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Efficient Coupling of Acoustic Power into Granular Materials
BRANDON MORROW, ELI OWENS, Presbyterian College — Granular materials are made up of a collection of distinct, macroscopic particles such as a pile of sand. When these particles are packed together, they create a heterogeneous distribution of forces inside the granular material. This heterogeneous force distribution is not very well understood, and contributes to non-linear, highly dissipative, sound propagation. In order to maximally couple sound into a granular material, we seek a coupling device to impedance match with the granular material. An example of a coupling device that works in air is the cone on a speaker. Current methods of probing granular materials involve sending high energy waves, where most of the energy is lost through dissipation. Finding a coupling device would allow deeper non-destructive probing at lower energy than currently available. To analyze the effects of each coupling device on the acoustic power, we buried piezoelectric sensors in sand to determine the amplitude directly below, and at an angle from the source. During our measurements, we swept the frequencies from 10Hz-10kHz in order to observe the effect of the coupling device on the amplitude at different frequencies within our system. This allowed us to find a coupling device that produces the highest amplitude for the lowest driving energy.

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