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Macro-Mini Actuation of Pneumatic Pouches for Soft Wearable Haptic Displays

Researchers at Stanford have developed technology to bring new dimensions to wearable haptic devices and better reflect the breadth of haptic interactions in our lives. Currently, to replicate the kind of pressure intrinsic to many forms of social touch such as hugging, existing wearable haptic displays use light weight pneumatic pouches that can embed into things like jackets and vests, and often rely on force feedback. However, exerting the proper pressure over the appropriate contact area remains challenging to render. As such, existing single-pouch designs are inadequate for emerging opportunities in areas like robot teleoperation and virtual/augmented reality. To better meet these needs, the Stanford team has implemented a new macro-mini actuation approach using stacked pouches. This design strategy offers improved control, coverage of large areas, fast dynamic response, and higher spatial resolutions.

Watch a short video

Stage of Development
The researchers have demonstrated the pneumatic macro-mini approach using a huggable robot embedded with distributed force sensors. Future work will focus on improving models of the pouch interaction and integrating stacked pouch actuators into a wearable haptic design.

Applications

- Remote social touch (e.g., rendering social interactions such as hugging or patting between physically-separated users)
- Augmented/virtual reality experiences

- Teleoperation of robots
- Motion guidance (e.g., directional cues to robots)

Advantages

- Control of contact area of pneumatic pouches
- Ability to cover large areas while maintaining a fast dynamic response and higher spatial resolutions
- The stacked pouch concept allows for pressure/force feedback to a user - something that cannot be rendered by vibrotactile actuators alone
- Existing commercial products in this area are limited

Publications

- **B. H. Do, A. M. Okamura, K. Yamane, and L.H. Blumenschein** (2021) *Macro-Mini Actuation of Pneumatic Pouches for Soft Wearable Haptic Displays*. In IEEE International Conference on Robotics and Automation, Accepted.

Patents

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