

UNIVERSITI TEKNOLOGI MARA

**NOVEL TECHNIQUES FOR VOLTAGE
STABILITY ASSESSMENT AND
IMPROVEMENT IN POWER SYSTEM**

ISMAIL BIN MUSIRIN

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ABSTRACT

This thesis presents novel techniques for voltage stability assessment and improvement in power system. A novel line-based voltage stability index termed as Fast Voltage Stability Index (*FVSI*) was developed and used to evaluate the voltage stability condition on a line. The value of *FVSI* was used in order to determine the most sensitive line and corresponding weak bus in the system. The results obtained from the voltage stability analysis using *FVSI* were utilized to predict system violation, identify most sensitive line corresponds to a load bus and estimate the maximum loadability and operating margin in the system. A new Evolutionary Programming (EP) based acceleration search algorithm was developed to accelerate the process in estimating maximum loadability in a power system. The maximum loadability estimated from the proposed acceleration search technique was found in a good agreement with those obtained from the conventional voltage stability analysis technique. The application of *FVSI* was extended for the evaluation of the overall system stability and determination of loaded buses in a radial distribution system. The effect of reactive power load variation on total losses in the system was also investigated. The proposed *FVSI* was consequently used as the line outage severity indicator in the implementation of contingency analysis and ranking. New automatic contingency analysis and ranking algorithms due to line and generator outages were separately developed. These algorithms have profoundly reduced the computation burden experienced in the conventional technique. Finally, a novel Reactive Power Planning (RPP) algorithm using the state-of-the-art of EP for voltage stability improvement was developed. The *FVSI* was used as the objective function for the developed optimisation technique. A performance comparison in terms of loss minimization and voltage stability improvement was made when loss minimization was taken to be the objective function. It was found that the proposed algorithm with *FVSI* as the objective function has been able to produce a better result as compared to the techniques developed in the literature.