**INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI**
**SHORT ABSTRACT OF THESIS**

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**SHORT ABSTRACT**

The model order reduction problem involves approximating the dynamics of an original large-scale model by a reduced-order model to a high degree of accuracy. This thesis focuses on model order reduction of continuous-time Linear Time-Invariant (LTI) and Linear Time-Varying (LTV) systems over a finite time interval. The reduced-order models obtained are based on minimising an appropriate error criterion. To begin with, the finite horizon H2 error norm for LTI systems is expressed in terms of the pole-residue representation of the reduced-order system and interpolation-based time-limited H2 optimality conditions are derived. A projection framework for rational interpolation-based model reduction over a finite time interval is introduced based on the optimality conditions. An iterative algorithm for time-limited H2 optimal model reduction is proposed using the interpolatory framework. Secondly, the finite horizon H2 error norm for LTI systems is expressed using a gramian framework. Based on this, analytical expressions of the gradients of the time-limited H2 error norm are derived. The gradients are used with a standard quasi-Newton procedure to obtain reduced-order models, which satisfy the time-limited H2 optimality conditions more accurately than projection-based algorithms. Next, the focus is on LTV systems. Two methods for computing the reachability gramian of a continuous-time LTV system are proposed using output trajectory information obtained by simulating the system with various inputs. Another method for numerically computing the reachability gramian of an LTV system using the modified adjoint of the LTV system is proposed and a finite horizon H2 norm for such systems is discussed. Finally, the finite horizon H2 norm, introduced in the previous work, is used to define a finite horizon H2 error norm, which is used as a performance measure for model reduction of continuous-time LTV systems. The functional derivatives of the finite horizon H2 error norm are obtained, which when equated to zero give conditions for the optimality of the error norm. The optimality conditions are used to propose a projection-based iterative scheme for model order reduction of continuous-time LTV system.