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Model reduction of bilinear port-Hamiltonian systems

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Port-Hamiltonian systems have emerged as a fundamental framework for modeling a wide range of physical phenomena due to their energy-based structure and inherent stability properties. To address the complexity of such models, various structure-preserving model reduction techniques have been developed for both linear and nonlinear port-Hamiltonian dynamics. In this work, we focus on bilinear port-Hamiltonian systems and explore novel model reduction methods that maintain their intrinsic structure. By leveraging techniques designed for bilinear systems with quadratic outputs, we propose both interpolatory and balancing-based reduction approaches. These methods ensure computational efficiency while preserving the key dynamical and physical properties of the original system, making them well-suited for large-scale applications.

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