ABSTRACT

This study addresses the challenge of achieving a stable teleoperation over the Internet, improving the convergence rate in the presence of high communication time delays, and maintaining consensus in the platoon while the lead agent is being teleoperated over Internet. The first part of this thesis dealt with stable teleoperation where we employ a passivity-based formalism to establish stability using wave variables and wave scattering techniques, and we enhance the convergence rate by combining it with predictor-based approaches. The elevated time delay within the teleoperated communication layer - The second part is known to induce collision between the agents as well as descensus behaviour in the platoon, which reduces the convergence rate and increases the settling time in the convergence of power variables. This issue is addressed in this paper by utilizing a Smith predictor on the operator end and Minimum Jerk (MJ) predictors on the remote end. We present experimental and simulation results to demonstrate the improvements, ensuring stable teleoperation under high communication time delays.

Contributions of this thesis work include:

- Setup a teleoperation platform over Wi-Fi and the Internet.
- Identify the instability in the system, and implement the wave variable method to introduce stability which leads to witnessing the convergence issue.
- Implementing Smith Predictor and MJ predictor to compensate convergence issue.
- Design a platoon multi-agent system where the first agent is teleoperated over internet.
- Study the performance of the approached model in Simulink and Hardware.