

OPTIMAL COORDINATION OF DIRECTIONAL OVERCURRENT RELAYS USING PSO-TVAC CONSIDERING SERIES COMPENSATION

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DOI: 10.15598/aeee.v13i2.1178

Abstract. *The integration of system compensation such as Series Compensator (SC) into the transmission line makes the coordination of directional overcurrent in a practical power system important and complex. This article presents an efficient variant of Particle Swarm Optimization (PSO) algorithm based on Time-Varying Acceleration Coefficients (PSO-TVAC) for optimal coordination of directional overcurrent relays (DOCRs) considering the integration of series compensation. Simulation results are compared to other methods to confirm the efficiency of the proposed variant PSO in solving the optimal coordination of directional overcurrent relay in the presence of series compensation.*

Keywords

Directional overcurrent relay coordination, particle swarm optimization (PSO), power system protection, series compensation, time varying acceleration coefficients (PSO-TVAC).

1. Introduction

Overcurrent protection could be used as the primary protection in distribution or sub-transmission networks. Directional overcurrent relays (OOCRs) have been commonly used as an economic alternative for the protection of sub-transmission and distribution system or as a secondary protection of the transmission system [1]. Directional OCR coordination in power distribution network is a major concern of protection engineer to assure service continuity.

Many attempts and strategies based on conventional and computerized methods have been made in the past

to coordinate overcurrent relays. A simplex method is proposed to solve the optimum coordination of overcurrent relay timing. A linear programming is proposed in [2],[3],[4]. In [5], the optimum coordination has been obtained considering the configuration changes of the network into account. Authors in [6] present a review of the major contributions in this area.

The difficulties associated with using the mathematical optimization of complex engineering problems have contributed to the development of alternative solutions. In the literature, many standard optimization methods and hybrid variants based on metaheuristic algorithms have been proposed and applied with success for solving many complex problems related to power system protection coordination [7]. Authors in [8] proposed a Hybrid GA-NLP Approach for solving the optimal coordination of direction overcurrent. A seeker optimization method is adapted and applied to solving the optimal coordination of directional overcurrent relays DOOCRs [9].

The problem of relays coordination becomes more complex with the presence of series compensation. Series capacitor (SC) is commonly installed on long transmission lines to increase loadability of the line, enhance system stability and reduce line losses [10]. The presence of SC in transmission lines affects the voltage and current signals at the relaying point and it can disturb selectivity the coordination between different relays, this affects greatly the service continuity and power quality delivered to consumers. Therefore it is necessary to carefully carry out a study to determine new setting of DOOCRs and distance relays [1]. Many papers have been proposed to solve the optimal coordination of directional relay considering the series compensation. In the literature many variants based on PSO have been proposed to enhance the performance of the standard PSO algorithm to solve the power system protection coordination. Authors in [10] proposed