

Modal Analysis of Power Harvesting Host Structure

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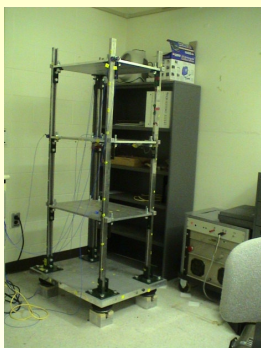
June 25, 2004



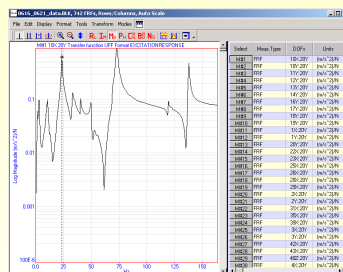
1



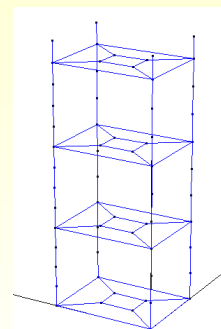
This presentation will cover the modal testing and subsequent data analysis



Performed modal test on the host structure



Extracted 9 modes in the 0-70 Hz range



Animated the mode shapes using ME'scope

2



Roving hammer impact test used to determine the natural modes of the structure

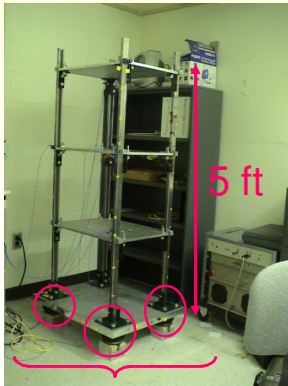
Natural Modes of Host Structure



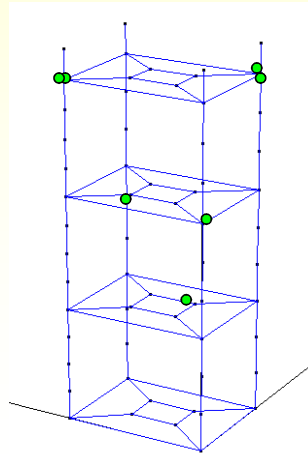
Design and location of auxiliary structure



Improve Power Harvesting



Air bearings



3

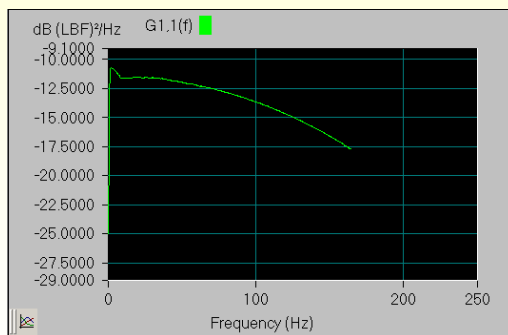
63 impact locations

7 reference accelerometers (1V/g)



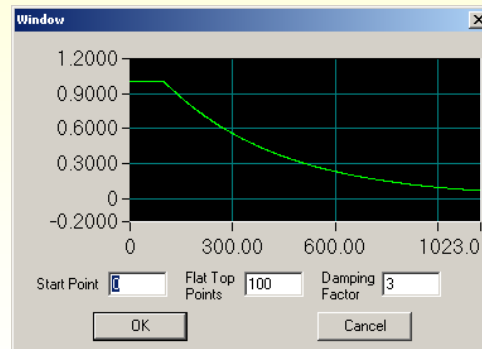
Data collected using 8-channel Spectrabook and RT Pro SB Software

Lines	400	Points	1024
Freq	150	deltaT	2.7 ms



Input Power Spectrum

Large, soft-tip hammer



Exponential Force Window

4

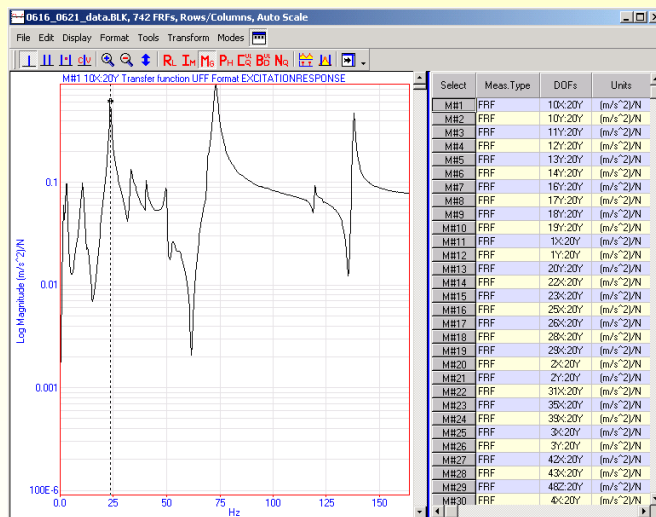


Frequency response data analyzed using *ME'scope*

742 FRF measurements

Used last year's modal analysis to help find the natural frequencies

Extracted 9 modes from 1 to 70 Hz

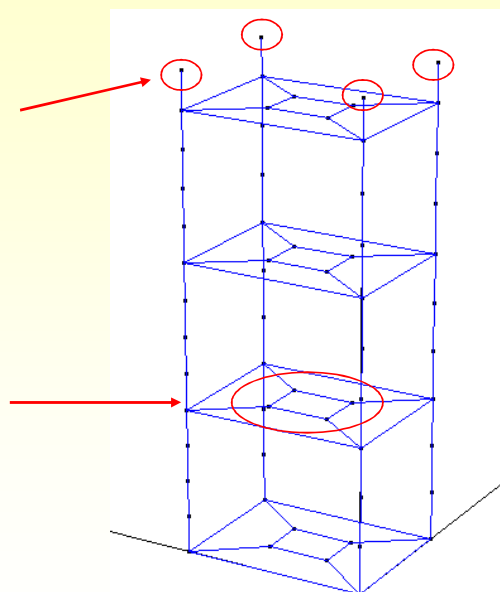


5

ME'scope used to animate mode shapes

Response in vertical direction applied to all points on leg

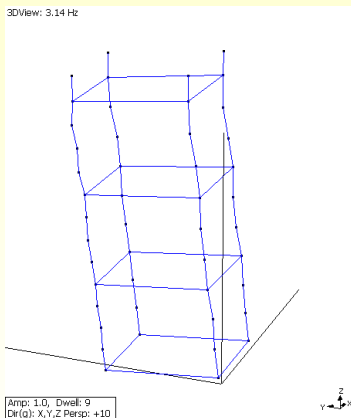
No data taken in the horizontal plane



6

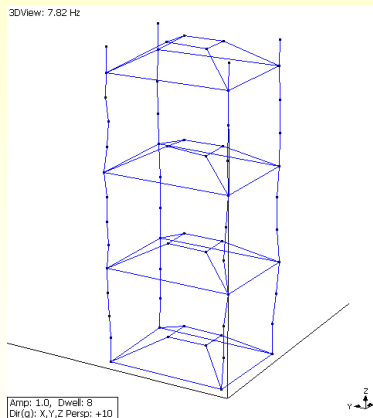
Rigid body modes of the structure

Mode 2 3.1 Hz



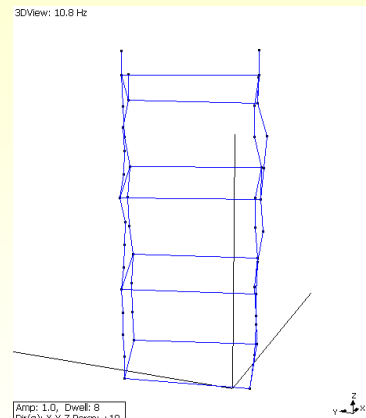
Rigid body motion
along Y axis

Mode 3 7.8 Hz



Rigid body motion
along Z axis

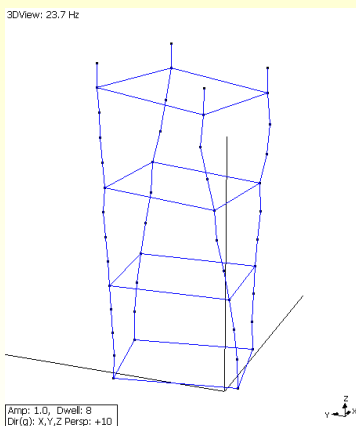
Mode 4 10.8 Hz



Rigid body twisting

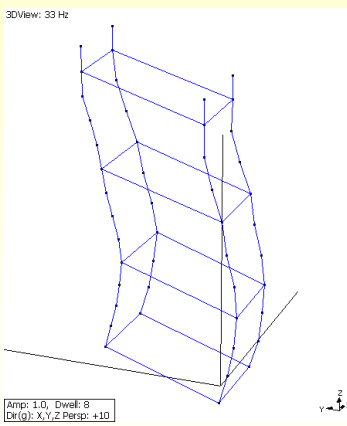
Twisting and bending modes

Mode 5 23.7 Hz



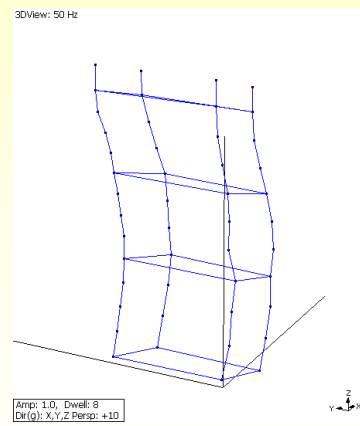
1st Torsion

Mode 6 33 Hz



1st Bending in the Y
and Z directions

Mode 8 50 Hz



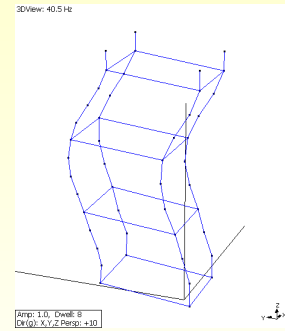
1st Bending in the X
and Z directions

Conclusion: modal analysis of host structure enables optimization of tuned auxiliary structure

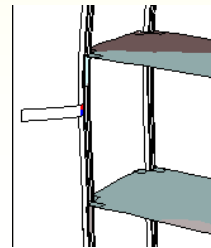
Performed experimental modal analysis



Determined first 9 modes of the system



Optimize tuned auxiliary structure



9



Comparison with last year's results

	Last Year	This year	
Mode #	Freq (Hz)		Mode Shape
1	2.1	1.4	Rigid X
2	2.75	3.1	Rigid Y
3	7.82	7.82	Rigid Z*
4	11.8	10.8	Rigid rotation
5	13.9		2 nd Rigid X
6	23.5	23.7	1 st Torsion
7	29.6	33	1 st Bending Y
8	38.2	40.5	2 nd Bending Y
9	46	50	1 st Bending X
10	65.5	69.1	2 nd Bending X
11	70.2		3 rd Torsion