Improvising Design with a Haptic Instrument
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**Motivation**
Programing inhibits haptic design when the focus is on abstract values, not the output.

Haptic sensations are hard to describe, making it difficult to elicit feedback on haptic designs.

**Inspiration**
A haptic instrument is any tool with real-time control and feedback of a haptic device, and multiple output sensations. We are inspired from musicians using their instruments for ideation and communication.

**Concept**
Real-time feedback from a haptic instrument lets us explore ideas in a hands-on way.


**Design**

We designed a particular haptic instrument. mHIVE, a mobile Haptic Instrument for Vibrotactile Exploration, controls low-level parameters of vibrotactile sensations to help haptic designers create, share, and evaluate their designs.

Output is driven through dual actuators connected to the audio jack.

Main screen controls frequency (horizontal axis, from 0-180Hz) and amplitude (vertical axis, 0-100%).

Users found square waves important for many sensations, but didn’t need all four waveforms.

Different waveforms allow for different haptic “timbres.”

**Study Results**
We conducted a preliminary qualitative study. Four participants used mHIVE in a 1-hour interview, discussing both the sensations they felt and their experience with mHIVE. We used phenomenology to investigate participant experience, generating design guidelines.

Participants enjoyed mHIVE, explored a wide variety of sensations, and communicated ideas haptically, but there was cognitive overhead of both memory and attention.

On-screen trail uses visual feedback to aid memory and attention.

Users found visualization helpful, but wanted even more visual feedback.

Users can record haptic notes, replay them later, and combine into compound notes.

Recording and replaying were essential for some haptic notes, but mHIVE needed a looping or repeating feature for usability.

Users found this envelope difficult-to-use, but resulted in more pleasant tactons.

Users found this intuitive and easy-to-use.

**Conceptual Drawings**
- Programming inhibits haptic design when the focus is on abstract values, not the output.
- A haptic instrument is any tool with real-time control and feedback of a haptic device, and multiple output sensations. We are inspired from musicians using their instruments for ideation and communication.
- Real-time feedback from a haptic instrument lets us explore ideas in a hands-on way.
- Main screen controls frequency (horizontal axis, from 0-180Hz) and amplitude (vertical axis, 0-100%).
- Different waveforms allow for different haptic “timbres.”