Abstract

The scope of optimization in power system is ample. In general, optimization helps efficient and economical operation of the electrical system. It is worthwhile to note that power system problems are mostly non-linear, non-convex and often require optimization of two or more conflicting objectives. The problem can also be a mix of discrete and continuous variables that are needed to be handled by the optimization algorithms. During earlier days, classical numerical optimization methods were in use. The classical methods suffered from convexity, assumption of continuity and normally employed a gradient based search that had the tendency to converge to local optima. Revolution in numerical optimization introduced several evolutionary algorithms (EAs) and techniques in last three decades. Most of these methods could successfully overcome the problem of premature convergence and explore the search space in pursuit of global optima. The primary scope of this research is in analyzing performance of state-of-the-art variants of differential evolution (DE) algorithm for single objective optimization and evolutionary algorithms for multi-objective optimization problems in power system. This thesis presents a review of algorithms success history based adaptive differential evolution (SHADE) and its variant the linear population size reduction technique of SHADE (L-SHADE) for single objective optimization; decomposition based multi-objective evolutionary algorithm (MOEA/D) and summation based multi-objective differential evolution (SMODE) for multi-objective optimization. Further, operational and security constraints in the electrical network are also very common. Penalty function has been the most common and simplest way to deal with the constraints in power system problems. In this thesis, we include review of three constraint handling (CH) techniques for EAs - superiority of feasible solutions (SF), epsilon (ε) constraint handling and stochastic ranking (SR) methods. The constraint handling techniques have successfully been implemented in conjunction with the EAs and applied to existing and newly proposed formulations of constrained optimization problems in power system such as optimal power flow (OPF), economic-environmental dispatch and optimal reactive power dispatch. In addition, studies on optimal siting of wind turbines in a windfarm and distribution network loss minimization are also presented in relevant chapters. The final chapter of the thesis concludes with potential future works on optimization in smart grid.