Title:
Placement of Phasor Measurement Units in Power Networks with consideration of System Observability and Optimal Distribution of Measurement Redundancy

Abstract:
In this thesis in addition to optimal placement of phasor measurement units (PMUs) a new method is proposed for optimal distribution of measurements' redundancy. Since the buses having first order redundancy degrade the system observability by missing their measurements, this method is used to reduce the number of these buses by increasing their redundancy. On the other hand, the proposed method, in spite of the previous methods, is used to enhance the system observability by improving the redundancy order of the other low order redundancy buses without increasing the number of the lower orders. Moreover, in this thesis a new method is proposed for expanding the power system equipped with PMUs. In this method, the optimal location of new PMU(s) in the sense of measurement redundancy will be obtained easily and without need to perform the previous optimization algorithm. In addition, by using this method, the optimal PMU placement can be obtained considering the contingencies such as PMU outage or line outage. It should be noted that the proposed methods are implemented on the IEEE 14-, 30, 57- and 118- bus power networks. The simulation results are compared with previous methods. In addition, simulations are performed with and without considering the effect of zero injection buses.

Keywords:
Optimal PMU Placement, Redundancy, Optimal Distribution of Measurement Redundancy, Reliability, Observability, System Expansion