Postprint of Research on Model Reduction for Free-Free Modal Dynamic Models of Flexible Spacecraft

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Abstract

For flexible spacecraft with a central rigid body-flexible appendage configuration, the Lagrange equations are applied to derive the dynamic model, and the modal expansion method is utilized to obtain the unconstrained modal dynamic equations. Model reduction is then investigated based on the theories of modal cost analysis criterion and internal balancing reduction criterion, respectively. The modal cost analysis criterion can reveal the contribution share of each mode to the total system value, retaining the modes with larger contributions to form the reduced-order system. The internal balancing reduction criterion transforms the system model into an internally balanced system through a nonsingular linear transformation, and within the internally balanced system, discards the modes corresponding to smaller values on the diagonal of the Gram matrix to constitute the reduced-order system. Finally, numerical simulations are performed for model reduction of the unconstrained modal dynamic model of a central rigid body-single flexible beam spacecraft, and numerical computations of system model reduction are carried out using both criteria. The results demonstrate that both reduction criteria can effectively reduce the original system model.

Full Text

Preamble

The provided text consists primarily of encoding artifacts, corrupted characters, and mathematical placeholders without substantive content. No translatable academic prose could be extracted from this section.

Note: Figure translations are in progress. See original paper for figures.