HEURISTIC GRASP FOR PLANNING METERING SYSTEMS FOR ELECTRICAL POWER NETWORK MONITORING

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Abstract- During real time power system monitoring, State Estimation (SE) is responsible for providing a complete and reliable database that will be used by security assessment programs in an Energy Management System. Basically, SE filters statistically small metering errors and should be able to correctly identify and remove bad data. Also, as part of the SE process, system topology and observability are determined.

Data redundancy is crucial for the success of SE. Adequate redundancy levels enable SE to efficiently process bad data and also to achieve good and reliable estimates, even in case of temporary data loss. Data redundancy may be evaluated considering the number, type and topological distribution of metering devices. Although highly redundant metering systems would be desirable, they are often not achieved due to financial constraints. Besides, during power system operation, topology changes or temporary malfunction of the data acquisition system may reduce data redundancy for SE. Even critical redundancy levels may be achieved, leading to inadequate performance of bad data processing routines.

Planning metering systems for power system monitoring is a complex task to address, not only due to the problem dimension itself (number of possible configurations), but also to the need of establishing a trade-off between SE performance and metering system costs. With an adequate metering system, SE can successfully process the available information and obtain reliable estimates of system operating conditions, which can then be used for further analyses and to take control actions.

This work presents a heuristic in GRASP for solving the problem of planning metering systems that are adequate for processing SE function and power system monitoring. Meter placement is considered a NP-hard combinatorial optimization problem. GRASP is employed to achieve a trade-off between investment costs and reliability of the SE process. Tests with the IEEE-14, IEEE-30, IEEE-118 bus test systems and with part of a real Brazilian system were performed to illustrate and validate the proposed algorithm. The obtained results have also been compared with results obtained with the application of genetic algorithms, previously reported in the technical literature.

Keywords: Evolutionary Computation, State Estimation, Optimization, Power Systems Monitoring.