

Modal Analysis of MARS Solar Panel and Planar Vibrations

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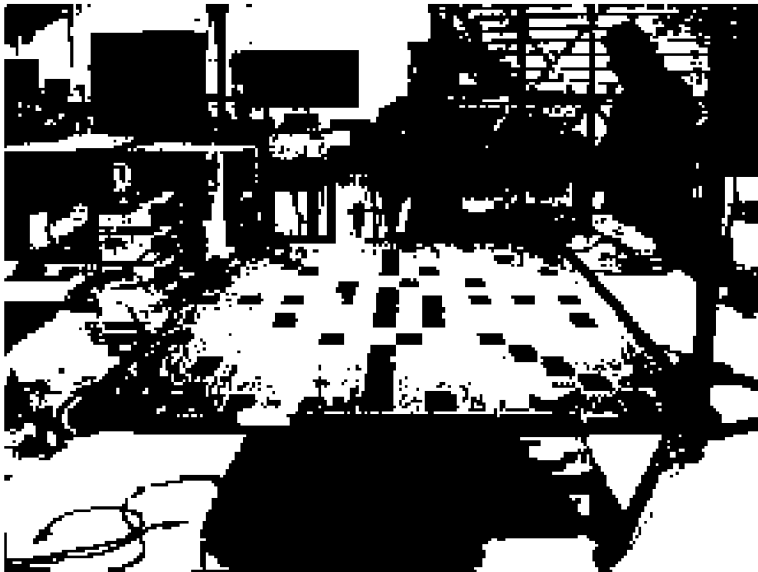
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Jet Propulsion Laboratory, California Institute of
Technology
Pasadena, CA

SIRI Spring Quarter Final Presentations – JPL 180-101
Friday 15 June 2007
Pasadena, CA 91109

Solar Panel Mock-Up Assembly

Front View of Solar Panel Mock-up.



Rear View of Solar Panel Mock-up.



Current-sensing resistor attached to active cells

Piezoelectric actuator

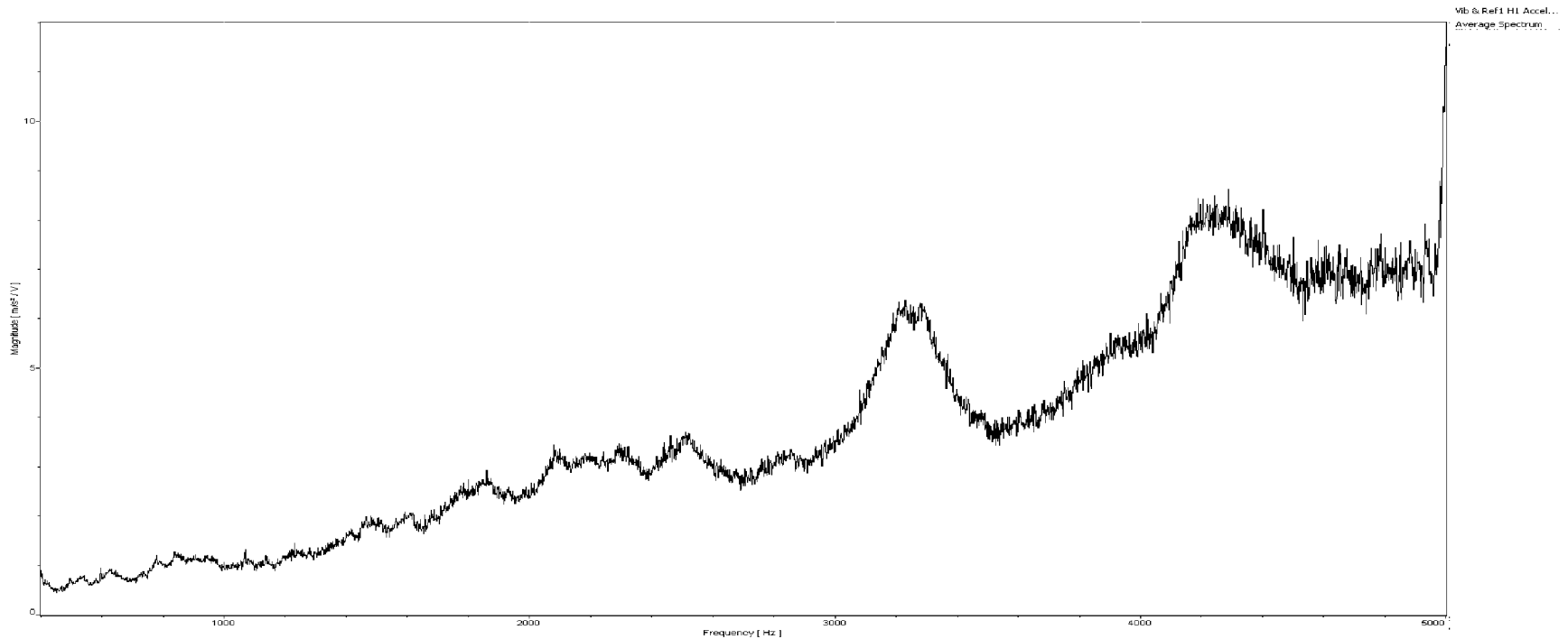
Panel rib structure

Solar Panel Mock-Up Assembly Test Setup

- 3-Channel Piezo Amplifiers
- Solar Panel Mock-Up Assembly
- Test Enclosure
- Polytec Scanning Laser Vibrometer Controler and DAQ Hardware w/ Signal Generator

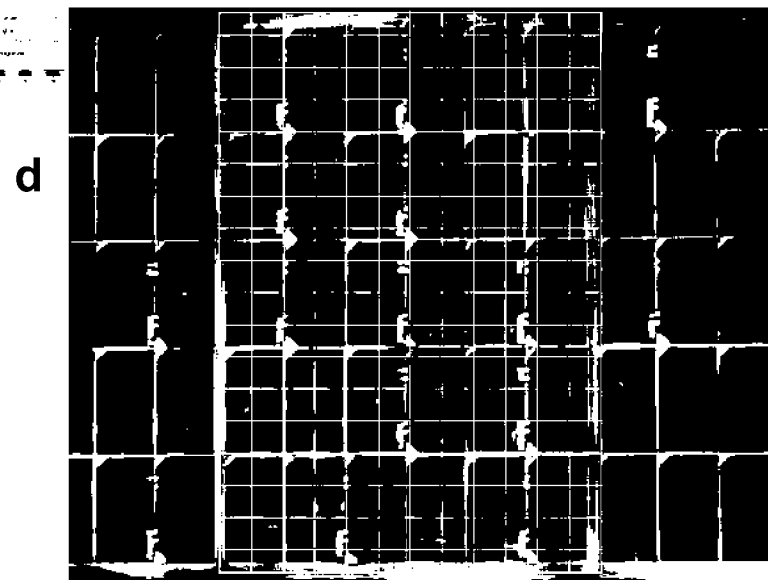
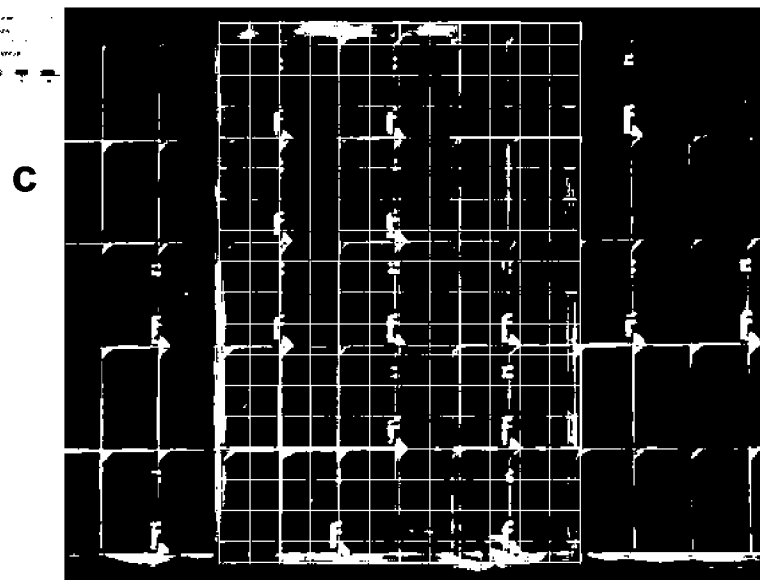
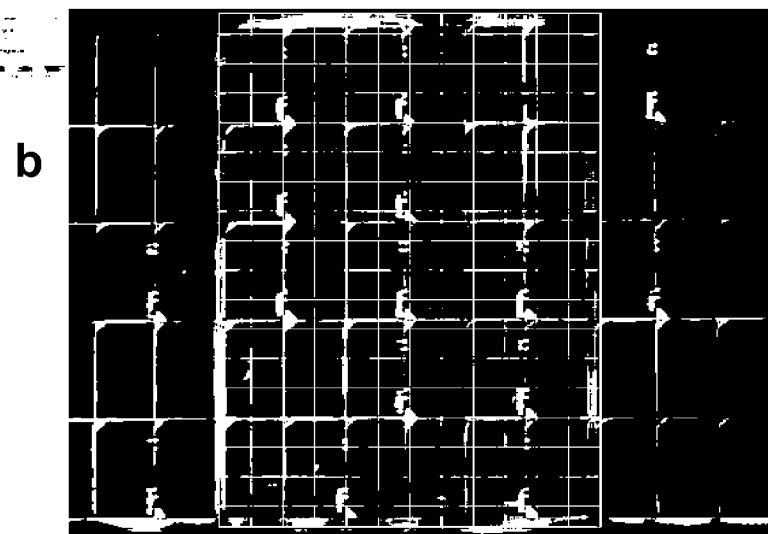
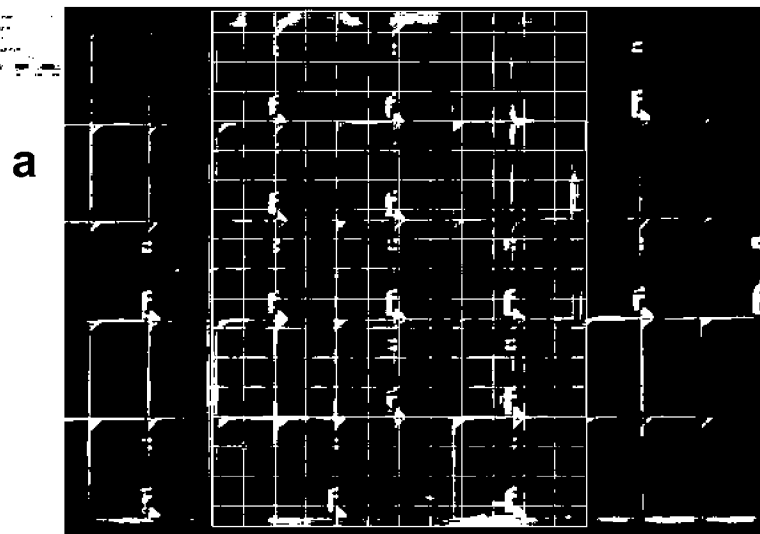


FRF Plot from test



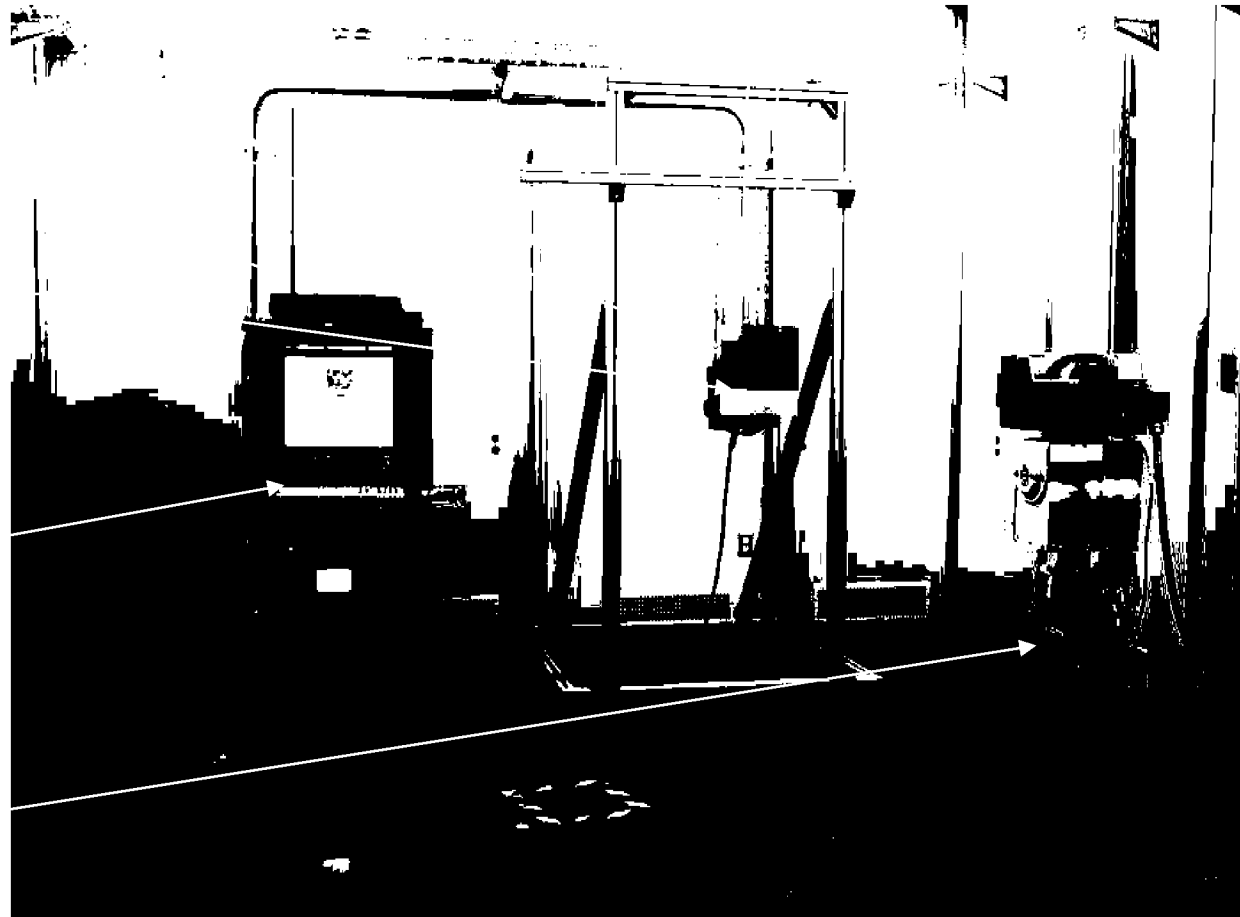
Mode Number	1	2	3	4	5	6	7	8
Frequency, Hz	425	501.6	626.6	779.7	848.4	1079.7	1410.9	1467.1
Mode Number	9	10	11	12	13	14	15	16
Frequency, Hz	1593.8	1860.9	2295.3	2301.6	2520.3	2825	3225	4207.8

Spatial Acceleration Plots of Center Sub-Panel at Resonant Frequencies: a) 425 Hz b) 848 Hz c) 3225 Hz d) 4208 Hz.

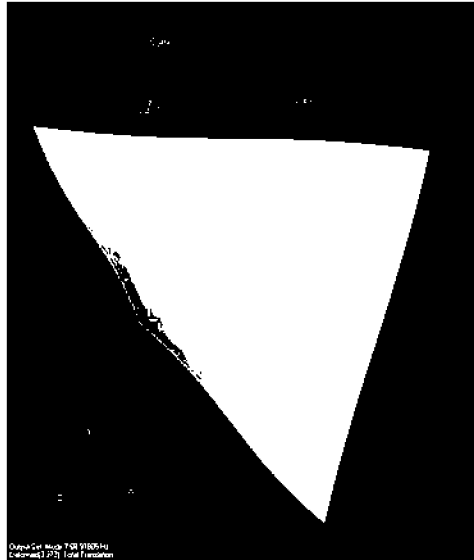


Plastic Plate Test Setup

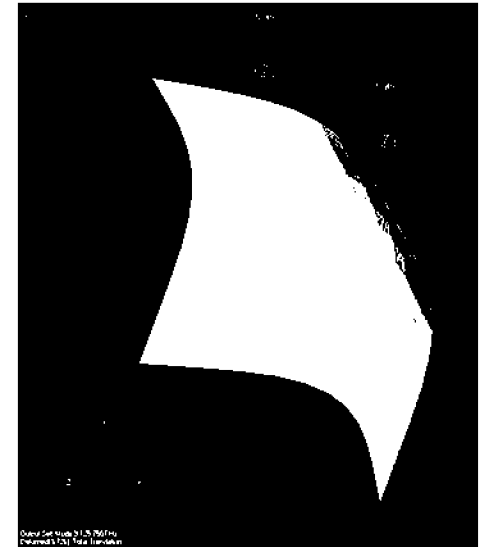
- Shaker
- Signal amplifier
- Plastic plate
- Polytec Scanning Laser Vibrometer Controller and DAQ Hardware w/ Signal Generator
- Scanning laser head.



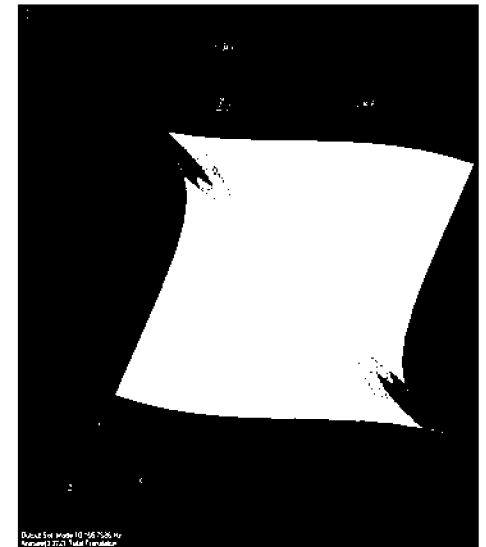
Finite Element Model predictions



1st mode 3rd mode

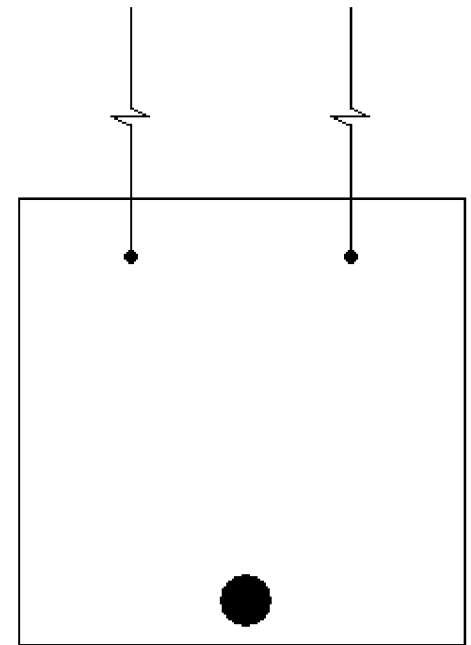
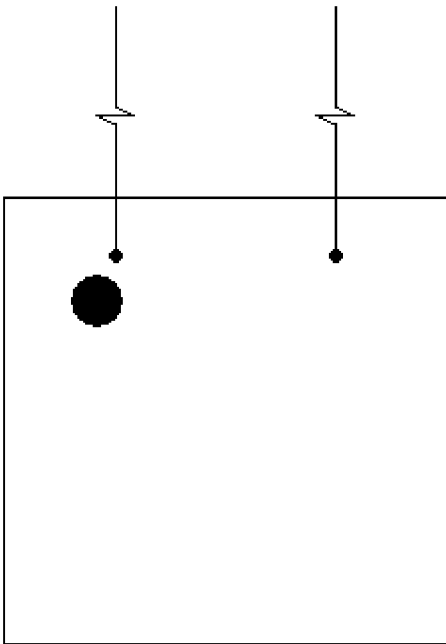


2nd mode 4th mode



Two tests done on the plate

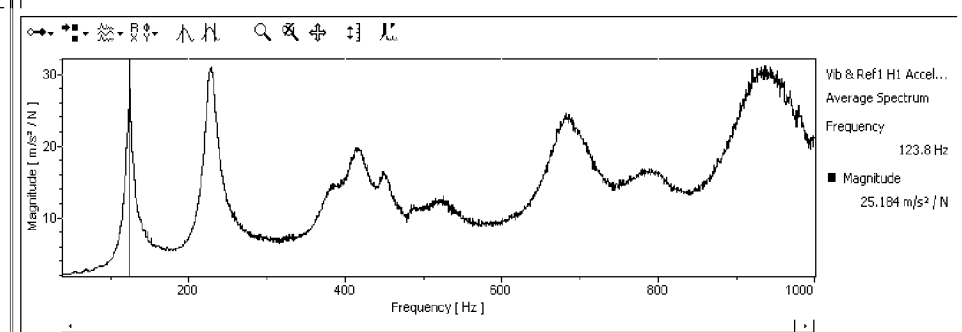
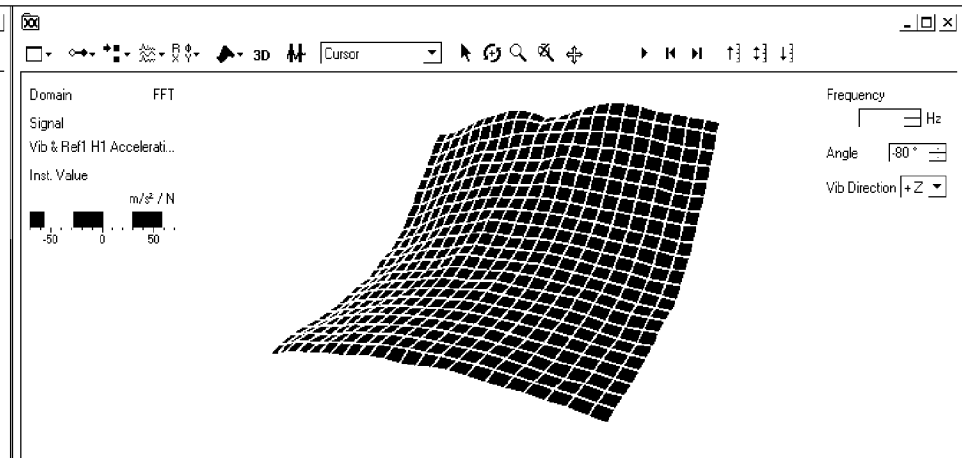
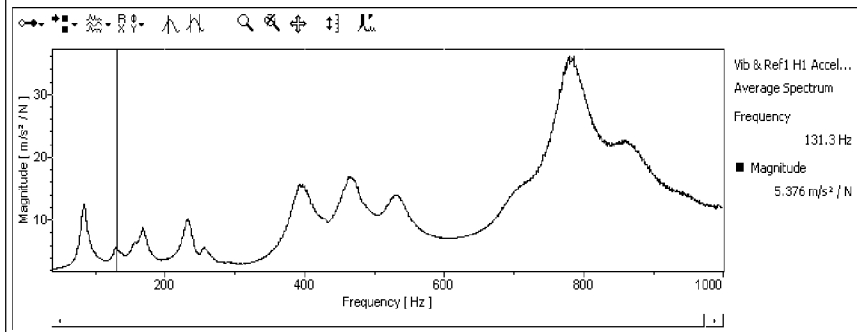
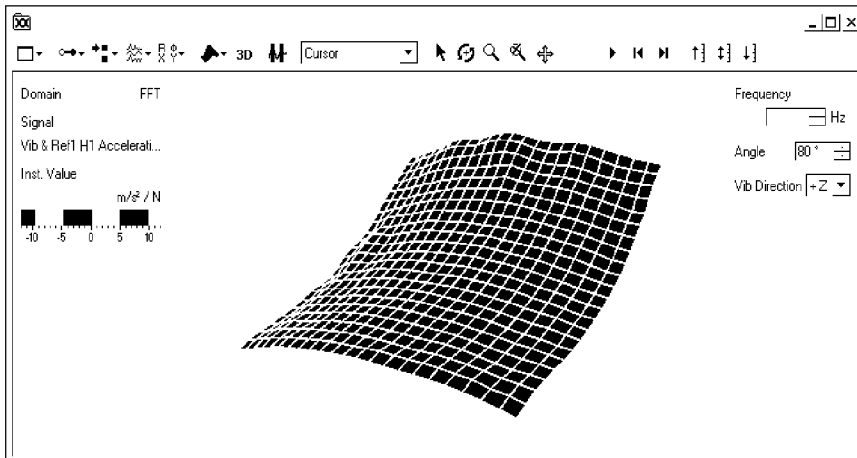
- In first test plate was excited at the corner. (Left)
- Second test was done by exciting it at the bottom in the middle. (Right)



Results from both tests.

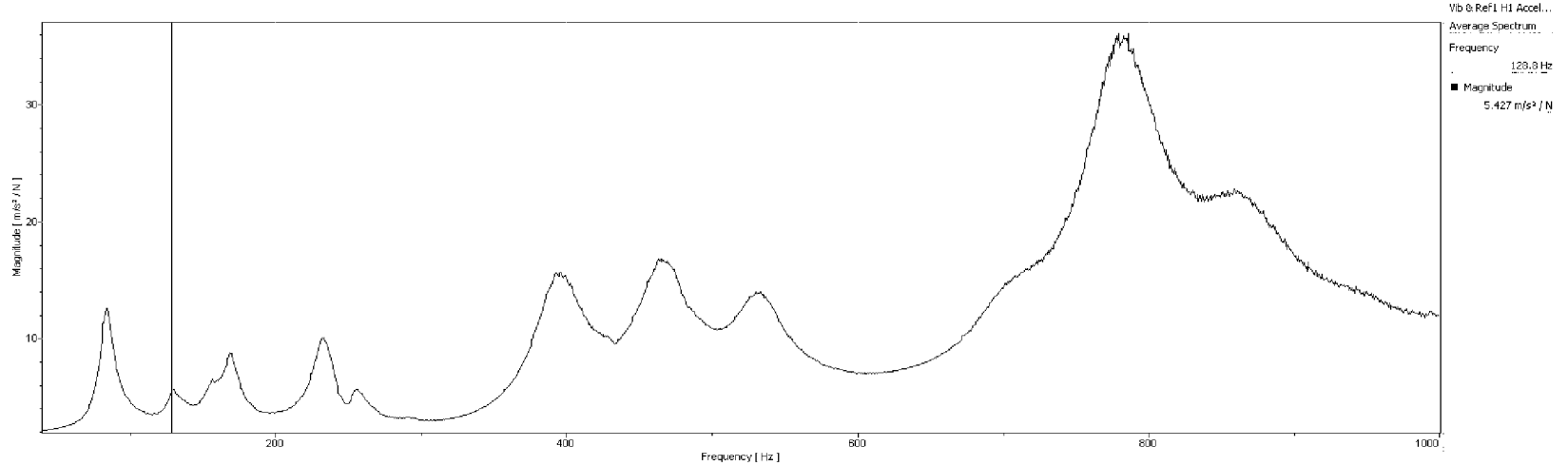
First test

Second test

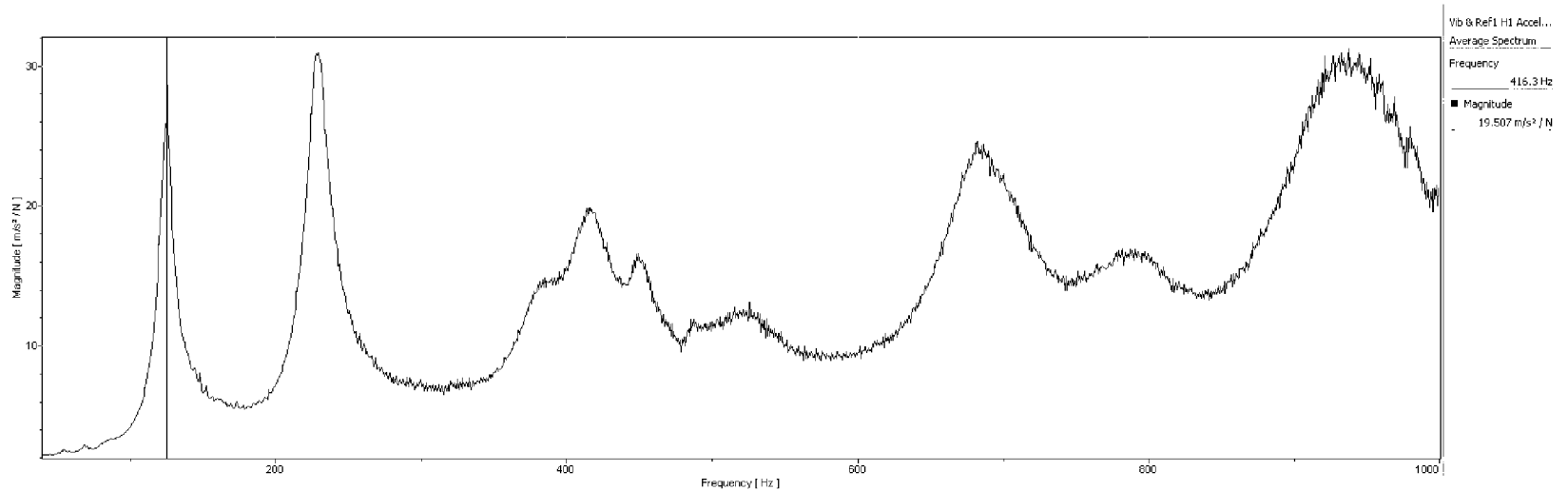


Frequency Response Functions from two tests

1st
Test



2nd
Test



A mode shape at 123 Hz from 2nd test

Domain FFT

Signal

Vib & Ref1 H1 Accelerati...

Inst. Value

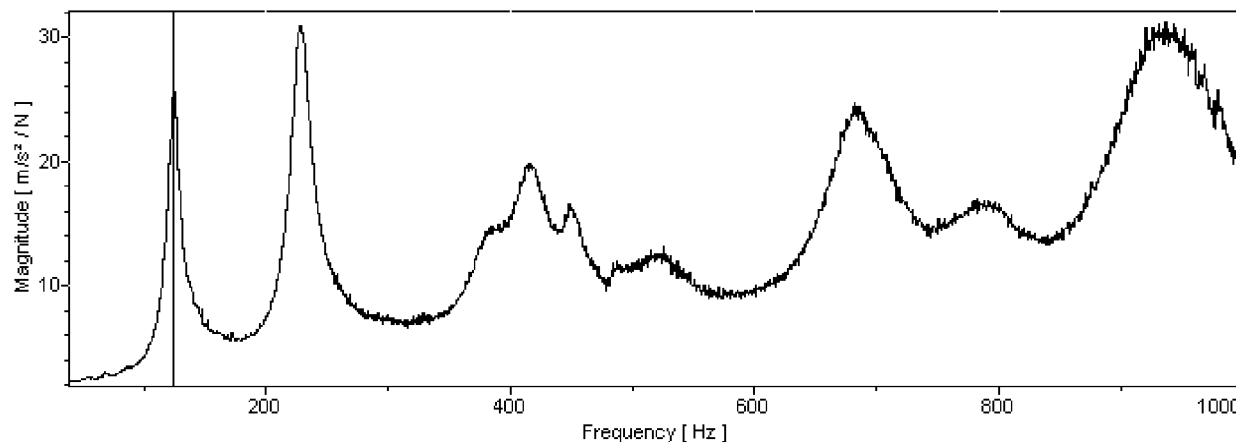
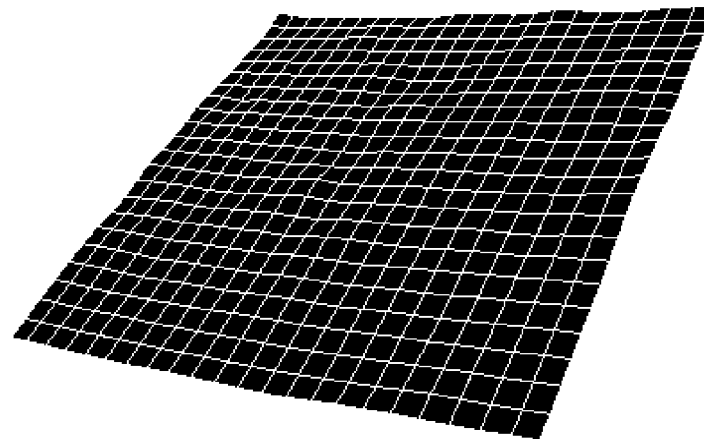


Frequency

123.75 Hz

Angle 0°

Vib Direction +Z



Vib & Ref1 H1 Accel...

Average Spectrum

Frequency

123.8 Hz

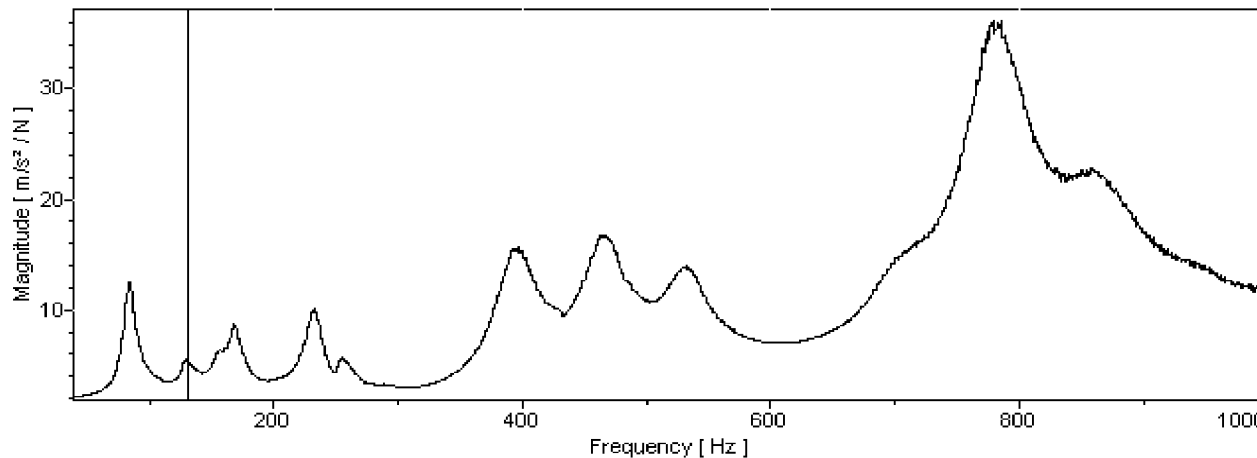
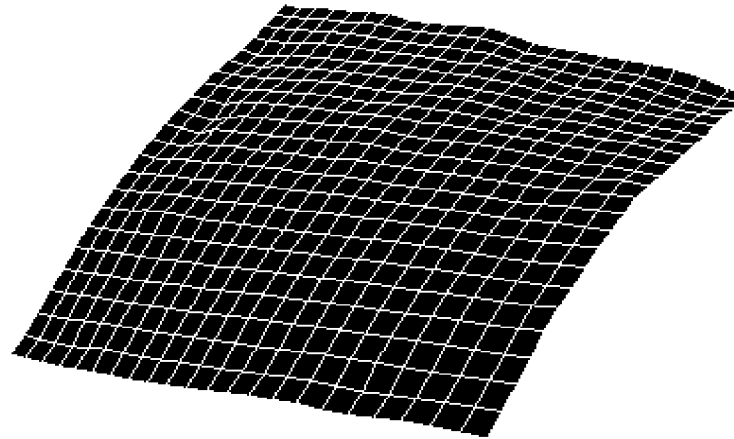
■ Magnitude

25.184 m/s² / N

Plate's shape at 130 Hz from 1st test

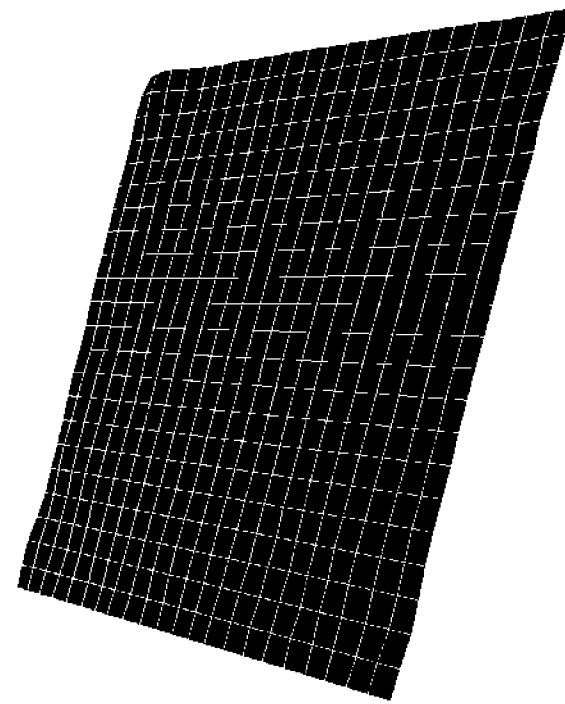
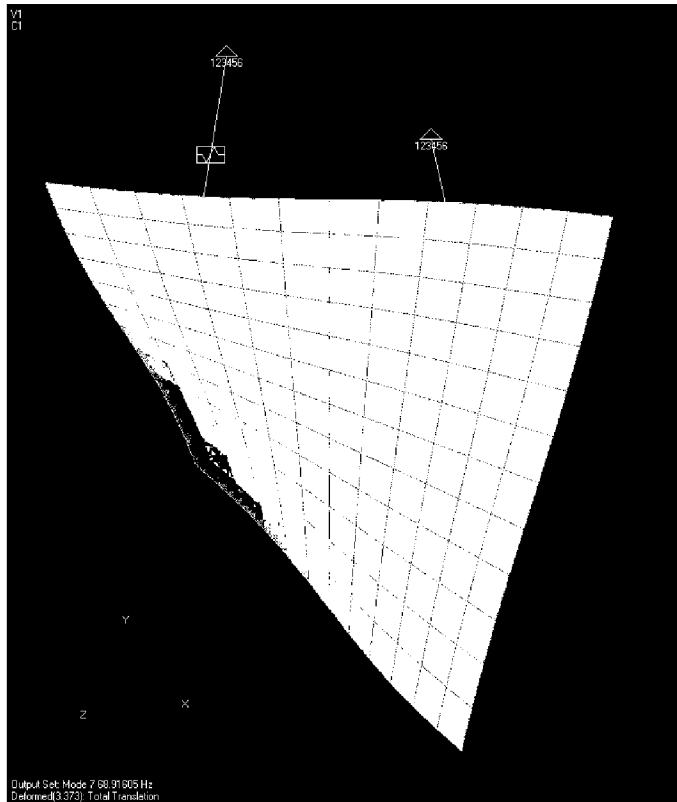
Domain FFT
Signal
Vib & Ref1 H1 Accelerati...
Inst. Value
m/s² / N
-10 -5 0 5 10

Frequency 131.25 Hz
Angle 0°
Vib Direction +Z



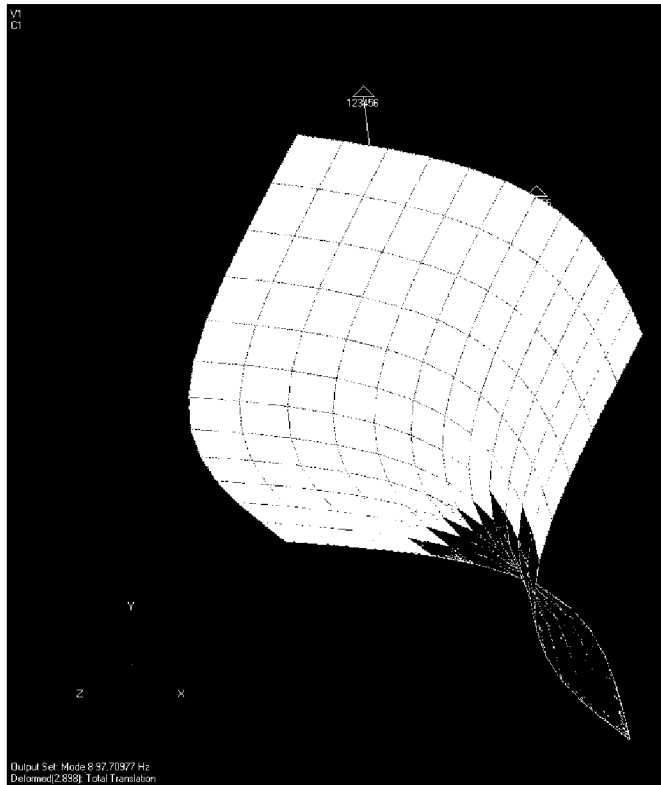
Vib & Ref1 H1 Accel...
Average Spectrum
Frequency 131.3 Hz
■ Magnitude 5.376 m/s² / N

1st mode from first test at 84 Hz

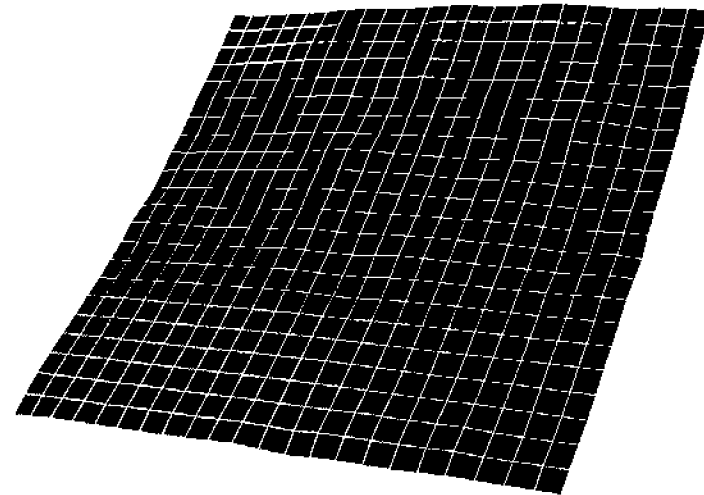


Frequency: 81.905 Hz
Angle: 0.0
No. Elements: 100

2nd mode from second test at 123 Hz

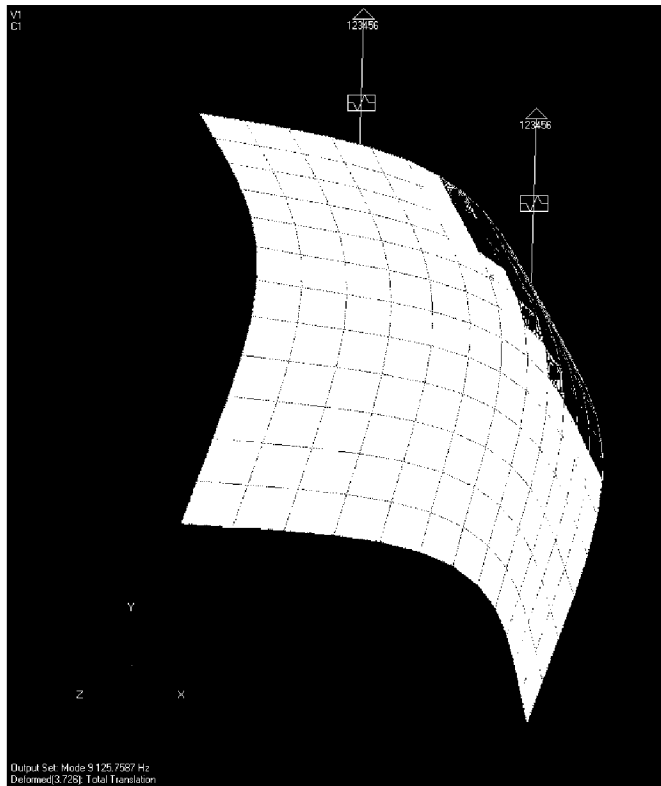


Display
Signal
Unit Value

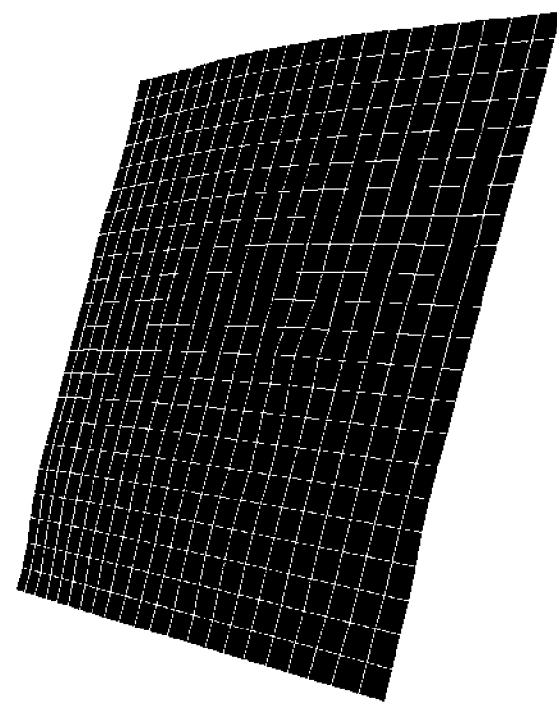


Frequency
Amplitude
Vibration

3rd mode from first test at 168 Hz

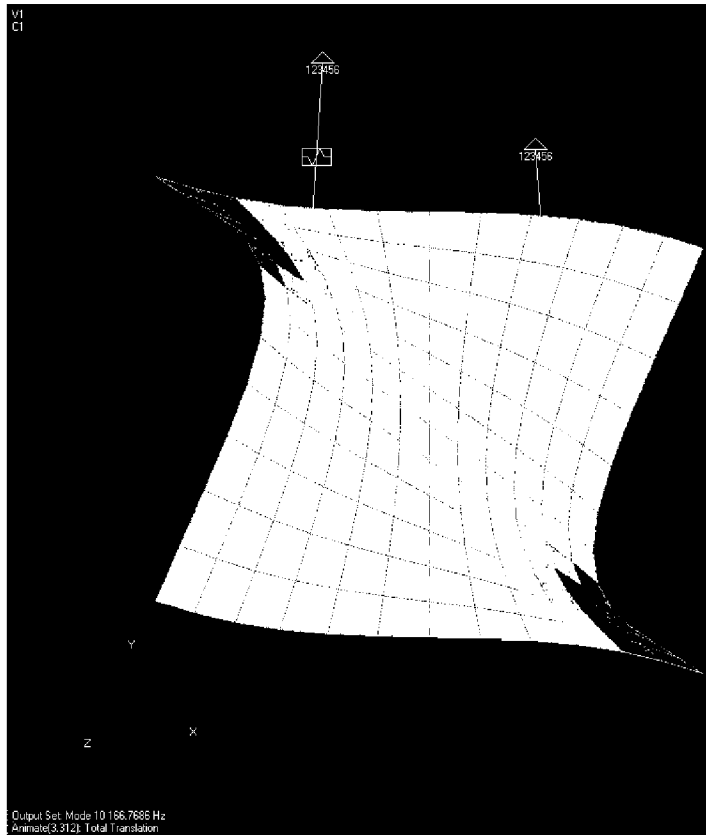


Down: 123456
Scale: 1234567890
Unit Value: 123456
100% 200% 300% 400%

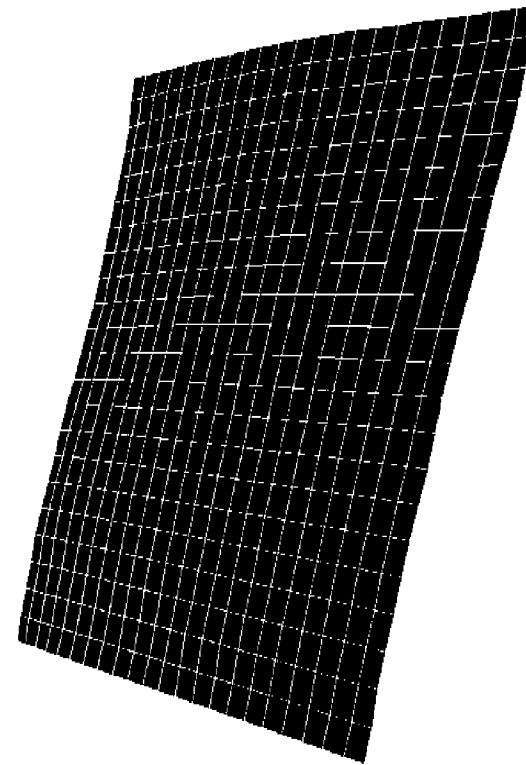


Frequency: 125.7587 Hz
Angle: 123.456
No. Elements: 123456

4th mode from firs test at 232 Hz



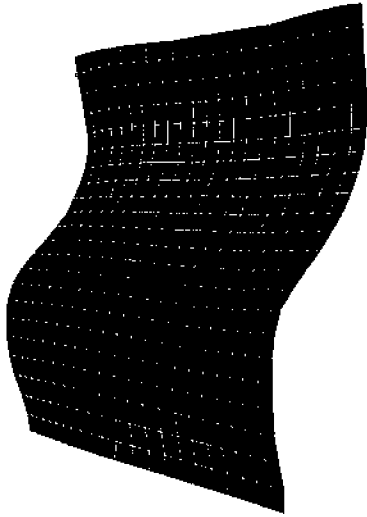
Drawn: 2/1
Light: 123456789
No Value: 123456
45 30 0 30 45



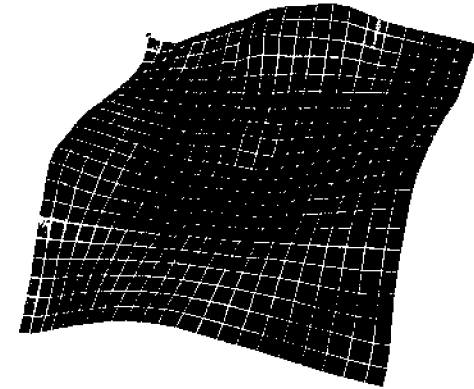
Frage: 123456
Ange: 123456
Vorgehen: 123456

Higher modes from tests

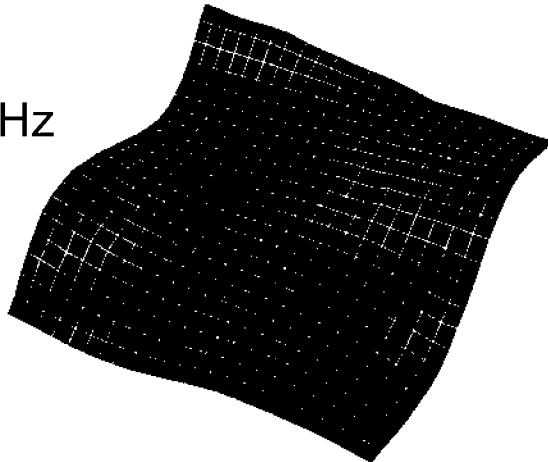
394 Hz



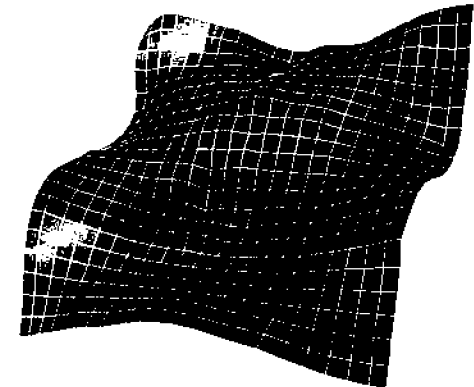
416 Hz



465 Hz

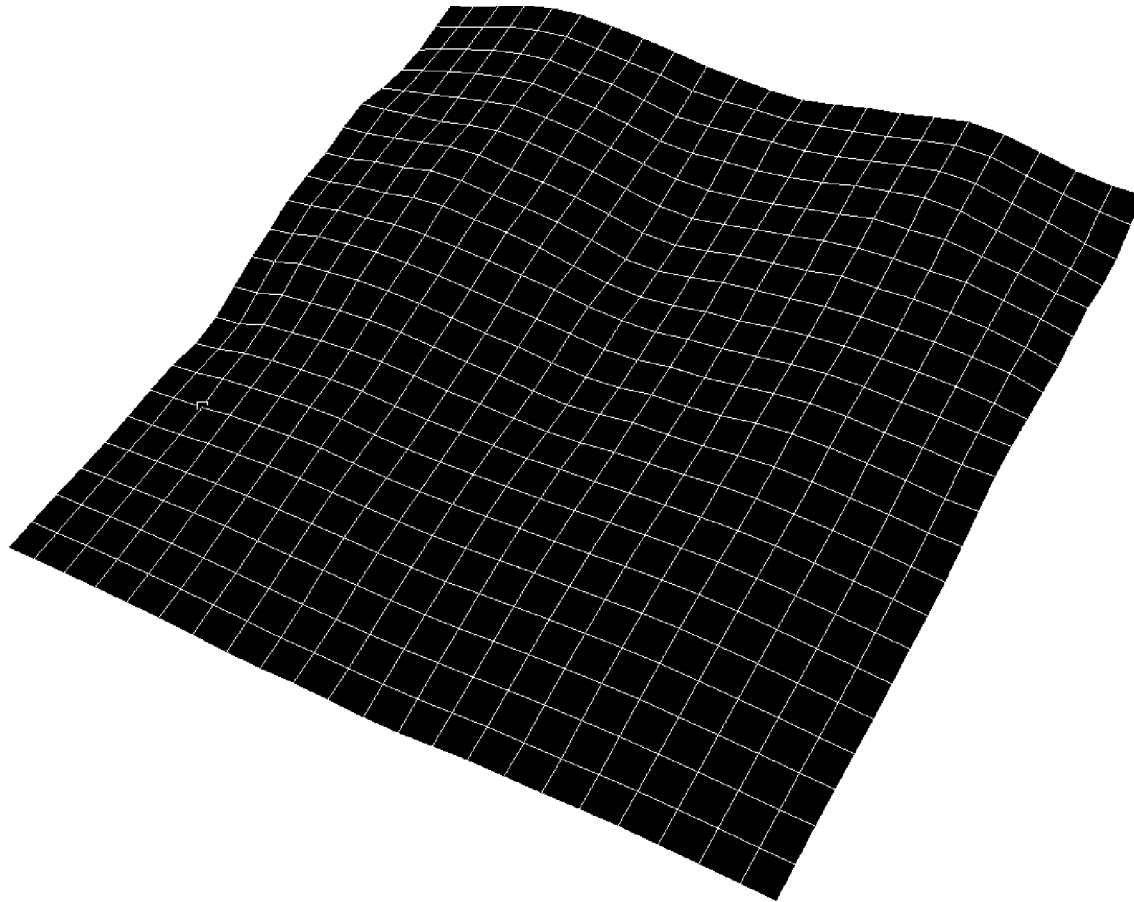


683 Hz



A higher mode at 778 Hz

Domain FFT
Signal
Vib & Ref1 H1 Accelerati..
Inst. Value
m/s² / N
-100 0 100



Frequency 778.13 Hz
Angle 0°
Index 371
Inst. Value -9.823 m/s² / N
Status Optimal
Vib Direction +Z
2D Point
X:
Y:
Z: m
L: Unknown

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- R. Brett Williams and Rebecca Tokototo
- Rick Guglielmino
- SIRI Program
- Members of 355L group

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