

Design of Acoustic Metamaterials for Vibration Control

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HOT Shot accelerated delivery of an additively manufactured, 3D acoustic metamaterial that demonstrated frequency filtering over a wide band (several kHz)

Hypothesis and Motivation

- The goal of this experiment is to demonstrate 3D printed metamaterials for frequency filtering in a flight environment
- Though ground-based vibration tests can elucidate frequency filtering in a controlled environment, HOT Shot offers true flight conditions to validate the material behavior for more extreme shock scenarios

Experimental Details

- Metamaterial sample mounted with opposing accelerometers to verify input/output filter
- Material frequency range of 2-5kHz targets typical harsh vibration ranges experienced by sensitive components
- Ground-based vibration test confirmed desired filtering behavior.

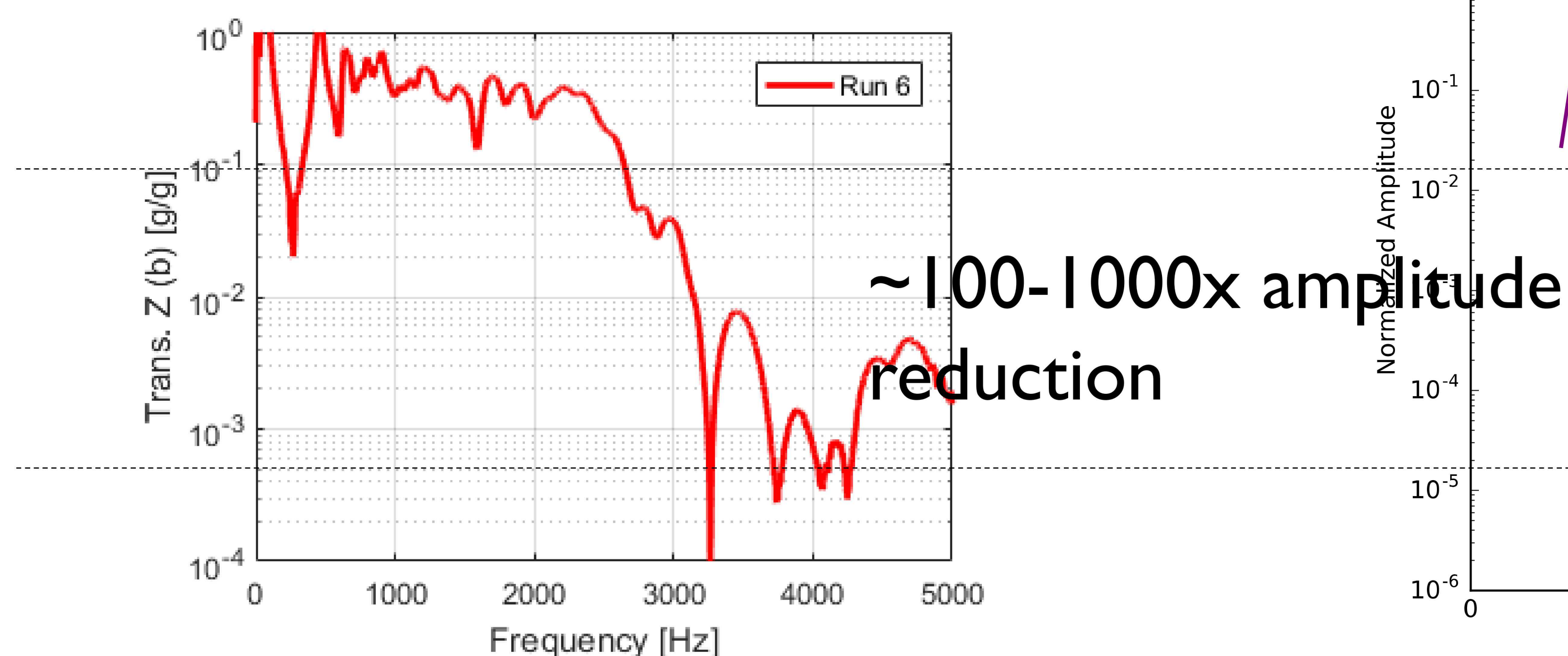
Lessons Learned

- Metamaterial thickness can be significantly less than originally thought and still achieve frequency filtering.
- Ground-based shock test for HOT Shot elucidated shear failure mode that was missed by the finite element modeling. - requires more detailed failure modeling
- HOT Shot provides the team with access to data that calibrates models for these more extreme environments.

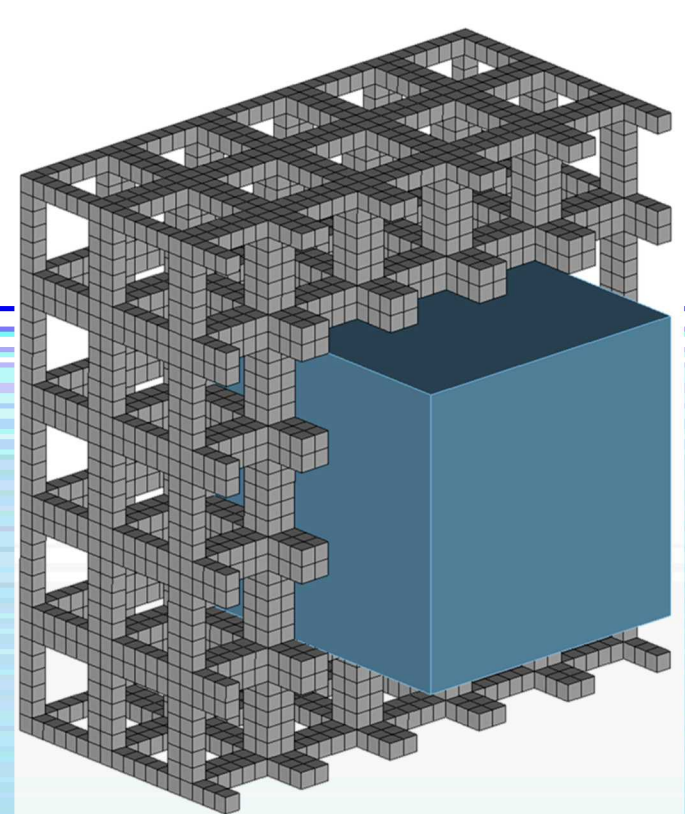
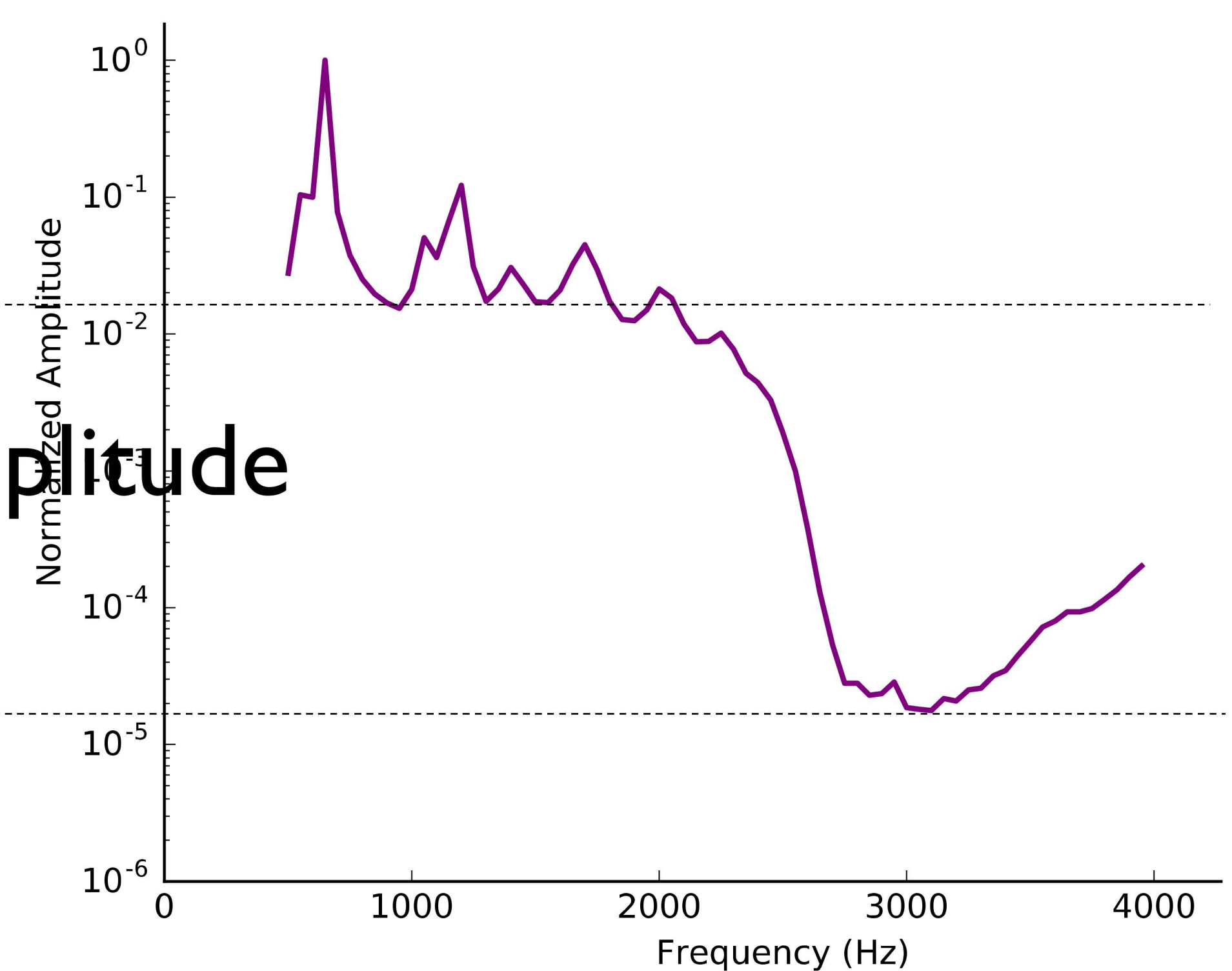
Next Steps

- Repeat ground-based shock test with reduced metamaterial thickness to achieve desired filtering
- August 2019 flight test to gather more data

Ground-based vibration test results



FEM simulation results



Triaxis
accelerometers

