**Comparative Analysis of Soft Computing Techniques for solving Combined Economic Emission Dispatch Problems**

Srija Mustafi, Anupam Khan

IT Cell, Damodar Valley Corporation, DVC Towers, VIP Road, Kolkata-700054.

**Abstract:** One of the most important aspects of power system operation is to supply power to the consumers economically. Cost optimization comprises of dividing the total load demand among a number of generators so that the total generating cost is minimized. The conventional techniques used have a tendency to reach to the local minima, so more accurate techniques are needed.

Another dimension closely related with this problem is the environmental matters. The effort is continuously being made to curb the emission from the existing power generators. The generation of electricity from fossil fuel releases several contaminants, such as sulphur oxides (SO2), and oxides of nitrogen (NOX) into the atmosphere, which cause harmful effects on human beings, plants and animals. So, their control is a significant issue at the global level.

The objective is now two fold - to minimize the total cost, and minimizing the total emission. This is a multi-objective optimization problem which may, however be combined into a single objective function using some price penalty factor.

We have considered the fuel cost characteristics of the generators and the emission as third-order polynomials. The developed algorithm is validated by applying it to test systems having different sets of generators.

Soft computing and machine learning methods are currently being used successfully to solve various types of problems. Thus, the objective of the study is to introduce various optimisation methods, like Simulated Annealing, Genetic Algorithm and Artificial Neural Networks for efficient and economic operation and planning of electric power generation systems, and their applications in solving practical operating Combined Economic Emission Dispatch problems. This includes the investigation of their individual performance and also, the comparison of their performance against conventional methods as well as among themselves.

SA is an optimisation technique which is able to converge upon the optimal solution, even for problems with features which present difficulties for other popular optimisation techniques such as those where the location of the global optima is deceptive.

Genetic Algorithm is inspired by the natural selection process. It consists of processes like selection, crossover and mutation. Exploration along with exploitation enables it to come out of local minima to explore global minima.

ANN technique is roughly based upon how the human nervous system works. It requires a dataset to train itself based on which it updates the weights and biases. We fed it some training dataset, and after it is trained, its performance is tested.

Major contribution of the power generation is due to fossil fuel power plants and their emission is a source of pollution for the environment. Many countries have scheduled strategies for the reduction of the amount of the pollutants from fossil fuel power generation units. CEED is an optimisation problem with conflicting objective because the minimum cost of power generation is conflicting with pollution minimization. This paper is made so as to optimize both the cost of power generation and pollutant emission rate.

Keywords: Combined Economic Emission Dispatch (CEED), Simulated Annealing (SA), Genetic Algorithm (GA), Artificial Neural Networks (ANN).