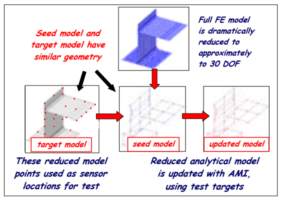
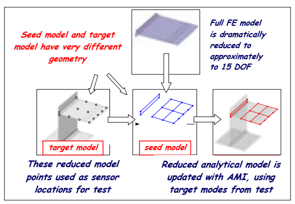
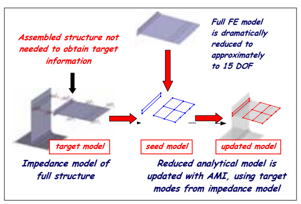
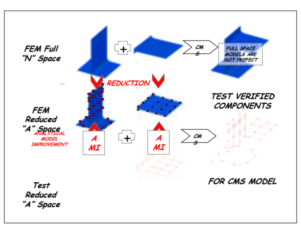
Structural Dynamics and Acoustic Systems Laboratory
University of Massachusetts Lowell

SOME RECENT STUDENT THESIS AND PROJECT WORK IN THE SDASL



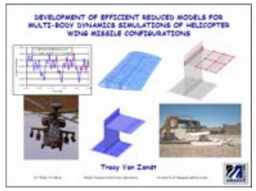






MASTER'S THESIS – TRACY VAN ZANDT

DEVELOPMENT OF EFFICIENT REDUCED MODELS FOR MULTI-BODY DYNAMICS SIMULATIONS OF HELICOPTER WING MISSILE CONFIGURATIONS



ABSTRACT

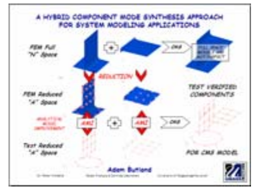
Multi-body dynamics simulations often include a representation of the flexibility of some components. This flexibility is defined by finite element models of these components, and these models are typically validated and updated based on experimental modal data. Developing these large finite element models, performing the test, and updating the model can be difficult and time consuming.

An alternate approach is proposed in which experimental modal data are used to update a reduced-order model. Two methods are used. In the first, more traditional method, a detailed finite element model of the complete assembled structure is developed. This model is reduced and then updated based on test data. In the second method, as a departure from the standard approach, only a portion of the structure is modeled. This component model is then updated using data from the complete structure test, and the updated model is able to represent the flexibility of the complete structure.

An example structure which mimics a helicopter, wing and missile configuration is presented to demonstrate the application of the proposed techniques.

MASTER'S THESIS – ADAM BUTLAND

A HYBRID COMPONENT MODE SYNTHESIS APPROACH FOR SYSTEM MODELING APPLICATIONS



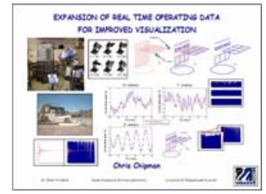
ABSTRACT

Component Mode Synthesis (CMS) using constraint modes is a very common approach used for the generation of large analytical system models. The major limitation of the method using experimentally derived components is inability to easily obtain the required information from testing. An alternate approach is proposed which utilizes frequency and shape information acquired from modal testing to update finite element models using analytical model improvement techniques on a reduced order model. The connection degrees of freedom are then rigidly constrained in the analytical model to provide the boundary conditions necessary for constraint modes and fixed interface normal modes.

Due to common measurement difficulties encountered with test data, extracted mode shape information must be further processed to smooth known contamination of the data. Using information from the finite element model, a new technique referred to as VIKING (Variability Improvement of Key Inaccurate Node Groups) is proposed to better condition the measured and extracted parameters. The CMS approach is then used with this test verified, reduced order, VIKING conditioned model to generate the system model for further analysis. A laboratory structure is used to show the application of the technique with both analytical and experimental components to describe the system. Comparisons are made to show the usefulness of the approach.

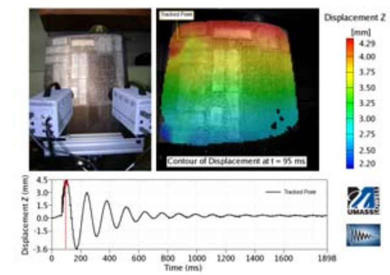
MASTER'S THESIS – CHRIS CHIPMAN

EXPANSION OF REAL TIME OPERATING DATA FOR IMPROVED VISUALIZATION



ABSTRACT

Real time operating data is normally limited to relatively few data points. Unfortunately, viewing this limited set of data often times presents more confusion as to the actual system deformations. An expansion technique, using traditional experimental modal test data, is presented to augment this limited set of degrees of freedom to provide a clearer representation of the actual deformations. Comparisons of the expanded operating data with a larger set of operating data are presented to show the usefulness of the technique.

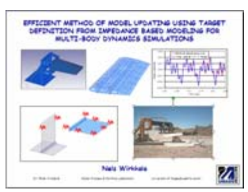


Hardware and software tools employed

Polytec · FEMAP · LMS · PCB PIEZOTRONICS · FEMtools · Vibrant Technology, Inc. · Trilion

MASTER'S THESIS – NELS WIRKKALA

EFFICIENT METHOD OF MODEL UPDATING USING TARGET DEFINITION FROM IMPEDANCE BASED MODELING FOR MULTI-BODY DYNAMICS SIMULATIONS



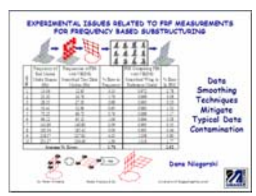
ABSTRACT

Multi-body dynamics simulations are commonly used to predict the characteristics of an assembly of rigid and/or flexible components. The flexible components originate from finite element models which must be validated and updated using experimental modal data. This updating process can be computationally intensive and time consuming. Methods of generating accurate models more efficiently for use in the simulations are needed.

This work describes an alternate approach of generating accurate finite element models for multi-body dynamics simulations. The method combines the techniques of model reduction, direct model updating, and frequency-based substructuring (FBS), to transform a reduced-order, "free-free" component of an assembly into a model which contains the flexibility of the full physical structure. In this study, a finite element model of an aluminum plate is modified using target information from FBS such that the updated model has the flexibility and dynamic characteristics of a larger assembly.

MASTER'S THESIS – DANA NICGORSKI

INVESTIGATION ON EXPERIMENTAL ISSUES RELATED TO FREQUENCY RESPONSE FUNCTION MEASUREMENTS FOR FREQUENCY BASED SUBSTRUCTURING



ABSTRACT

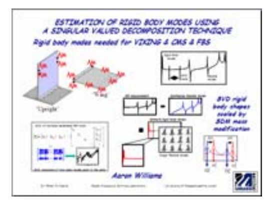
Frequency Based Substructuring is a very popular approach for the generation of system models from component frequency response data. Analytically, the approach has been shown to produce accurate results. However, implementation with actual test data can cause difficulties and problems with the system response prediction. The source of these experimental difficulties needs to be understood.

This work identifies and addresses commonly encountered issues that contaminate test data and determines the effects of each on the resultant system model. Common approaches used are investigated to show their inability to completely mitigate the problems. An approach is proposed to condition test data for Frequency Based Substructuring using information from a finite element model. This is referred to as VIKING (Variability Improvement of Key Inaccurate Node Groups). This new method uses smoothing functions from the component finite element models to better condition the measured response functions.

The VIKING data conditioning technique is used with analytical simulations with known distortion as well as with actual test data to obtain an accurate system model. A laboratory structure is used to show the application of the technique. Comparisons to other common data smoothing techniques are made to show the usefulness of the VIKING approach.

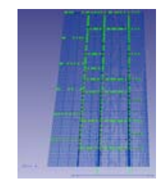
MASTER'S THESIS – AARON WILLIAMS

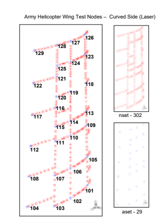
ESTIMATION OF RIGID BODY MODES FOR SYSTEM MODEL DEVELOPMENT

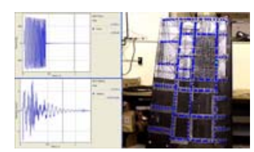


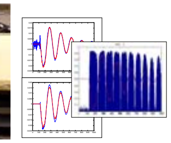
ABSTRACT

Rigid body modes are a necessary set of modes used in the development of component system models. Often these modes are difficult to obtain during modal testing due to instrumentation limitations or test difficulties. Using a combination of singular value decomposition, modal parameter estimation to purge higher order mode effects and structural dynamic modification, a set of appropriately scaled rigid body modes are derived. Several variations of this approach are presented for a simple structure to show the use of the technique.









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