the reference value and vibrations are less than conventional status. Also, Genetic Algorithm (GA) has been used and compared with the results.**

I. SIMULATION RESULTS

In this section, GA is employed and compared with PSO. The results of running GA and PSO are shown in table 1. Comparison between two methods with a same function shows that PSO results in fitness function with lower value.

PSO response has more disturbances but faster convergence speed in the case of optimization of V_{dc} & I_d. Generally, PSO responses have less fluctuation in comparison with GA responses in the case of optimization of V_{dc}. In the case of optimization of double-objective function for PSO, V_{dc} response reaches to steady state with higher speed and less fluctuation, I_d response reaches to steady state with higher speed and more fluctuations and M response has not a good performance in comparison with GA responses. Figure 1 compares PSO and GA for V_{dc} response with two types of objective functions.

TABLE 1. RESULTS OF PSO AND GA

Method	Type of Function	K_P & K_I	Fitness Function value
PSO	Single-Objective	K_P=610.9952 K_I=700	0.0084
	Double-Objective	K_P=65 K_I=150	4.9996
GA	Single-Objective	K_P=617.9668 K_I=39.1076	0.0089
	Double-Objective	K_P=1.7748 K_I=150	5.1100
Trial & Error	Single-Objective	K_P=1 K_I=70	0.4030
	Double-Objective	K_P=1 K_I=70	5.4095

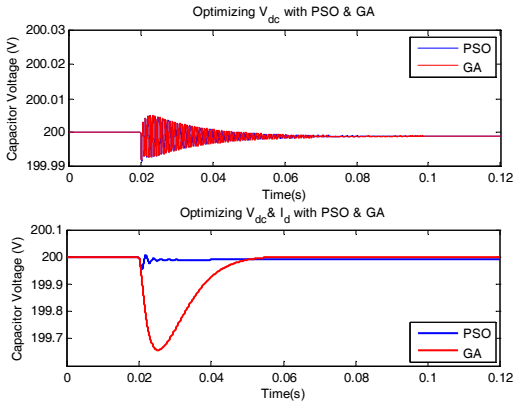

Figure 1. Capacitor voltage response

Traditional solution is the calculation of these coefficients by using trial and error method. In new method, the time of reaching to steady state value, settling time the fluctuations and overshoot have been decreased, too.