LA-UR- 99-1284

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Title: TIME SERIES BASED MODEL UPDATING IN NONLINEAR SYSTEMS USING SINGULAR VALUE DECOMPOSITION

Author(s): Francois M. Hemez, ESA-EA
Paula Beardsley, ESA-EA
Winston Rhee, ESA-EA
Thomas D. Burton, Texas Tech University

Submitted to: 1999 ASME Mechanics and Materials Conference
June 27-30, 1999
Virginia Tech University

Los Alamos
NATIONAL LABORATORY

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Time Series Based Model Updating in Nonlinear Systems Using Singular Value Decomposition

T.D. Burton*, F.M. Hemez, P. Beardsley, and W. Rhee*
*Department of Mechanical Engineering
Texas Tech University, Lubbock, TX
and
ESA-EA, Los Alamos National Laboratory
Los Alamos, NM

The problem considered is the use of time series data to do model updating in nonlinear structural systems for which the mathematical form of the system nonlinearities is known ahead of time. This work is a departure from most classical model updating work, which utilizes modal data to update linear structural dynamics models. In the present application a singular value decomposition (SVD) of the measured data (e.g., m of the N coordinates are measured at n sampling times) is the basis of the updating. The SVD produces a representation of the data as a linear combination of the so-called principal components, which are analogous to modal coordinate time histories in a linear system. The structural dynamics model parameters are updated by minimizing the differences in the SVD's of the experimental data and the model simulations. This method, proposed by Hasselman et al (IMAC 1998), has been applied to both simulated and actual experimental data for low degree of freedom spring-mass systems with cubic nonlinearity and light damping. The main results that will be presented are the following: 1) the SVD updating is robust in the presence of noise, 2) SVD based updating is effective for both linear and nonlinear systems, and 3) in some cases the nonlinear updating problem is actually easier to do than the linear problem because of the additional "information" contained in the harmonics produced by the nonlinearity. A possible limitation of the approach is the computing time needed to do the parameter optimization.

References

Hasselman, T.K., Anderson, M.C., and Wenshui, G., "Principal Components Analysis For Nonlinear Model Correlation, Updating and Uncertainty Evaluation," *16th International Modal Analysis Conference*, Santa Barbara, California, Feb. 2-5, 1998, pp. 664-651.

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