INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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This thesis explores three key areas: real-time modal identification, dynamics of stochastic systems on configuration manifolds, and damage detection. It introduces an error-adaptive approach for real-time modal identification using first-order eigen perturbation techniques, which converge faster than existing methods and work independently of sampling frequency. This lays the groundwork for health monitoring of systems on smooth manifolds. The study proposes methods for solving stochastic systems on manifolds using an Ito-Taylor expansion and manifold-tangent space isomorphism, significantly reducing global error and computational costs. It also presents a framework for studying stochastic Hamiltonian systems on manifolds, ensuring accurate trajectory computation and geometric integrity. Finally, a damage detection algorithm, Recursive Principal Geodesic Analysis (RPGA), is introduced. This algorithm effectively identifies anomalies in systems like the spherical pendulum and inverted spherical pendulum-cart system. Together, these findings enhance the understanding of structural dynamics, providing tools for real-time structural health monitoring and geometric symplectic analysis of stochastic systems on manifolds.