PSO based Line Loss Mitigation and Voltage Stability Margin Improvement Using Shunt Type Fact Device

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Abstract--- Voltage profile of a power system is directly interacted with reactive power. One of the major causes of voltage instability and hence voltage collapse is due to imbalance management of reactive power. Flexible AC transmission System (FACTS) devices uplifts voltage stability limits and reduces line losses. Identification of an appropriate location to fix the FACTS device is a critical task. This paper deals with Constraint Factor Particle Swarm optimization (CFPSO) algorithm to find optimal location as well as size of FACTS device (Static Synchronous Compensator – STATCOM) to meet the objectives. The proposed approach was investigated on standard benchmark system IEEE 30-bus. From the outcomes, it is pragmatic that, there is an improvement in voltage stability margin and minimization in power loss by optimally locating STATCOM device in the power system.

Keywords--- Facts, Cfpso, Statcom, Voltage Stability, Optimal Location, Power Loss.

I. Introduction

Due to unexpected increase in power demand, economical and ecological restrictions and power loss in transmission lines, voltage parameter of the modern power system is unable to maintain within the prescribed limit. It's well known that, voltage profile is directly interrelated with reactive power. The principle causes of voltage instability problems and its prevention were discussed in [Sandeep Gupta,2010].The previous world records of voltage collapse pointed out, voltage instability is an unusual phenomena which have result in a major blackout.[Esmaeil G,2013]. The voltage collapse is avoided through balancing the reactive power demanded by the load or adding additional reactive power prior to reaching the point of voltage collapse.

Conformist reactive power control methods used to improve voltage stability limit are outdated due to its own drawbacks. Last two decades, especially for reactive power management, many researches paid attention on Flexible AC Transmission System (FACTS) devices. FACTS devices are solid-state converters that have potential of control in various electrical parameters in transmission lines.[N.G. Hingorani and L. Gyugyi,2000]. Fixing FACTS devices at the appropriate location is the utmost efficient way to improve voltage stability of the system.[Mehrdad Ahmadi Kamarposhti, 2008]. Since the installation of FACTS controllers in a power system is a disbursement issue, suitable location to fix the device must be well defined.[Quyen and Tuan TRAN-QUOC, 2010].

This research article deals to employ a shunt family FACTS device called STATic synchronous COMpensator (STATCOM) for the utility of improving voltage stability margin as well as to minimize line losses. STATCOM considerably advances the stability of the system during and after disturbances especially when network is weak.[Y. del Valle and R. G. Harley,2006].Conventional optimization techniques such as linear programming, mixed integer linear and non linear programming have been examined to recognize best place to fix the FACTS devices. Since complexity occurs due to multiple local minima and overwhelming computational effort, research work is encouraged to apply different algorithms to fix the issue mentioned above. Appropriate placement and sizes of various FACTS devices in the power system was attempted using different Evolutionary Programming (EP) techniques such as Tabu Search and Simulated Annealing (TS/SA), Genetic Algorithm(GA), Repetitive Power Flow method (RPF), Fuzzy decision making and PSO[A. Lashkar Ara and A. Kazemi,2012].

In this article, PSO based technique is implemented to optimize the placement and rating of STATCOM in order to minimize the transmission line losses and increase the voltage stability margin in the power transmission network. PSO is a computational intelligence-based technique and can converge to the optimal solution in many problems where most analytical methods fail to converge. It has many advantages over other similar optimization techniques are reviewed below.

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