

Visualizing Sound Directivity via Smartphone Sensors



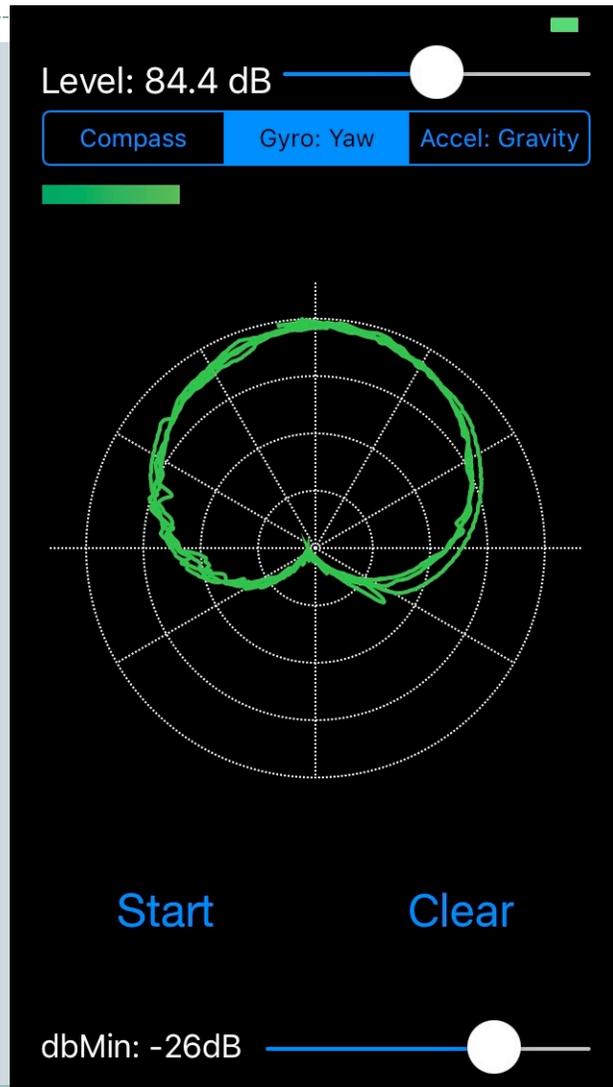
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WITH
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OMEGALAB STUDIOS
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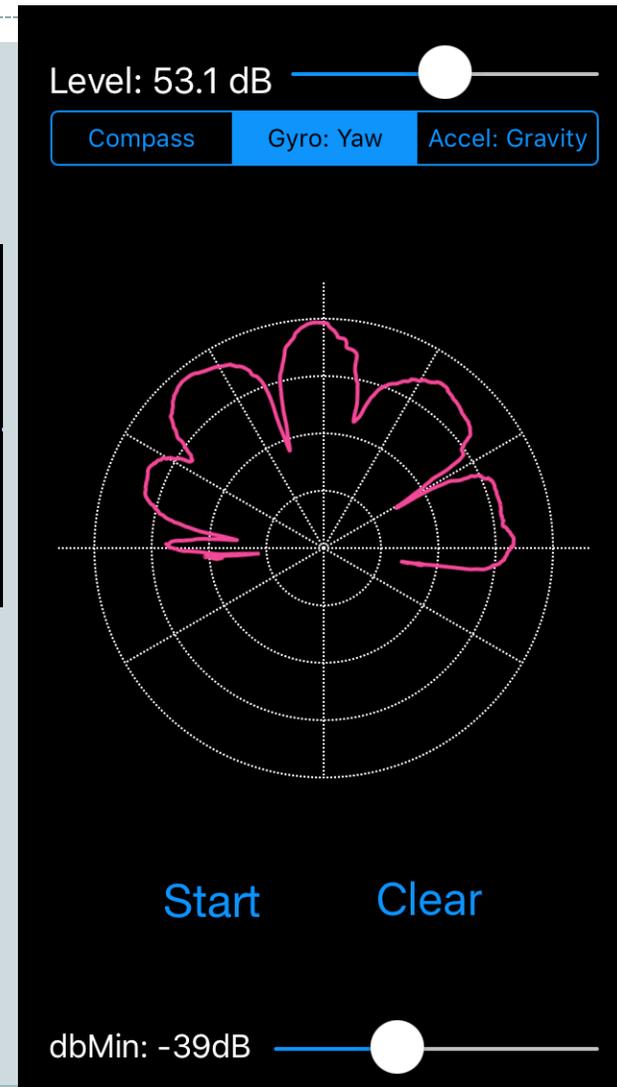
Session 1pED
5th Joint Meeting, Acoustical Society of America and
Acoustical Society of Japan



The App: Polar Pattern Plotter

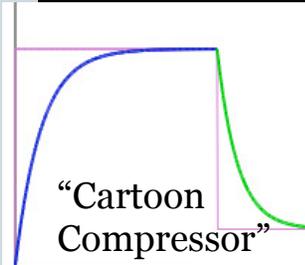
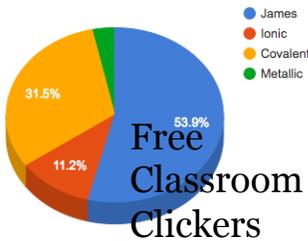
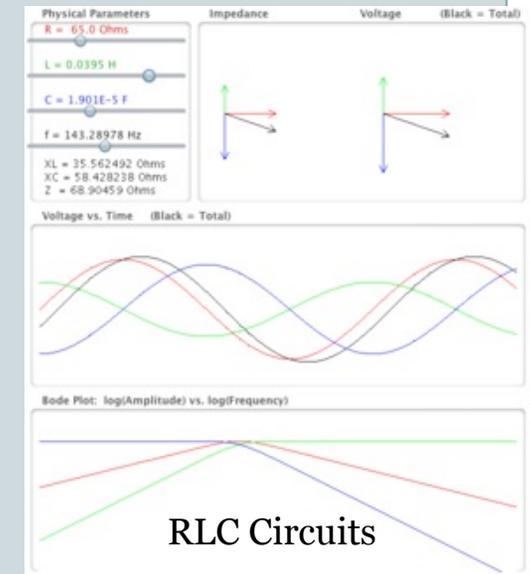
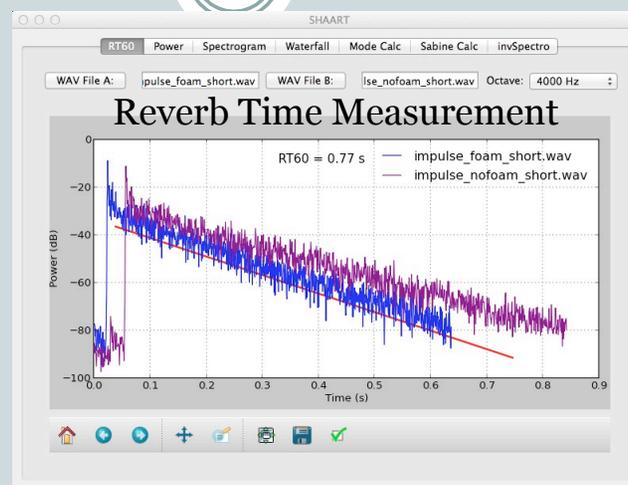
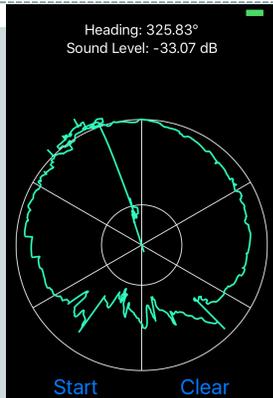


FREE! 😊



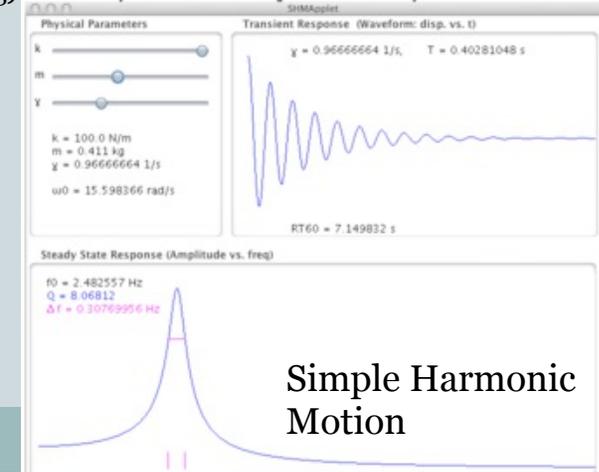
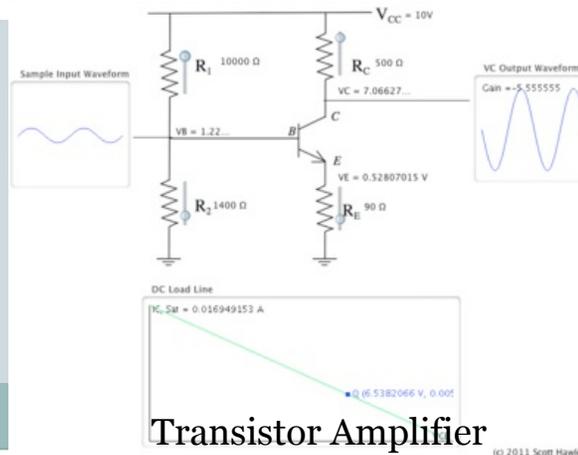
Sample of 'Apps' Developed for Teaching AETs

AET = Audio Engineering Technology, i.e. recording & live sound engineers



RhymeLink

Rhyming Thesaurus (Songwriting)



The Story of PPP

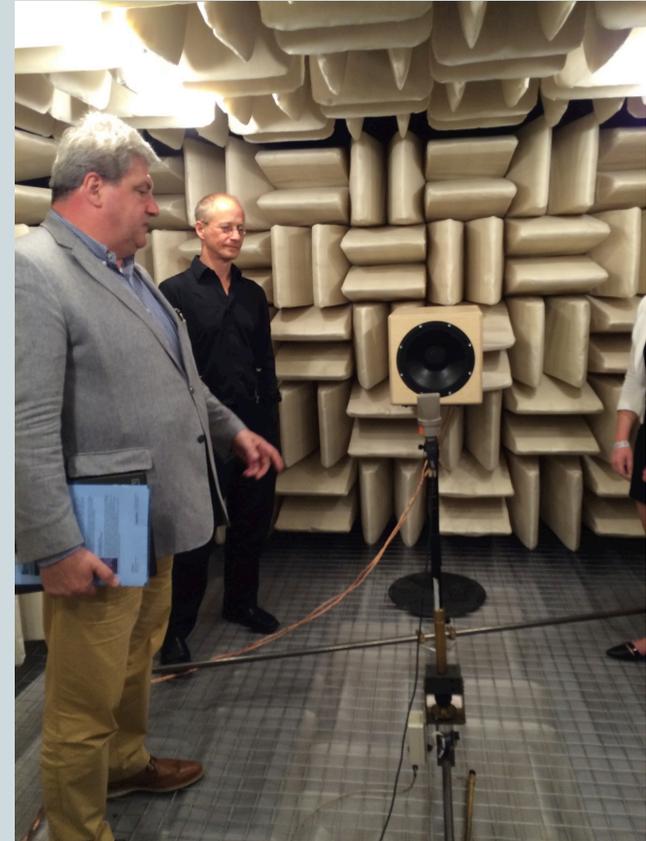


- May 2016: Taught Gen-Ed Electro-acoustics class for Study Abroad, needed labs for us to do!
 - Issues: student preparation, and “morale”
 - ✦ Not too math- or Excel- intensive
 - ✦ “Fast” and reliable
 - ✦ Should be related to SA trip: speaker & mic manufacturers
 - Idea: automated data acquisition & visualization?

Story p. 2



- Manufacturers use “robot” systems for polar pattern measurement (Neumann HQ):
- Had idea for app: Mic input + Compass data -> Polar Pattern! Asked online (“Audio Educators Forum”), no such thing. ...Yet!
- Wrote beta app in a couple days, students used my phone for lab



Story, p. 3



- Study Abroad bought Y-Adaptors for Phone Jack
- Lab setup:

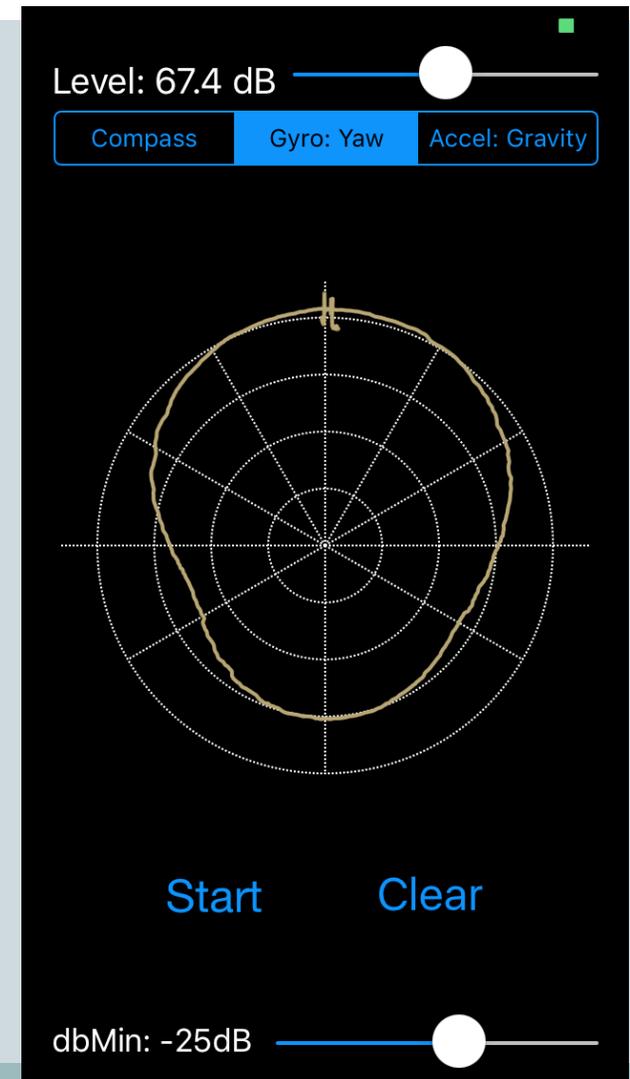
App queries
compass to get
rotation info

Note: Compass
near large
permanent
magnet!



Education Outcomes

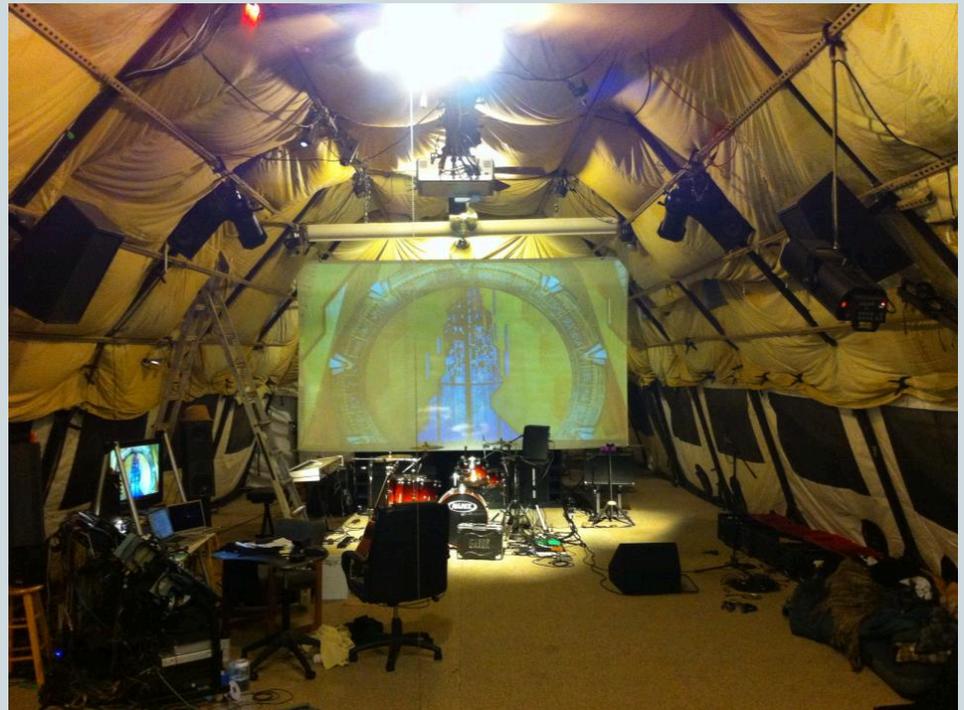
- Students got graphs!
- Students reported:
 - Enthusiasm for teacher's effort
 - Appreciation for visual representation
 - Appreciation that it was directly relevant to trip / mic-mfg
- Note: Dr. Yang-Hann Kim, in his Rossing Prize in Acoustics Education speech, identified visualization as *key* component for acoustics education.



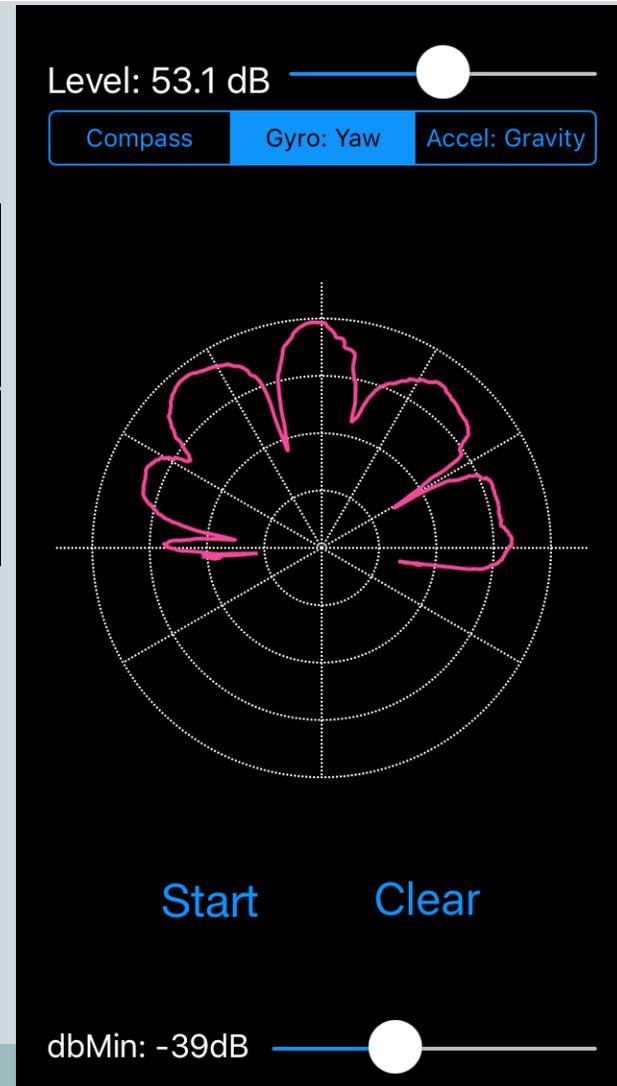
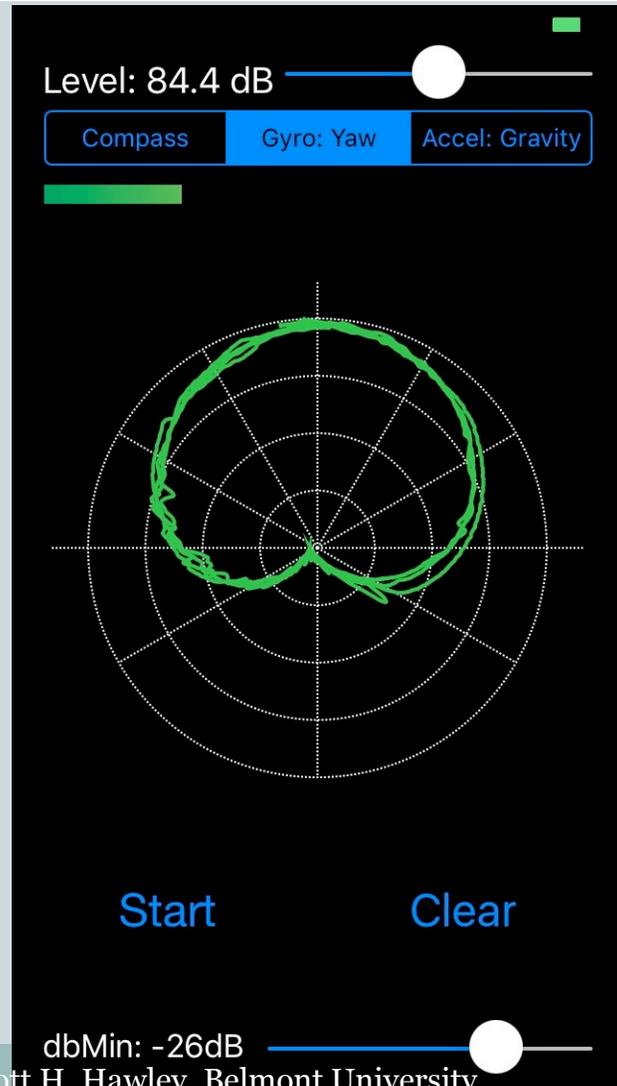
Continued App Development



- Partnered with Rob McClain of OmegaLab Studio for measurement
- Offers “free field” / anechoic space
- Measured mics & multi-speaker setups
- Found gyroscope is more reliable than compass
- Identified need for more UI elem’s: meter, graph scale

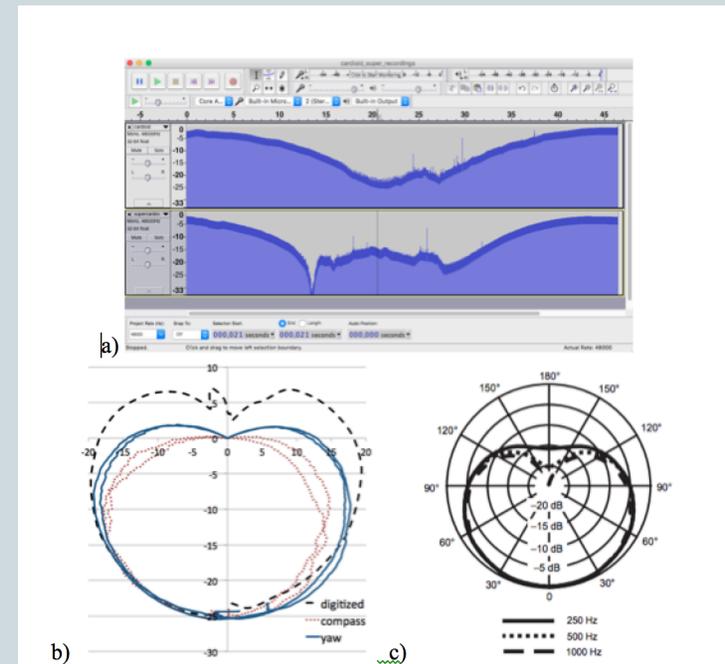
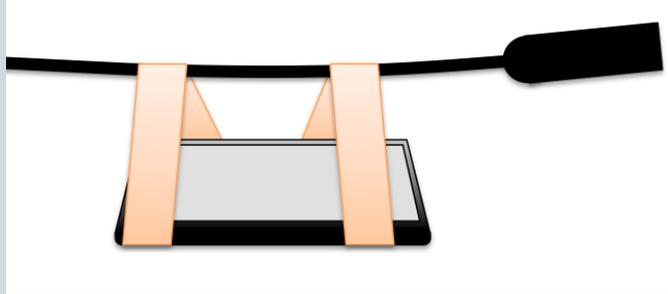
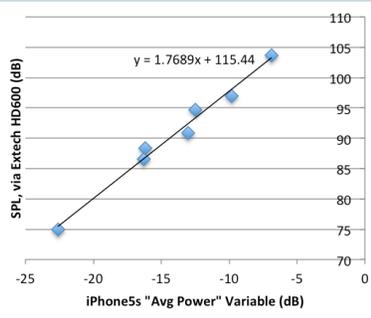
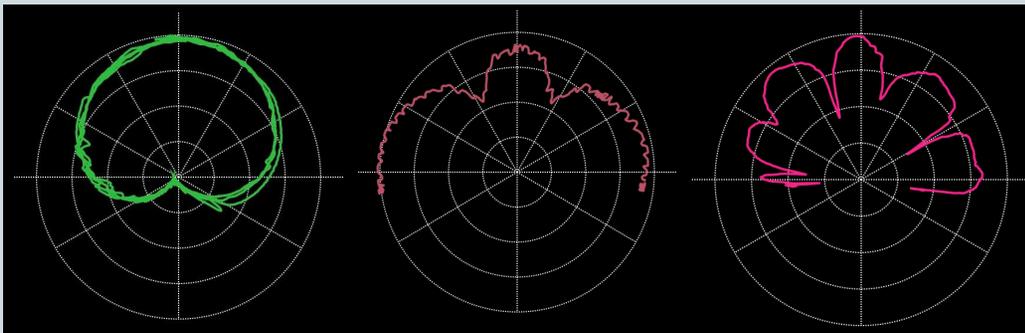


The App: Polar Pattern Plotter

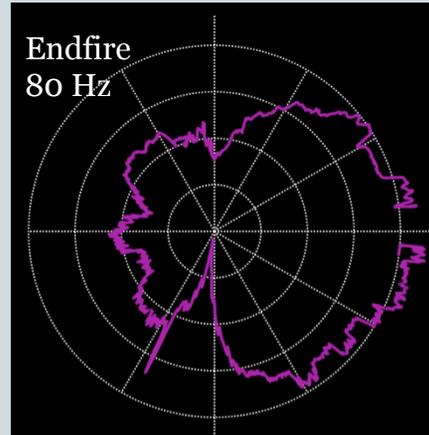
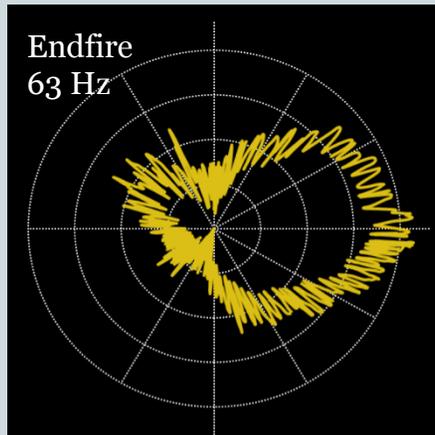
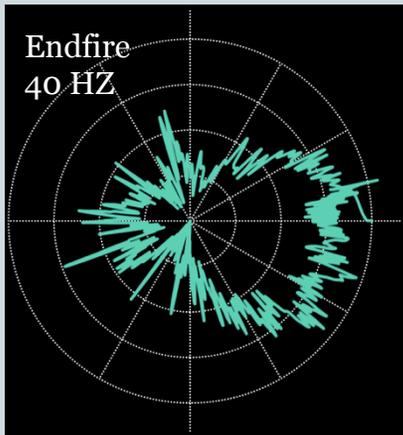
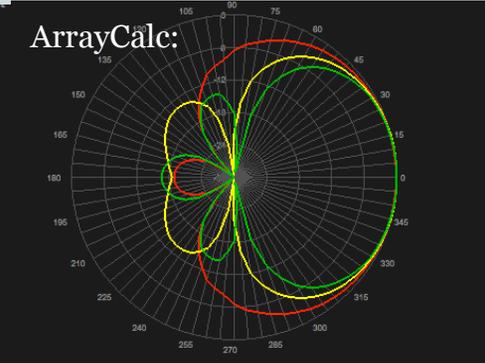
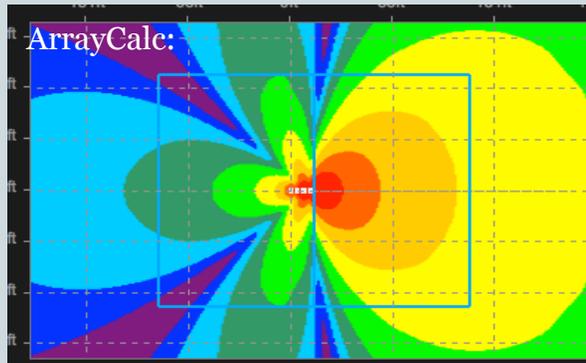
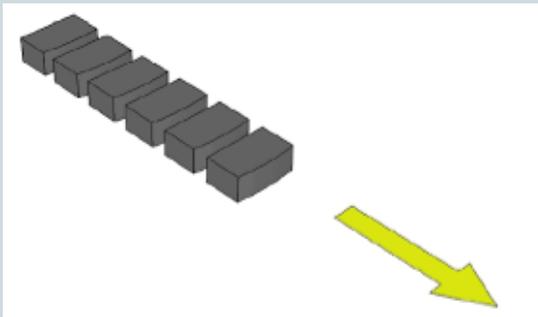


Paper for *The Physics Teacher*

- *The Physics Teacher* journal, features a running “iPhysics” section on labs using smartphones
- Samples from submission by Hawley & McCain:



Student Results: Endfire Subwoofer Array



M.Proctor, S.Dickenson, B. Hughes, J. Good, "Using Smartphones to Measure Subwoofer Array Patterns," *Student Project for PHY2010 – Physics for Audio Engineering*, in progress (unpublished, 2016).

Issues / Future Work

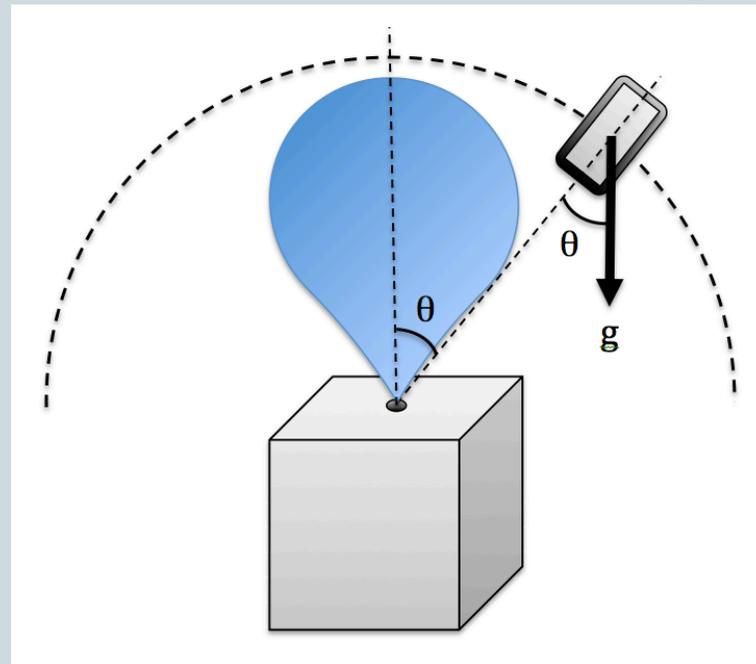


- **Issue: Angular drift**
 - Gyroscope/Compass API (“DeviceMotion”) lacks accuracy, e.g. shows 370° rotation when only 360° occurred (physically)
 - Seems to be a known issue with such devices
 - For now, added a tunable ‘drift correction’ multiplier (0.97).
 - ✦ This version is not pushed to the App Store yet.
- **Feature request: add a tunable filter, to**
 - Reject noise
 - Allow for simultaneous experiments (at different frequencies)
- **Some kind of “click” feature to reject room reflections?**

Future Work 2



- Study Fraunhofer Diffraction (using accelerometer):



- Release as Open Source on github.com/drscotthawley
- 3D Sound Visualization in VR, via HTC Vive

Connections: Student trip to Japan in 2018?!



- In May 2016, did a dual-class Study Abroad program in Electro-Acoustics (Physics) and International Music Business (with an emphasis on Product Marketing)
 - Brought students to **Germany & Austria** to visit Electro-Acoustics research institutes (TU-Berlin, Fraunhofer IDMT, ARI in Vienna) and product manufacturers (Neumann, AKG)
 - Personal connections established at AES *made* the trip great.
- In 2018 we want to visit Japan! (Part of why I'm here)
- **Colleagues in Japan:** Please come talk to me to establish connections for planning a good trip!
- **Contact info: scott.hawley@belmont.edu**