

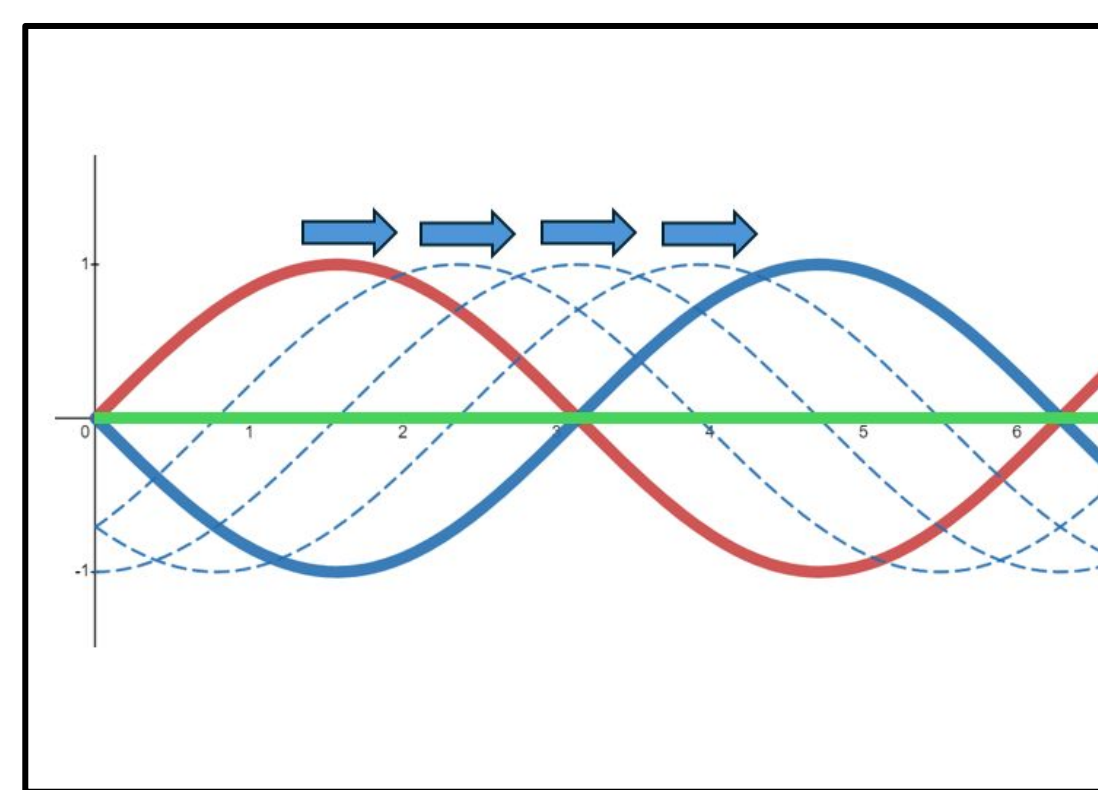
1. Introduction

A leading cause of fear of dental treatments is sharp dental drill noises. Our project demonstrates that it is possible to **distract the patient from drill-induced vibrations conducted through the teeth and jaw**, which will lead to a more pleasant dental experience.

2. Requirements

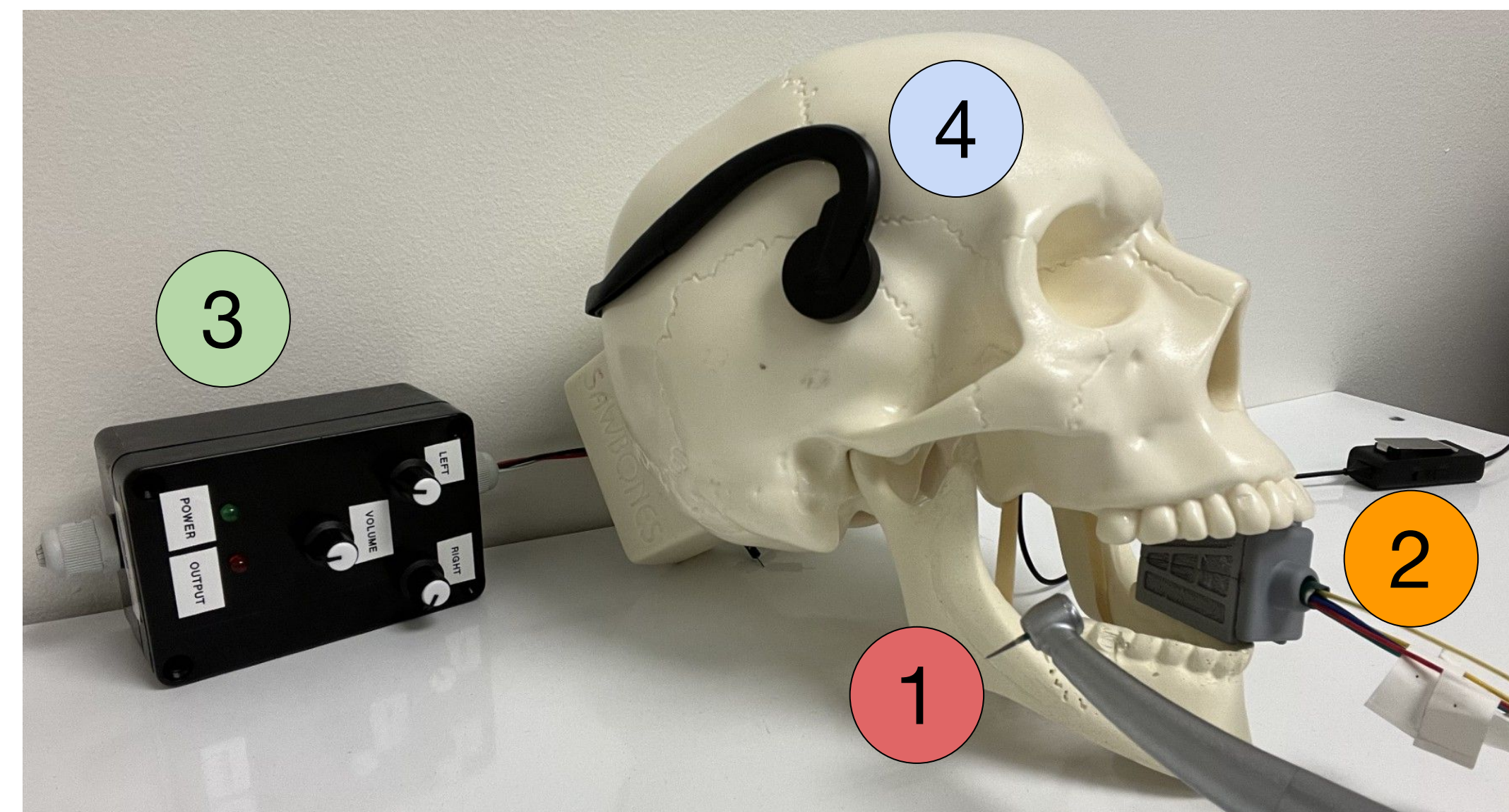
- Dampens drill vibrations perceived by the patient by at least 10%
- Distracts the patient with music
- Safe, sanitizable, and user-friendly for dental operations

3. Operating Principle: Phase Shift



Anti-vibration signal (blue) generated by shifting the input sinusoidal signal (red) horizontally, resulting in cancellation (green)

4. System Overview



- 1 Drill vibration input
- 2 Read signal
- 3 Shift phase for each ear
- 4 Inverted output and cancellation



System in use on a patient (left). The patient can use disposable bags on the system apparatus, which fulfills our sanitizability requirement.

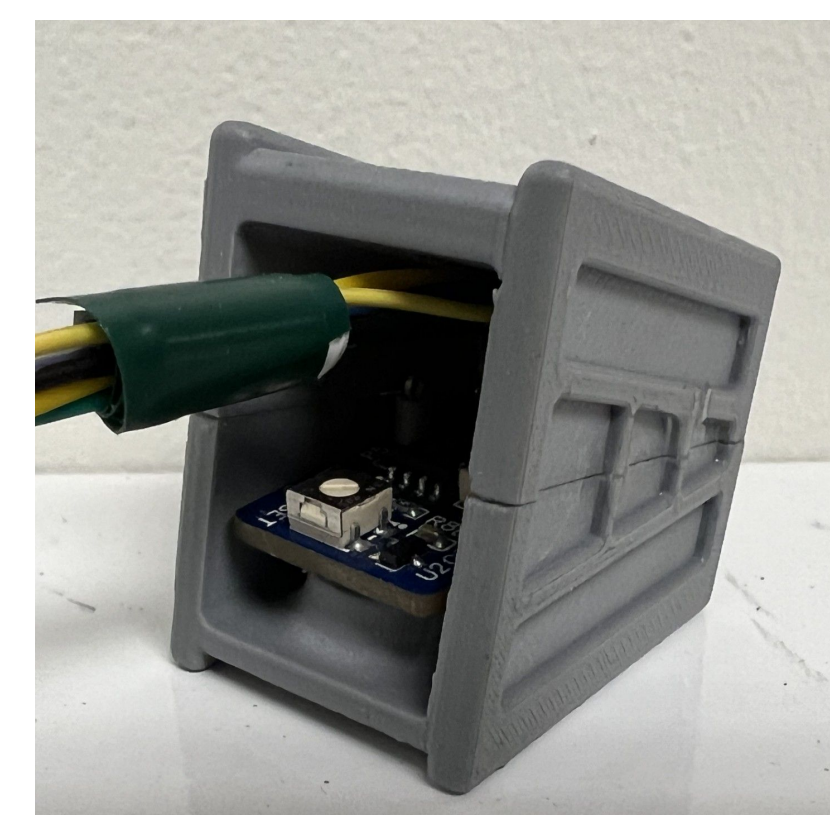
5. Subcomponents



Bone conduction headphones for transmitting anti-vibration signal to patient's head



Control box for patient to customize the phase shift of the output signal

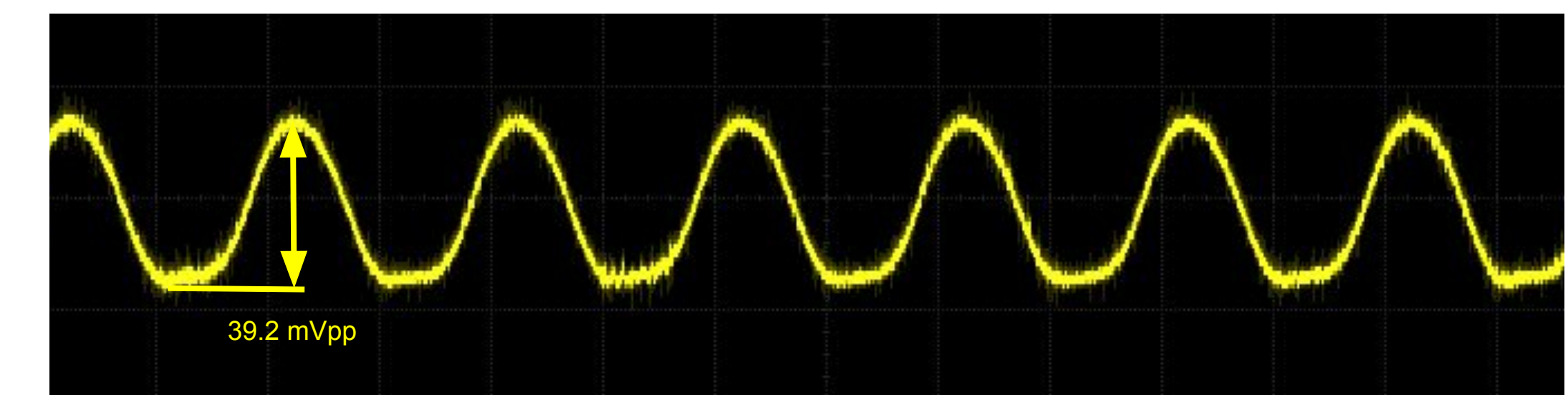


Mouth props for patient to bite onto during dental treatments. The left prop has an accelerometer for vibration measurement, and the right has a bone conduction vibrator for playing music.

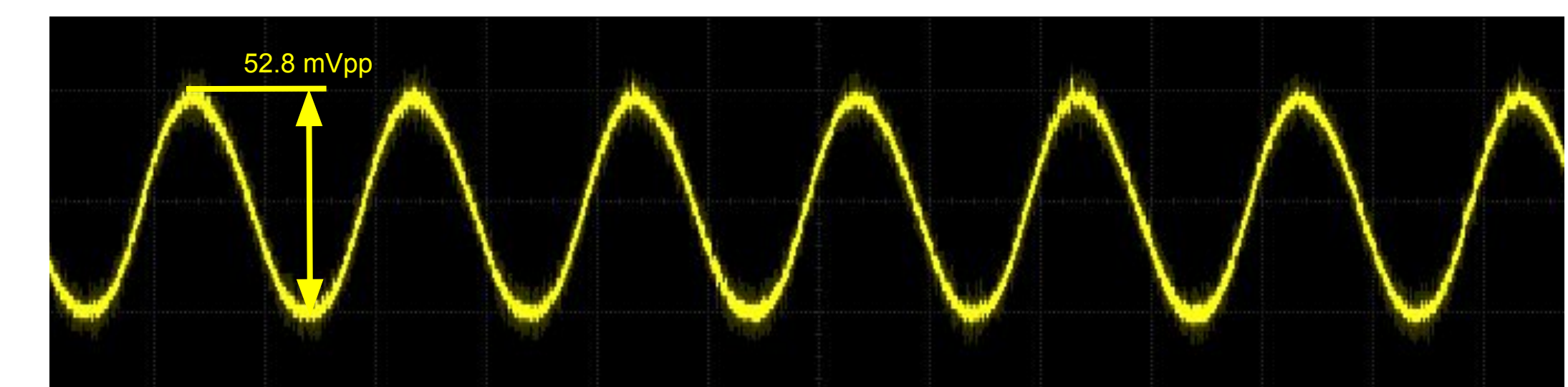
6. Experimental Results

Vibration Dampening System

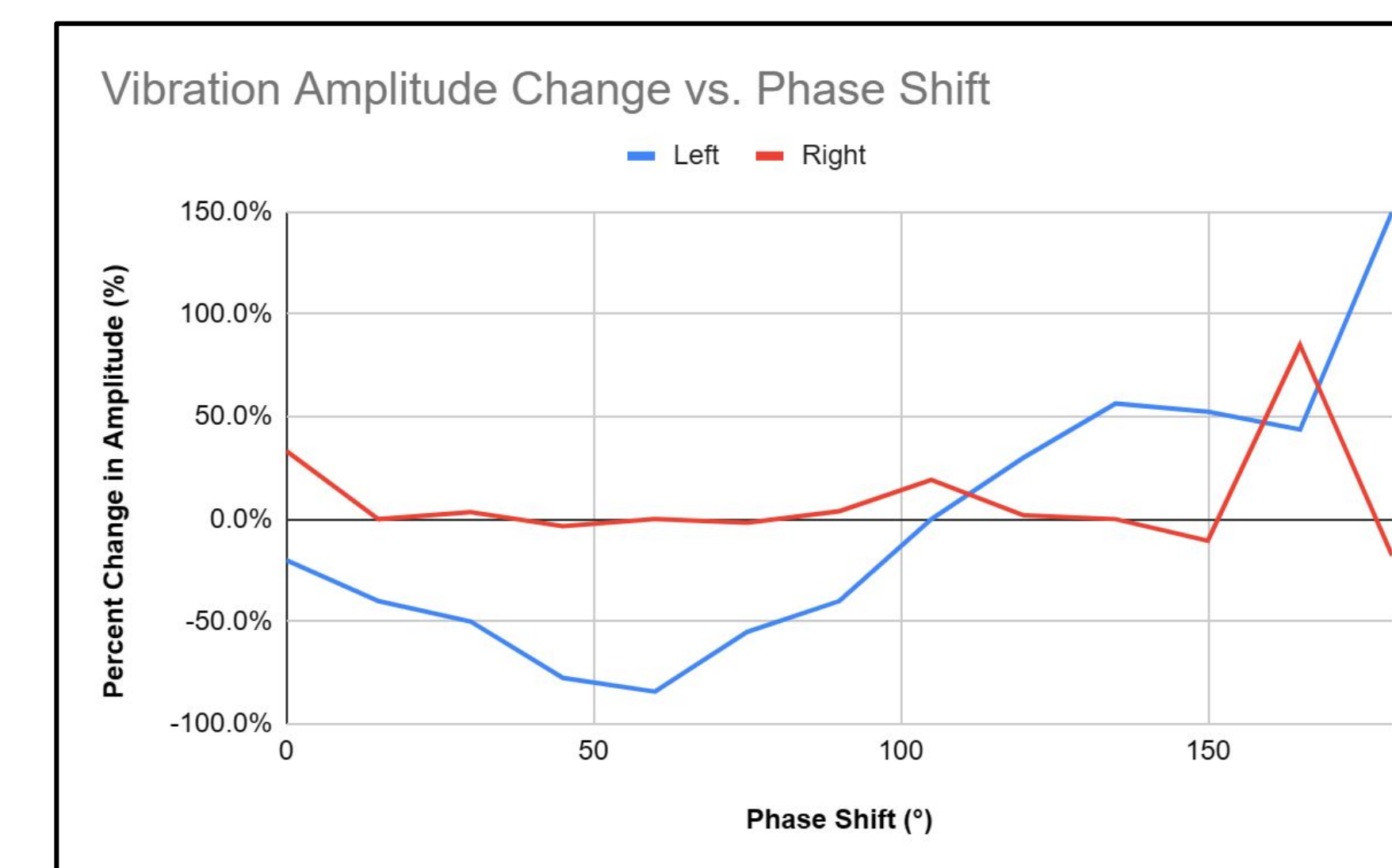
System ON
(39.2 mVpp)



System OFF
(52.8 mVpp)

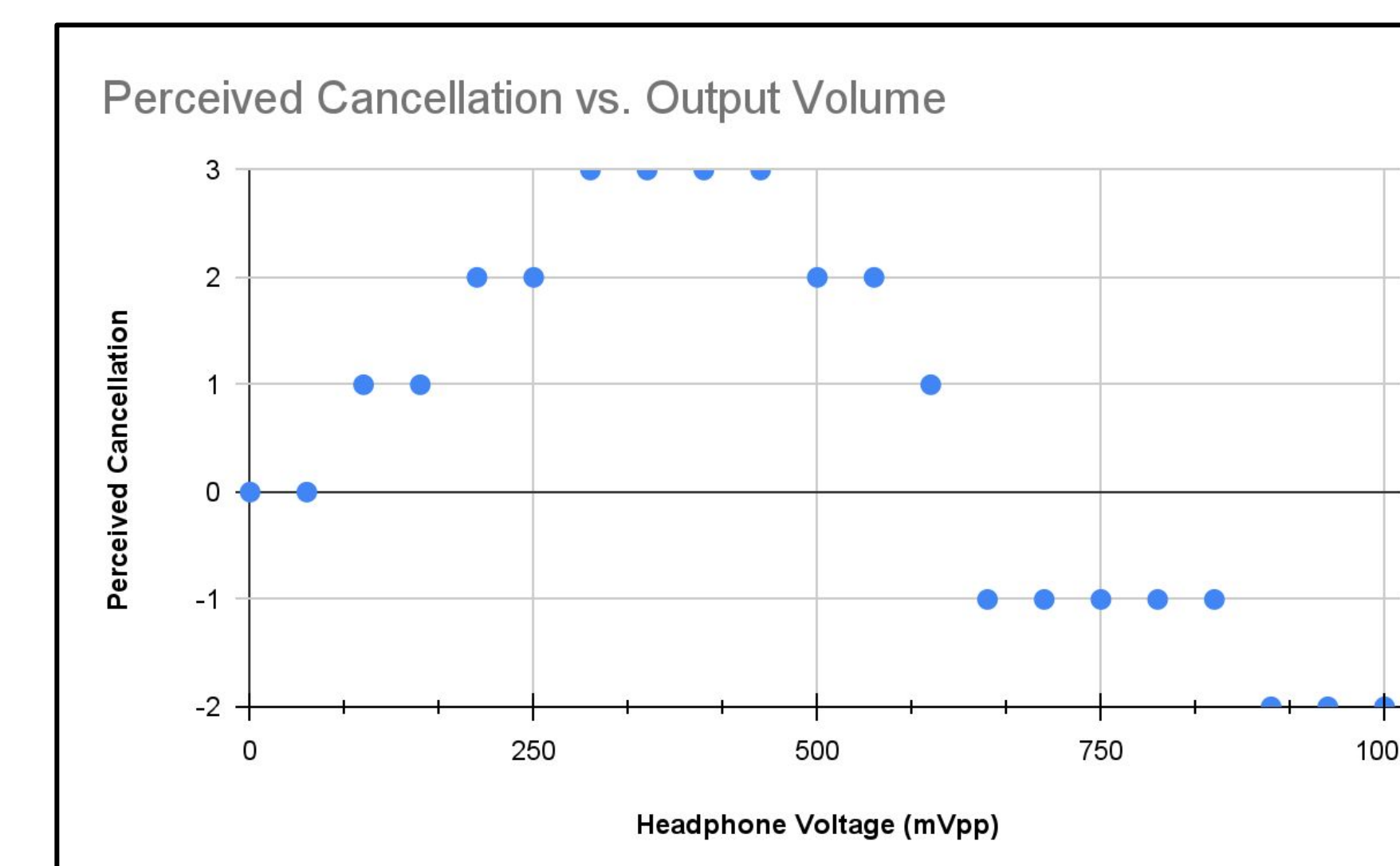


52.8 mVpp → 39.2 mVpp (25% vibration dampening!)



Tuning the Phase

For the ear on the same side as the signal input, we found that 60° phase shift maximizes vibration dampening.



Tuning the Volume

At a given phase shift, we tested the best headphone volume range for vibration dampening. This range differs between patients.

7. Path Forward

Future iterations of our design will have the accelerometer attached to the dental drill rather than in a mouth prop for more direct signal retrieval. The musical and vibration-dampening parts of the solution will be integrated into one system. We would also like to make the system wireless with bluetooth bone conduction headphones.