



**MASTER'S THESIS – DANA NICGORSKI**

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



**EXPERIMENTAL ISSUES RELATED TO FRF MEASUREMENTS  
 FOR FREQUENCY BASED SUBSTRUCTURING**

Mode	Frequency of Ref. Model Mode Shapes (Hz)	Frequencies of FBS with VIKING Smoothed Test Data Modas (Hz)	% Error in Frequency	POC Comparing FBS with VIKING Smoothed Wing to Reference Model	% Error In POC
1	13.06	12.65	3.10	0.972	2.78
2	25.20	24.76	1.76	0.969	3.08
3	28.55	27.30	3.68	0.965	3.53
4	53.41	52.90	0.95	0.985	1.52
5	70.25	69.72	0.76	0.988	1.17
6	96.12	95.10	1.06	0.994	0.58
7	141.63	140.80	0.59	0.995	0.55
8	185.54	185.42	0.06	0.995	0.46
9	218.57	227.82	4.23	1.038	3.80
10	251.27	254.48	1.39	1.018	1.77
Average % Error:			<b>1.76</b>		<b>1.92</b>

**Data Smoothing Techniques Mitigate Typical Data Contamination**

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.