Abstract of the thesis titled **Two-Rate Dynamic Output Feedback Control of Discrete-Time Plants with Some Applications**

It is well known that output feedback-based linear time-invariant (LTI) or single-rate controllers cause several performance limitations, the most important one being inadequate loop robustness for plants with unstable poles and non-minimum phase (NMP) zeros in close proximity. This is due to their inability to relocate the plant NMP zeros. The presence of NMP zeros in a feedback loop also causes important limitations, such as reduced quantization error handling capability and increased vulnerability to zero-dynamics cyber attacks, when control over communication networks is sought. Also, in decentralized setting, single-rate controllers often yield poor centralized performance for strongly coupled multi-input multi-output (MIMO) plants.

Further, LTI controllers cannot provide sufficient robustness against gain variations in case of such plants and hence cannot be used for consensus control of multi-agent systems consisting of such agents. Also, in the decentralized setting, LTI controllers are not capable of achieving the same level of performance for multi-channel plants, as can be obtained by centralized LTI controllers, especially when the multi-channel plant is strongly coupled.

To resolve the matter of loop robustness for single-input single-output (SISO) discrete-time plants, recently, a 2-periodic-based 2-rate controller has been proposed, that has loop zero placement capability. However, in this scheme, to make the design tractable, several *ad hoc* assumptions are imposed on controller parameters in the polynomial domain, which though manageable for SISO plants are not readily so for MIMO systems. This thesis first proposes an alternate SISO 2-rate controller having only a single 2-periodic gain in the forward path to avoid the *ad hoc* assumptions in the controller design and thus achieves some important improvements. However, the design still being polynomial-based, next, a generalised structure of the 2-rate controller is proposed for MIMO plants and designed using a state-space approach. The inherent zero relocation capability of this controller is also exploited to solve the problems associated with control over networks, as stated above. Further, the same is used to solve the leader-follower consensus control problem of multi-agent systems with agents having NMP zeros. Finally, the capability of a decentralized version of the above 2-rate centralized controller in respect of achieving some centralized performance is investigated.

Keywords: 2-rate control, NMP zeros, zero-placement, quantized control, zero-dynamics cyber attack, leader-follower consensus, decentralized control.