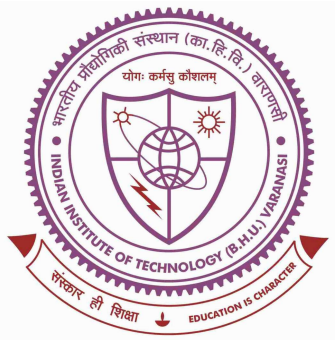
Rated Observation and Control for a Class of Dynamical Systems



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by

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Chapter 7

Conclusions and Future Scopes

In this short chapter, we conclude our work done in the thesis by summarizing the main attributes. We also emphasize on possible future scopes.

7.1 Conclusions

A switched high-gain observer with the desired convergence time for nonlinear systems is designed. With the switching structure, the proposed observer avoids the singularity problem. In the obtained results, the observer's states converge to the actual states within the desired settling time, and can be chosen as per our own choice. In this context, two problems have been examined. The first problem is related to the Van der pol oscillator systems, and the second one is on the Genesio-Tesi chaotic system.

Further, an adaptive super-twisting algorithm based method for the estimation of the unknown parameters of the system is developed. The estimated parameter converges to the actual parameter in the presence of uncertainty. The Lyapunov stability is also presented. The technique is illustrated by simulation of practical examples which show the effectiveness of the proposed scheme.

Next, the predefined-time controller for nonlinear polytopic systems is discussed. With this controller, the settling time function is invariant with respect to initial conditions and can be chosen by the designer in advance. Such kind of systems is said to be predefined time stable. Stability analysis of the nonlinear polytopic systems is discussed by using the control Lyapunov function. The effectiveness of the proposed results is studied through the simulations.

The guidance law is designed based on different approaches. Firstly, the design of the guidance law involves the implementation of the super-twisting algorithm for the missile-target motion in a plane. The gain values are adaptively tuned to minimize the risk of overestimation. Additionally, the design incorporates information obtained from an extended state observer about the target acceleration. Secondly, a guidance law based on ETASTA is proposed for unknown target acceleration, achieving the LOS rate at zero or a small neighborhood of zero in finite-time. A triggering condition is offered, using the minimum amount of control to meet the stability requirements. Lastly, a guidance law with predefined-time convergence is proposed, achieving the LOS rate to zero within a predetermined time that can be chosen in advance. The efficacy of these proposed techniques is illustrated via a practical example.

7.2 Future Scopes

The stabilization of the uncertain systems is a mature field, but still several directions can be explored for research and implementations. The outcomes of this thesis may be further investigated in the following research directions:

- Our work can be extended to include state stabilization through the observer.
- The proposed results can be extended to stabilize nonlinear polytopic systems in the presence of external disturbance.
- Our approach can be extended to multi-input nonlinear polytopic systems with a predefined time.
- Our work can be improved and extended to handle time-varying target acceleration in the guidance law with a predefined time.
- Discrete-time systems are essential and challenging to control, and we plan to apply our approach to this class of systems in the future.
- Our work on predefined guidance law can be extended to include the salvo attack of the missile-target.