Chapter 7

Conclusions and Future Scope

In this thesis, Multirate output feedback based discrete time sliding mode control has been investigated for congestion and admission control in the communication network. The algorithm proposed here contains two step process, design of sliding surface, and design of control law. Multirate output feedback based sliding mode control scheme is somewhat different from the other SMC techniques that samples the control input and system output at different rates. For discrete systems, DSMC control has a number of advantages. DSMC based congestion and admission controllers are more robust and immune to the external disturbances. Communication networks are non-stationary in nature and the number of users may change frequently, so it requires control algorithms, which may change its control parameters adaptively without disturbing QoS. The simulations have been done for 2\textsuperscript{nd} order and 3\textsuperscript{rd} order systems for the sake of simplicity and gives satisfactory results. The same algorithms may be applicable to higher order systems.

The thesis has addressed one of the remedy, \textit{chattering effect} in sliding mode control. From the frequency domain analysis of the control signal, the frequency at which undesirable chattering occurs is detected and removed by using appropriate IIR filters. This is one of the simplest ways to reduce chattering effect
and to provide smooth control. The simulation results show the reduction in chattering level.

To manage battery power in a wireless communication network, A-MAC protocol is being proposed in this thesis. Here DSMC based power control is possible but power related issues present in all layers of the network, so applying DSMC at each layer is not a practical solution to manage power. The comparison of proposed A-MAC with existing MAC protocols available for battery power management has been shown. A-MAC is a switching protocol, which switches the controller to use different algorithms to manage power. Simulation results show that after applying A-MAC algorithm, the lifetime of the network increases. The protocol is tested on FPGA based hardware along with some peripherals and satisfactory experimental results have been obtained.

Following are the areas where further research can be carried out

1. The Multirate output feedback based sliding mode control can be investigated for controlling traffic in the network.
2. The Multirate output feedback based sliding mode control can be investigated to control power in cyber physical systems
3. Investigation on the multimode sliding mode control for cyber physical systems can be carried out.
4. Investigation on frequency domain analysis of chattering in higher order sliding mode control can be carried out.
5. Investigation on frequency domain analysis of chattering in multisegment sliding mode control.
6. Investigation on the feasibility of higher order discrete time sliding mode control for congestion reduction in communication network.
7. Investigation on chattering free control law design for sliding mode control.
8. Investigations on energy efficient non-MAC protocol for communication networks.