Chapter 7

Conclusion and Future Scope

In **the first Chapter** of the thesis literature review, research motivation, research gap, and thesis organization are discussed briefly.

In the **second chapter** of the thesis, optimally tunned gains with the continuous twisting observer are applied to improve the power system performance. In this chapter, the elimination of the command filter and higher-order tuner is explained by the application of the proposed control using optimally tuned gains. This thus reduced the computational complexity, which can be observed from the obtained results. In this chapter, the proposed controller is designed by separating the nonlinear terms that simplify the controller expression. For matched/mismatched uncertainties, CNTO Observer was designed. Obtained results show the accuracy of the proposed observer.

In the **third chapter** of the thesis, control computation was reduced by the exact estimation of complex control terms using the ECRNN scheme. The claim of global stability in this chapter was shown by the convergence of state errors in the obtained results. These results justify the bounded constraints of the defined continuous differentiable functions. Enhance robustness was obtained in step perturbation of mechanical input power. The estimation speed of the proposed ECRNN scheme was governed by the adaptive laws, which worked effectively, as presented in the obtained results.

In **chapter four** of the thesis, direct adaptive laws are designed for unknown power system parameters. Also, a Nussbaum function was defined in the proposed scheme. This function design protected the control signal deviation in the case of an unknown control direction. This feature was shown in the obtained results under case 4. The robustness under disturbances was obtained using a super-twisting scheme in the backstepping control design. Further, the recursive error compensation was achieved by the respective filter design. The proposed scheme in this chapter effectively damp out the low-frequency oscillations under fault cases comparably with the other recent schemes.

In the **fifth chapter,** similar control approaches with objectives to smoothen the controller performance, enhancing the robustness under perturbation, providing control resiliency, and observer designing for uncertainties compensation were analyzed. In this chapter, the matched/mismatched uncertainties were compensated using IDO. The robust performance of the proposed scheme was shown in the obtained results under the influence of super twisting reaching law. The control effort in this chapter was minimized by the application of event trigger control. The finite time convergence of microgrid states was achieved through the proposed control algorithm and was shown in the obtained results.

In the **sixth chapter** of the thesis, the resiliency of the controller toward DOS attack was explored with the event-based control design in an autonomous ac microgrid. The task of minimum control effort under DOS attack was achieved using event trigger control. The stability of the autonomous AC microgrid was preserved by the Lyapunov stability analysis under the defined DOS frequency and duration. Obtained results in this chapter show the deterioration of system states beyond the stability bounds of DOS attacks.

7.1 Future scope of work

The proposed control approaches presented in the thesis for power system networks can be extended as per the following scope of future work.

- These schemes can be extended for the resiliency towards cyber threats in wide area networks. Also, the multiagent aspect in the proposed control sense can be incorporated.
- Event-based power sharing in DC/AC microgrids, along with adequate current sharing between converters and voltage regulation, can be realized using event trigger control.
- Pertaining to this control design for the microgrid, the effect of delay in information exchange can be the future scope of the work.