This thesis presents the assessment and improvement of stability domains for the angle stability condition of the power system using particle swarm optimization (PSO) technique. An efficient optimization method using PSO for synthesizing torque coefficients $K_t$ and damping torque coefficients $K_d$ to solve angle stability problems was developed and used to identify the angle stability condition on single and multi machine system. In order to accelerate the determination of angle stability, particle swarm optimization (PSO) is proposed to be implemented in this study. The application of the proposed algorithm has been justified as the most accurate with lower computation time as compared to other optimization techniques such as evolutionary programming (EP) and artificial immune system (AIS). Subsequently, a newly control technique named as proportional-integral-derivative (PID) incorporated with flexible AC transmission (FACTS) device is proposed in this study to improve the damping capability of the system. The minimum damping ratio $\xi_{min}$ was applied as an indicator to precisely determine the angle stability condition based on PSO technique. The proposed optimization technique was compared with respect to EP and AIS. On the other hand, the installation of static var compensator (SVC) as the compensating device has been compared with respect to power system stabilizer (PSS) with lead-lag (LL) controller. PSS with LL controller (PSS-LL) system has been chosen due to well used by researchers of power system around the world and it can be selected as a benchmark model for research purposes. The study was implemented on single machine with infinite bus (SMIB) system. Results showed that the implementation of SVC as a compensating device managed to improve the angle stability condition. The application of SVC-PID was then extended with multi objective (MO) optimization process. The proposed approach was a combination of $\xi_{min}$ and maximum damping factor $\epsilon_{max}$ as MO indicator in order to improve the damping capability of the system. The most suitable ratio of $\xi_{min}$ and $\epsilon_{max}$ was investigated and applied into PSO based search algorithm. It was found that the proposed SVC-PID algorithm with MO as the objective function has been able to produce a better result as compared to the techniques developed in the literature.

Malaysia is one of developing countries endowed with abundant resources of raw materials which have to be exploited especially in terms of technological provision in order to sustain and enhance aromatic plants industries and utilization. The essential oil from plant materials contains fragile aromatic molecules that can easily be destroyed or modified by changes caused during the extraction process. Even a subtle difference in extraction process conditions can have a significant effect on oil quality. Temperature one of important parameters that mostly affect essential oil production. In the conventional steam distillation method, high temperatures and extended heat were exposed to botanical plants that can cause thermal degradation to the extracted oil. In this research, a pilot-scale steam distillation system with temperature monitoring and control module was proposed to maintain process temperature at desired response, to avoid waste of energy usage and inconsistency of oil production quality and quantity due to uncertainties. In this study, the range of controlled steam temperature was set between 80°C to 90°C with time constant of desired reference model at 220 seconds with no overshoot. The model of steam temperature has been derived using auto-regression exogenous (ARX) function. For controller module, a Fuzzy Model Reference Learning Controller (FMRLC) was designed and applied to regulate steam temperature based on desired model reference heating profiles. In the FMRLC, fuzzy controller and inverse fuzzy elements were constructed using 49 and 121 IF-THEN rules respectively. In the study, the controller parameters were tuned until the error analysis, RMSE and SSE values reached as low as possible. The study also investigates the robustness and tracking set-point capability of FMRLC compared with several control methods i.e. Model Reference Adaptive Controller (MRAC-Lyapunov and MRAC MIT-rule), Fuzzy-PID and PID. From the results, it was found that the proposed FMRLC provides the best performance compared to the other controllers. Moreover, the actuation effort of FMRLC was minimised as it achieved lowest SSC among other controllers. Lower SSC value reflects on lower energy usage of the actuator and the resultant of FMRLC controller output response may reduce wear on the heating element. Further assessment has been done on actual Kaffir lime peel to confirm the reliability of designed system on the quality and quantity of production oil. The evaluation of oil quality by GC and GCMS identification has shown that the extracted oil contained all major constituents of Kaffir lime oil at 85°C steam temperature and the variation of temperature conditions (i.e. from 80°C to 90°C) is evidently influenced the amount of essential oil production.