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Balanced Truncation Model Reduction for Quadratic-Linear Systems

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We discuss balanced truncation for model reduction of continuous time quadratic-linear systems. Balanced truncation for linear systems mainly involves the computation of Gramians of the system, namely the controllability and observability Gramians. These Gramians were extended to the general nonlinear setting by Scherpen (SCL,1993) where it was shown that the Gramians are the solutions of nonlinear Hamilton-Jacobi equations. These solutions, in general, depend on the state vector which makes it hard to utilize them in the model reduction framework. In this talk, we aim to determine approximate Gramians for the quadratic-linear system which can be used to balance quadratic-linear systems in order to identify a reduced-order quadratic-linear system. We also investigate the important properties of the reduced-order system such as the Lyapunov stability of the system. The efficiency of the reduced-order system obtained by the proposed method is demonstrated for various semi-discretized nonlinear partial differential equations.