

# **Metaheuristics and transmission expansion planning: a comparative case study**

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## **Abstract-**

**Transmission expansion planning (TEP), the determination of the new transmission lines to be added to an existing power network, is a key element in power systems strategy. Using classical optimization to define the most suitable reinforcements is the most desirable alternative. However, the size of the problems under study is growing, because of the uncertainties introduced by renewable generation or electric vehicles (EVs) and because of the larger sizes under consideration given the trends for higher renewable shares and stronger market integration. This means that classical optimization, even using efficient techniques such as stochastic decomposition, can have issues when solving large problems. This is compounded by the fact that, in many cases, it is necessary to solve a large number of instances of the problem in order to incorporate further considerations. Thus, it can be interesting to resort to metaheuristics, which can offer quick solutions at the expense of an optimality guarantee. Metaheuristics can even be combined with classical optimization to try to extract the best of both worlds. There is a vast literature that tests individual metaheuristics on a specific case study, but wide comparisons are missing. In this paper, we test a Genetic Algorithm (GA), Orthogonal Crossover based Differential Evolution (OXDE), Grey Wolf Optimizer (GWO), Moth-Flame Optimization (MFO), Exchange Market Algorithm (EMA), Sine Cosine Algorithm (SCA) optimization and Imperialistic Competitive Algorithm (ICA). The algorithms were applied to the standard test systems of IEEE 24, and 118 buses. Results indicate that, although all metaheuristics are effective, they have diverging profiles in computational time and finding optimal plans of TEP.**

**Index Terms-** Transmission Expansion Planning (TEP), Optimization Algorithms, Uncertainty, Wind Farms, Electrical Vehicles (EVs).

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