

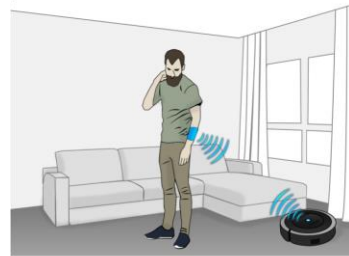
Intuitive, Wearable Haptic Devices for Communication with Ubiquitous Robots

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Challenge

How can we make haptic devices intuitive, unobtrusive, and wearable?



Humans and Robots



Humans and Agents



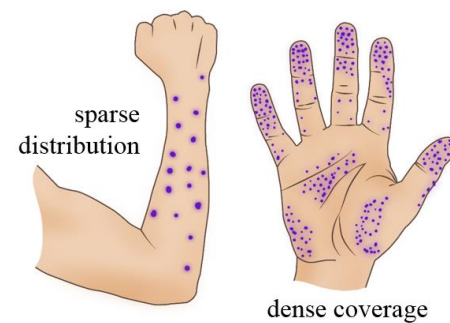
Humans and Humans

Scientific Impact

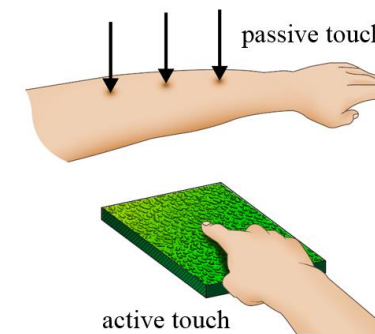
Haptic devices allow private, salient, touch-based information transfer between humans and intelligent systems

Solution

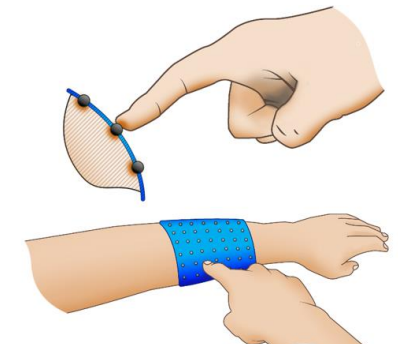
Overcome inherent trade-off between where we want to place devices for maximum wearability and where skin exhibits highest density of touch receptors



(a)

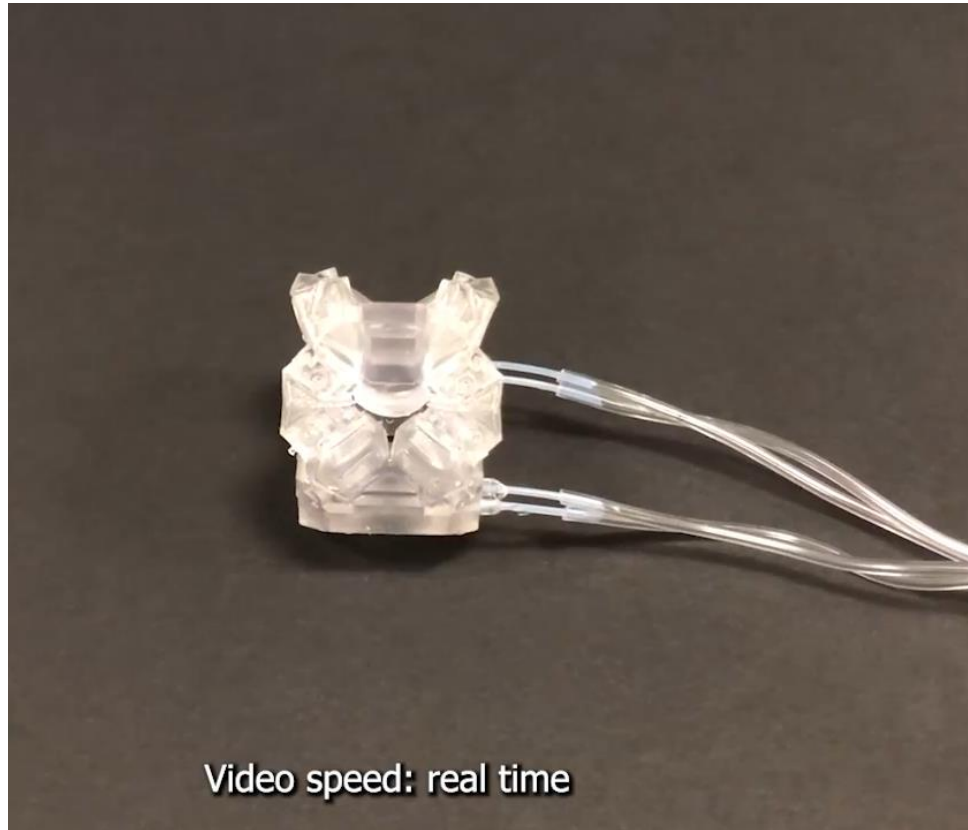


(b)



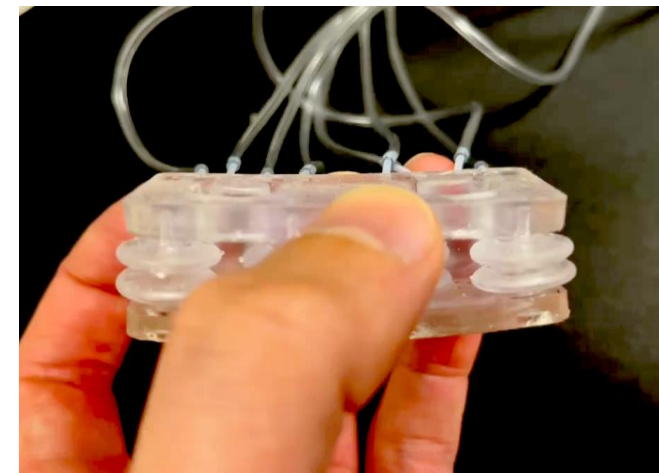
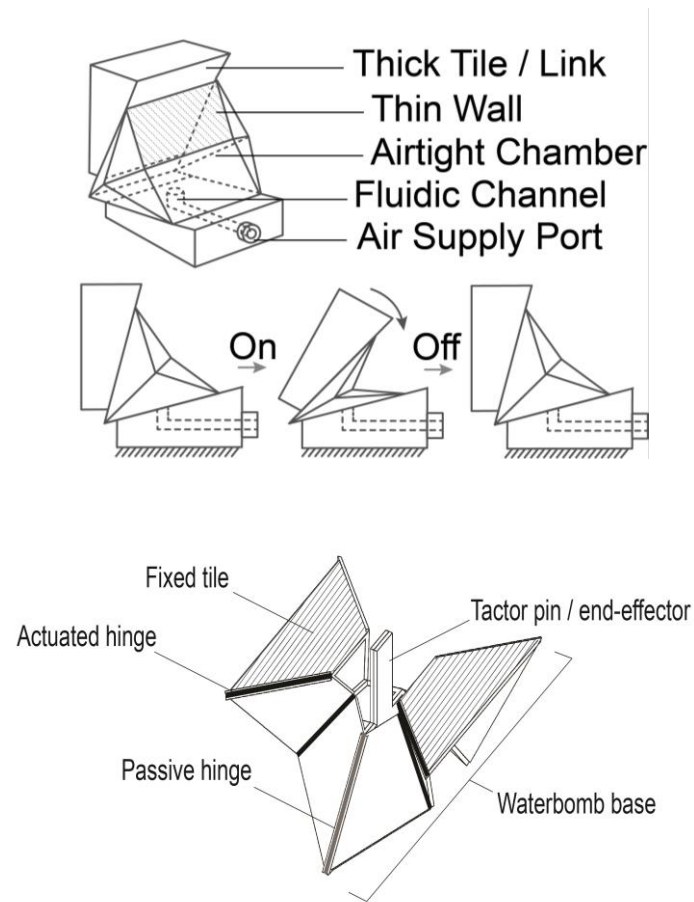
(c)

3-D Printed Soft Wearable Haptics



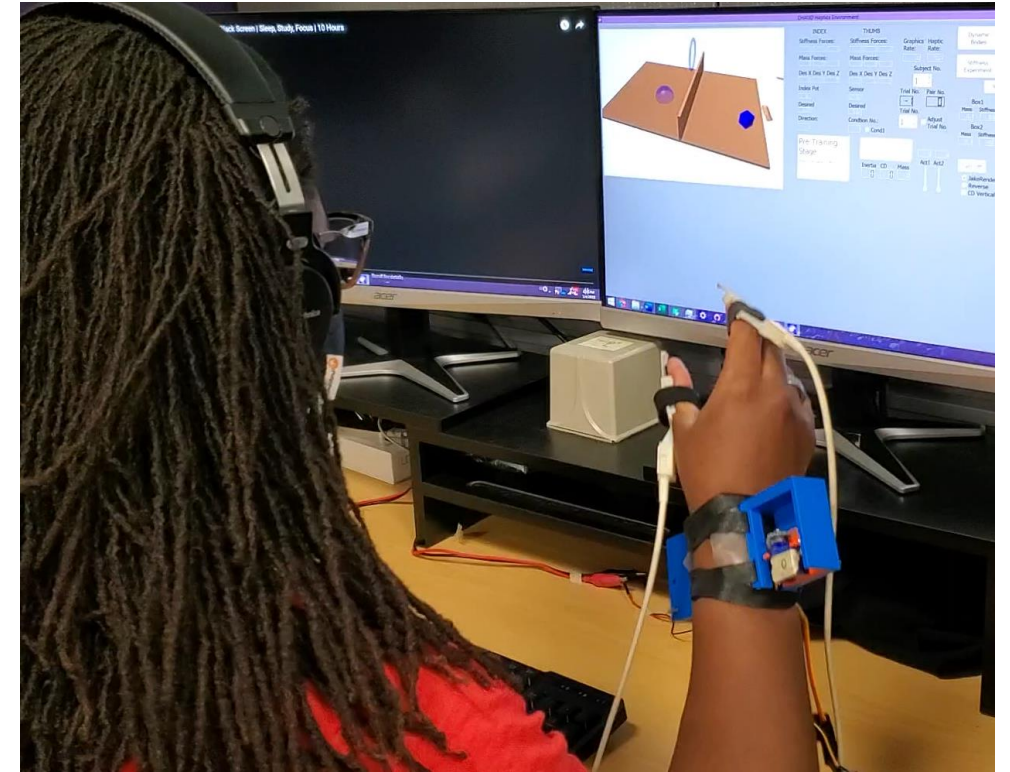
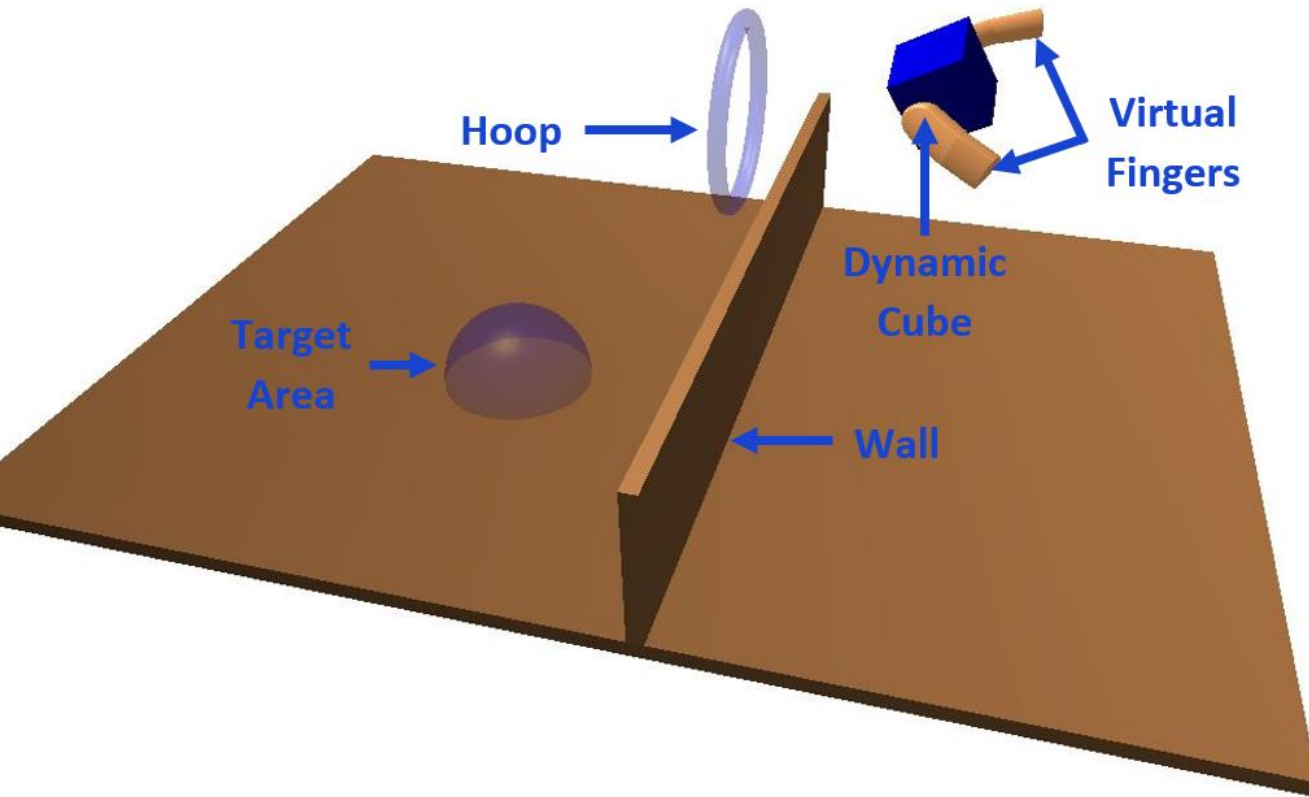
Video speed: real time

FingerPrint: 4-DoF Fingertip Haptic Device



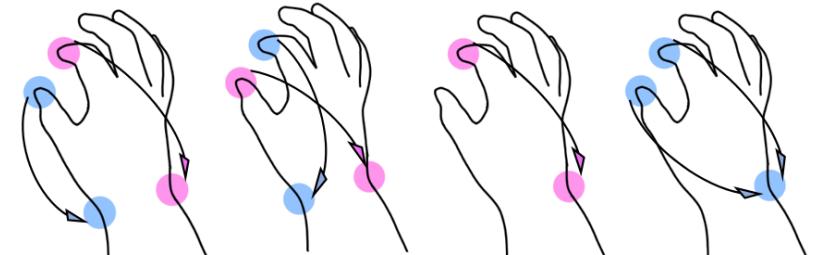
Multi-Contact Wrist Haptic Device

Mapping Fingertips to Wrist



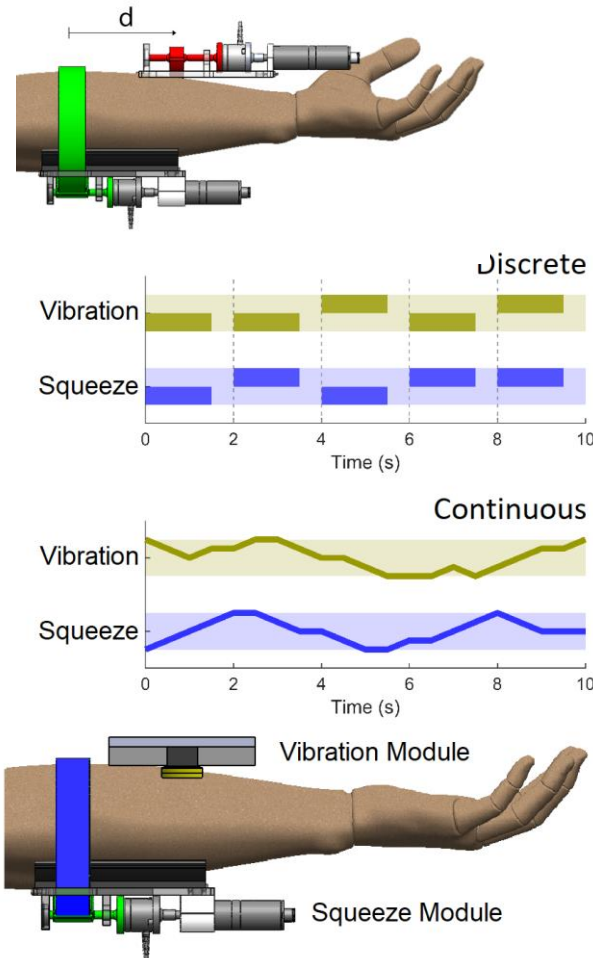
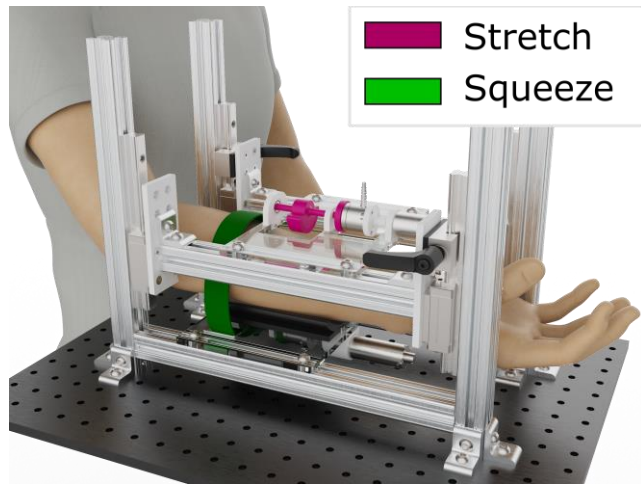
Users prefer a congruent mapping

J. Palmer, M. Sarac, A. Garza, and A. M. Okamura (Submitted)



Characterizing perception of wearable haptic cues

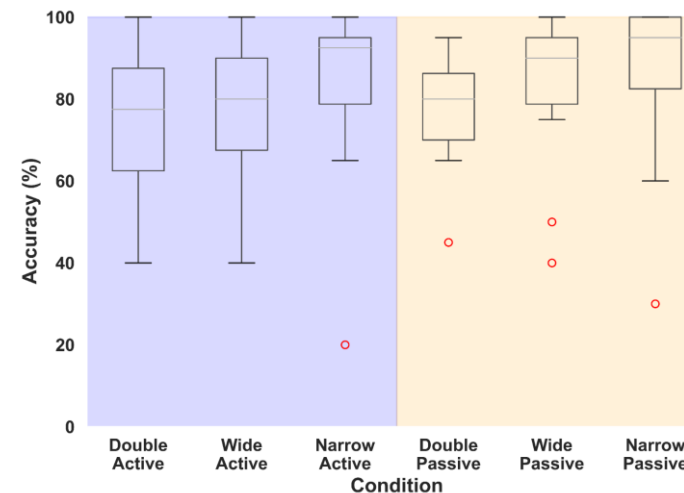
High-fidelity test beds enable accurate cue delivery



Perception of tactile sequences is affected by the user's focus direction and the user's agency over the feedback they receive

Zook and O'Malley, Eurohaptics 2022

Squeeze masks stretch, but effects can be mitigated by varying cue amplitude and separation distance, or by providing continuous rather than discrete cues



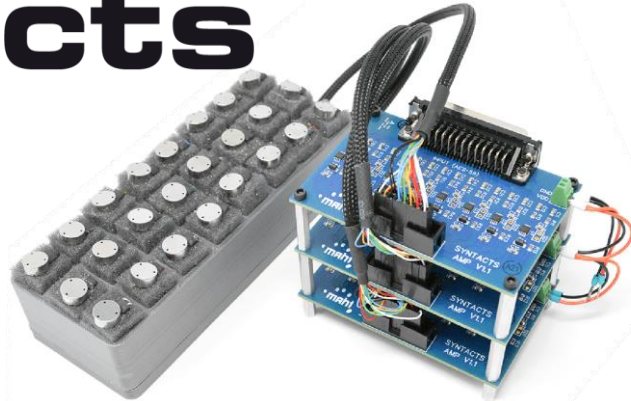
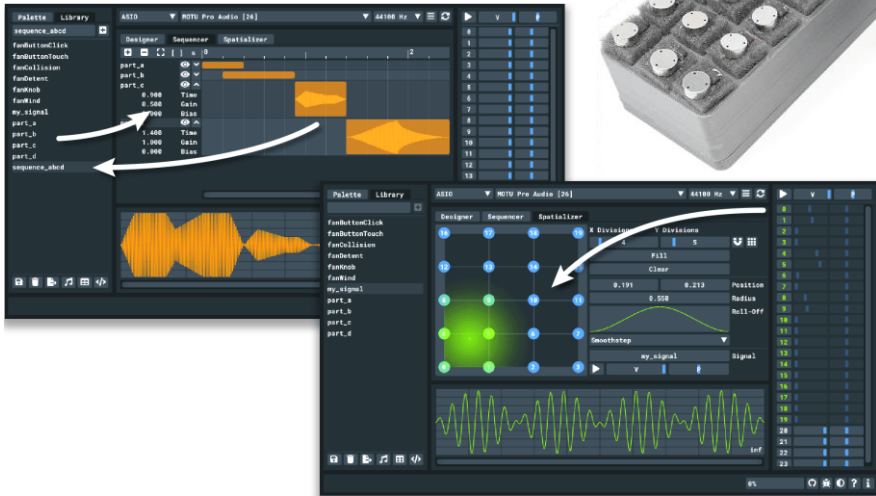
Open-source tools for wearable haptics

Software/hardware framework for vibrotactile cue development and delivery

syntacts.org



Pezent et al., IEEE ToH (2021)



Low-cost, untethered, battery-powered wearable haptic modules for stretch, vibration and twist cue



snaptics.org

Zook et al., IEEE WHC (2021)

