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Multi-objective optimization of smart grids considering environments with uncertainty

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The advancement of technologies brings greater complexity in the operation of smart grids and the development of new optimization tools supports network decision making. Environments with uncertainty arise due to the use of photovoltaic energy that can affect the availability of the electricity grid. To mitigate claims for reliability in the network, the algorithm used for optimization should flatten the demand curve, integrate renewables (solar energy) and reduce CO^2 emissions (encourage the use of electric vehicles).

In fact, this research presents the generation of a new multi-object algorithm called DEEPSO-MO. Which has proven to have very good results in its single objective version. In its hybrid version with VNS algorithm, it is the winner of the IEEE Congress on Evolutionary Computation / The Genetic and Evolutionary Computation Conference (IEEE-CEC / GECCO 2019) and I also win the IEEE World Congress on Computational Intelligence (WCCI 2018) competition.

The high performance is due to evolutionary and self-adaptive qualities that improve and performance, it also has some improvements that allow you to adjust internal parameters such as inertia, perception and cooperation. The multi-objective version used two novel strategies that are presented in detail, these are the method of niching and proximity to the Pareto front.

The results are validated with the test problems SCH, CONS, ZDT2 and FON showing good performance in terms of distribution and proximity to the Pareto front. Furthermore, we use an aggregators, it act an intermediary between power systems and end-users/stakeholders, they collect all information make the decisions representing a group.

Then, the aggregators can operate prosumer. Hence, this prosumer can buy/sell energy in the electrical network. The level of complexity consist in deciding either connect or disconnect from the network. The aggregator can use the prosumer to save money. Indeed, it has use the prosumer resources to increase the welfare of the grid and integrate them with other resources.

Finally, the model is successful, allows a constant generation for periods 1 to 8 and, from 20 to 24 and in the energy storage systems they operate for the expected peak hours, that is, the discharge period is between 11 and 17. The algorithm has been tested to maintain a good performance with the test functions and the case of intelligent microgrid study, however for future research it is still necessary to evaluate its performance with other test functions and for the optimization of micro-networks with a high percentage of solar energy.

Given an overview, this paper presents the scheduling of energy resources. Indeed, it is characterized as an optimization problem which seeks to increase the area under the curve. In fact, it is represented by operational costs minus incomes. In summary, these proportions define the profit of the smart microrred. Then, there are low amounts of power generation, incomes are higher and small expenses, but the profit of the network does not reach its maximum value, this is how the amounts of energy must be modified until reaching the equilibrium amount. Finally, the mechanism used to maintain balance is the optimization algorithm called VNS-DEEPSO.

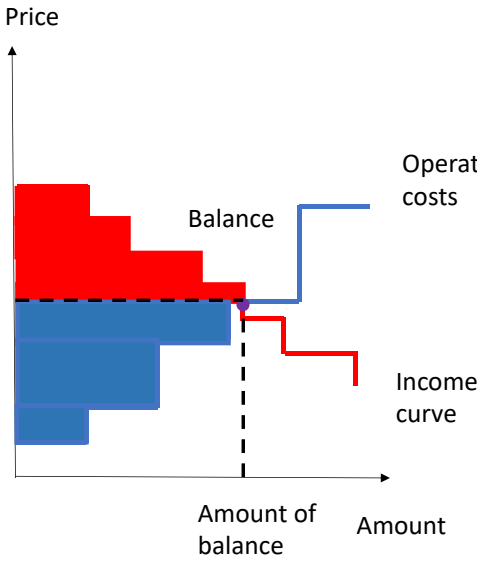

Figure 1. Profit of the smart microgrid

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