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Proper Orthogonal Decomposition Reduced-Order Modeling for Acoustic-Structure Interaction and Inverse Vibro-Acoustic Problems

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ABSTRACT

An approach will be presented to use the Proper Orthogonal Decomposition (POD) method of model reduction to solve inverse material characterization problems in vibro-acoustics of soft tissues. The computational cost of numerical solutions to the governing Helmholtz equations for steady-state vibro-acoustic analysis is significant, particularly as the wave numbers become large. However, the POD method of model reduction can derive reduced-dimension bases from a previously obtained set of simulated and/or experimental field measurements. These bases can be used in subsequent numerical analyses (e.g. finite element analyses (FEA)) and, in many cases, produce accurate and highly efficient numerical solutions. Through a test problem the capabilities of POD bases to be used within a FEA framework to accurately and efficiently solve the governing Helmholtz equations as the wave number becomes large will be presented. Furthermore an example will be shown to display the capabilities of POD-FEA to be used in a surrogate-model approach for the model-updating solution to an inverse material characterization problem.