ACOUSTIC METAMATERIALS RESEARCH UPDATE, V2.1 NOVEMBER 16, 2017

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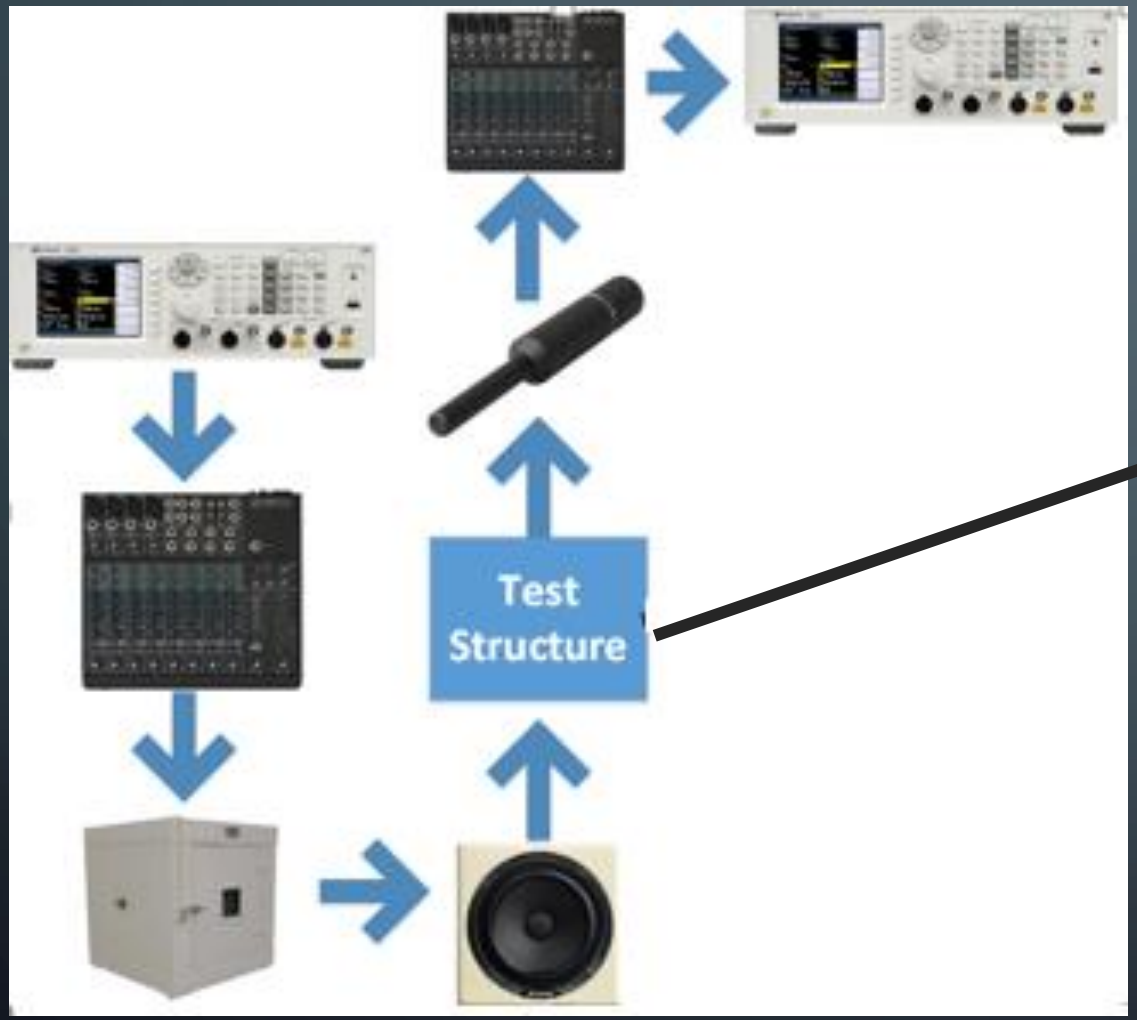
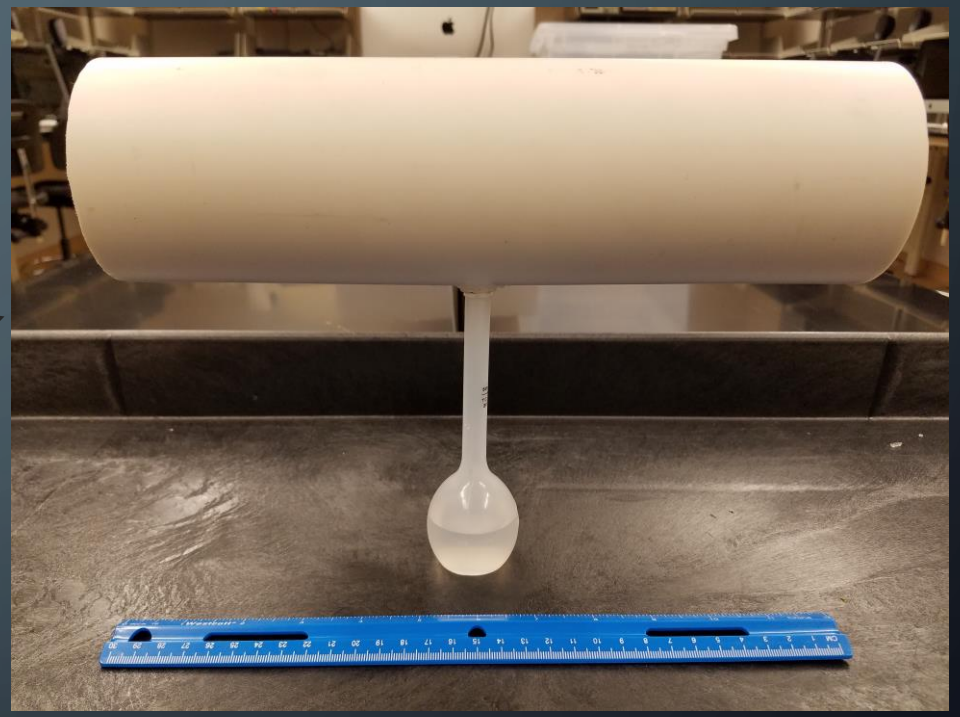
SINGLE RESONATOR EXPERIMENT

- Change the Volume with water and keep everything else constant
  - The Resonator's (Flask) cavity has a volume of Vcav ~47.78 mL
  - The Volumes that measurements were taken at
    - 1.) Empty (No Water)
    - 2.) 20 % of Vcav filled with water
    - 3.) 40 % of Vcav filled with water
    - 4.) 50 % of Vcav filled with water
    - 5.) 60 % of Vcav filled with water
    - 6.) 80 % of Vcav filled with water
    - 7.) 100 % of Vcav filled with water

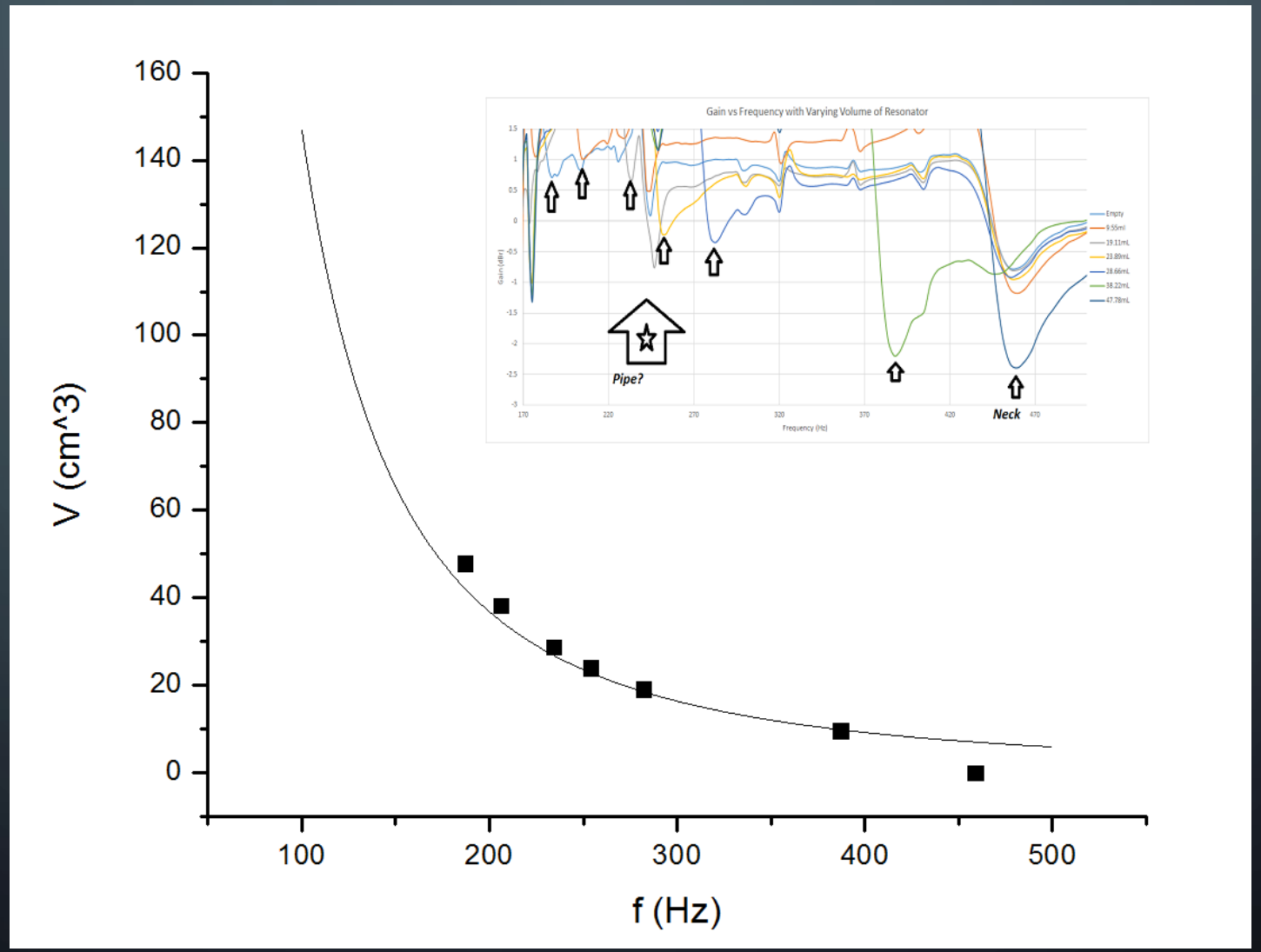
- $f_{resonance} = \frac{C}{2\pi}\sqrt{\frac{S}{V(l+\Delta l)}}$
  - C = Speed of Sound in Medium
  - V = Volume of the Resonator Cavity
  - S = Cross Sectional Area of the Neck
  - l = Length/Height of the Neck
  - Δl = Neck Length Adjustment, based on whether the neck is flanged
  - $Effective\ Length = l + \Delta l$

SINGLE RESONATOR LAB SETUP





SINGLE RESONATOR RESULTS, V2

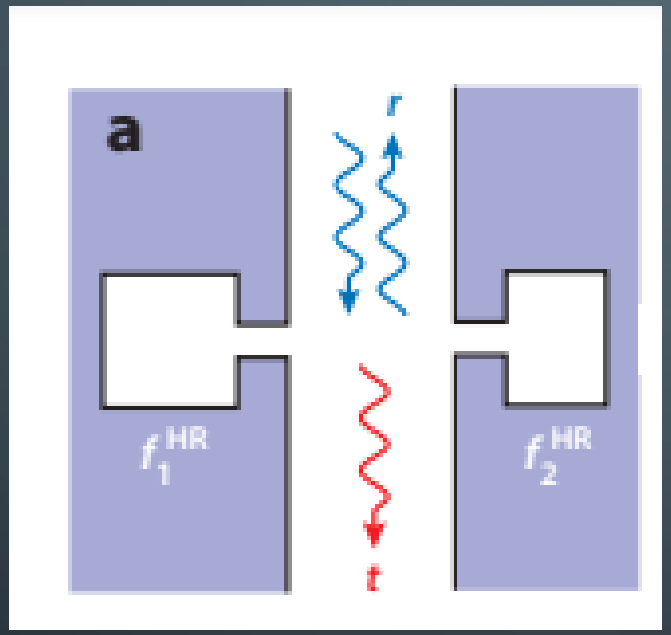


SINGLE RESONATOR RESULTS, V2

% of Cavity filled w/ Water	Cavity volume	Calculated Resonance Frequency	Measured Resonance Frequency
0 %	100%	175 Hz	187 Hz
20 %	80%	196 Hz	206 Hz
40 %	60%	226 Hz	234 Hz
50 %	50%	248 Hz	254 Hz
60 %	40%	277 Hz	282 Hz
80 %	20%	392 Hz	387 Hz
100 %	0%	N/A (INF)	459 Hz

MULTIPLE RESONATOR THEORY

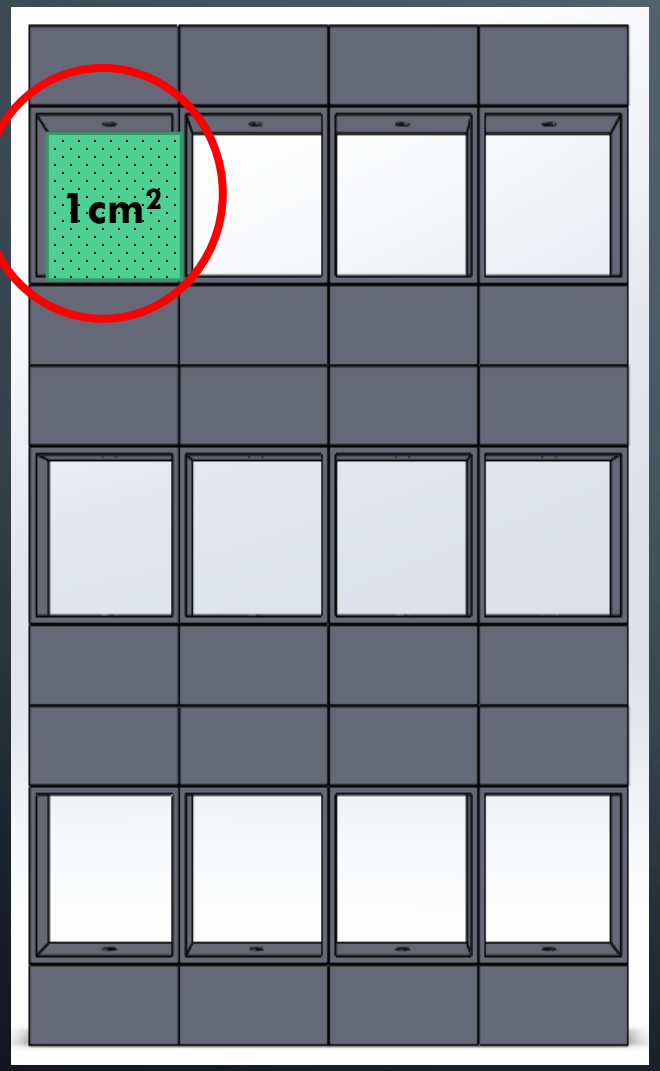
- Hybrid Resonance at $f0 = (f\,\mathrm{HR2} - f\,\mathrm{HR1}) / 2$



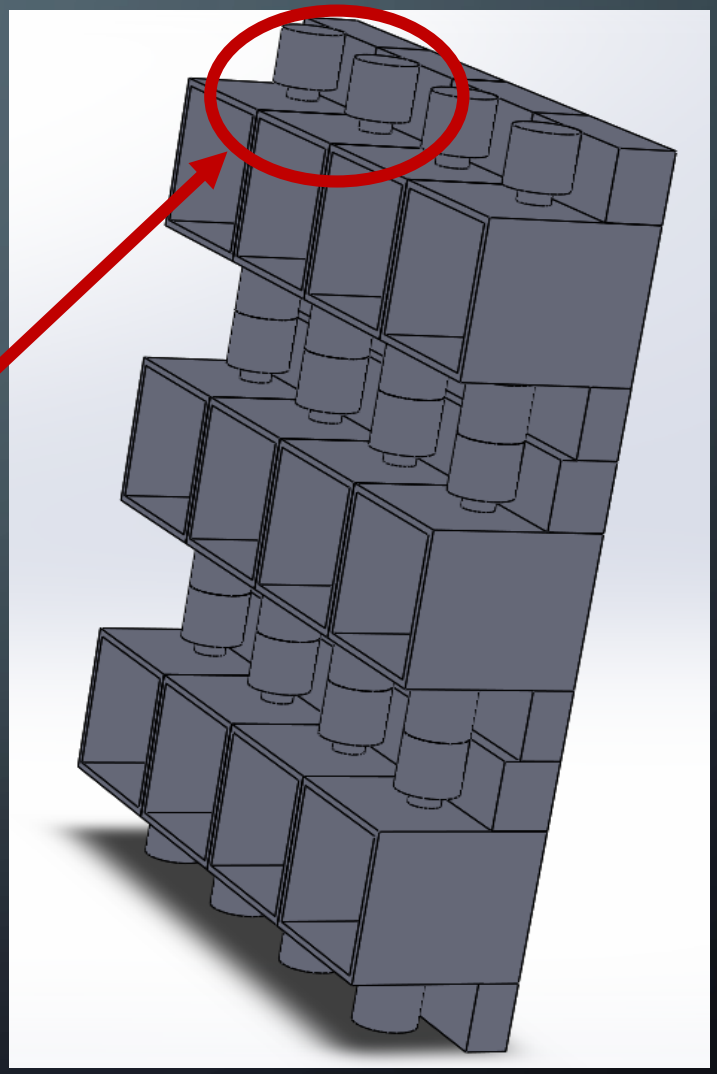
Sound Absorption Structures:
From Porous Media to Acoustic Metamaterials
By Min Yang and Ping Sheng
Published In: The *Annual Review of Materials Research*
Annu. Rev. Mater. Res. 2017. 47:83–114

MULTIPLE RESONATOR DESIGN, V2

Front View



Back Side View



FUTURE TASKS

- Confirm the remaining Comsol Model (Single Resonator w/ Flow)
- Finish the Coupled Resonator w/ Flow Comsol Model
- Create a Coupled Resonator Setup with the physical Model
- Test the Physical Model
- Print the Multiple Resonator Model and test the model