HYFAR: A Textile Soft Actuator for Haptic Clothing Interfaces

Authors: Jose Barreiros[1], Priyanshu Agarwal[2], et al.

Meta SIGGRAPH 2022

MOTIVATION

Haptic feedback is important in augmented and virtual reality (AR/VR) because it closes the loop of touch sensation and provides physical realism to the virtual world.

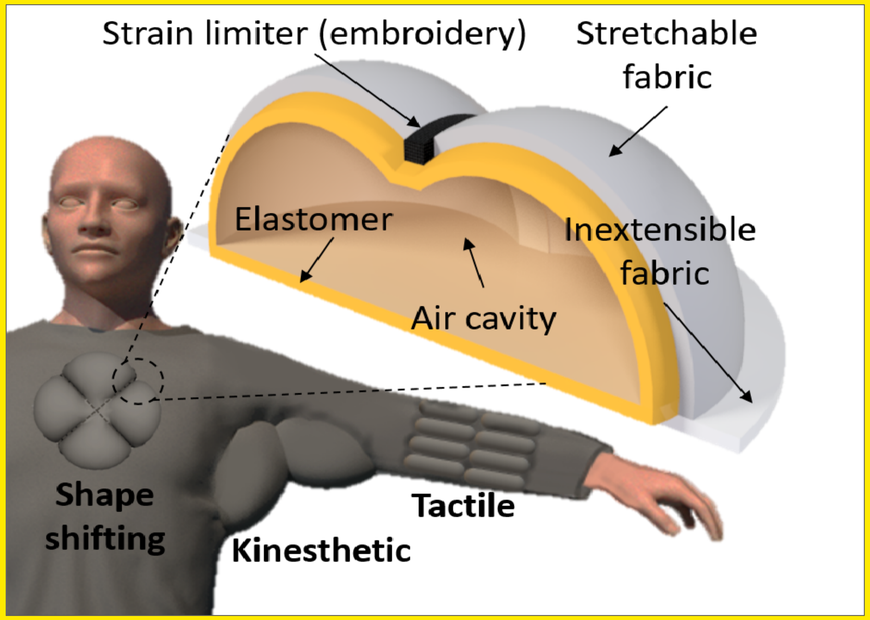
CHALLENGE

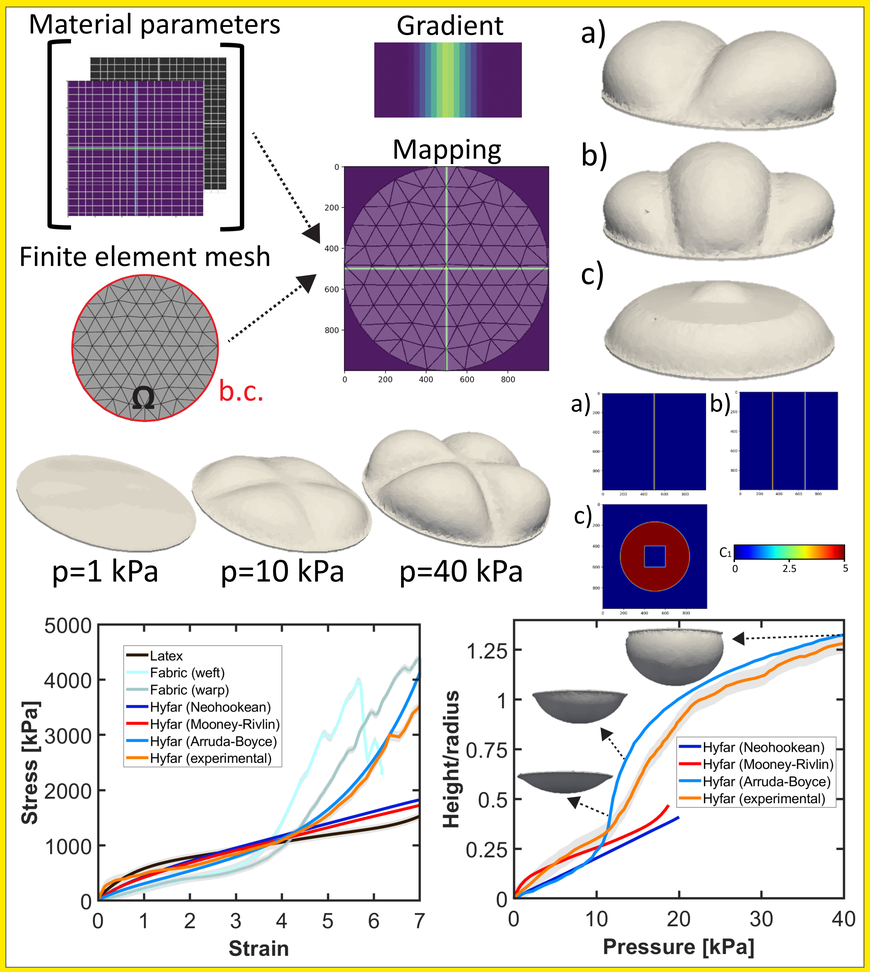
Clothing is appealing for whole-body haptic interfaces because it is in direct contact with the user's skin and provides a large space for delivering haptic feedback. However, most haptic garments are based on rigid devices which tamper the softness of clothing and increase encumbrance for the user.

OUR APPROACH

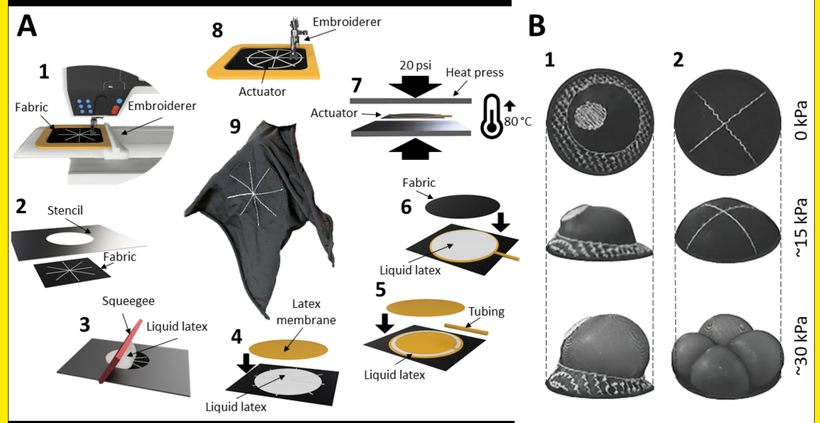
We introduce a HYperelastic FAbric-Reinforced (**HYFAR**) soft actuator that is pneumatically powered.

They are **soft**, can render ***high forces***, ***hyperinflate***, be ***manufactured from textiles*** **and at scale**, ***render low encumbrance*** to the user, and ***inflate into diverse shapes***.





FABRICATION



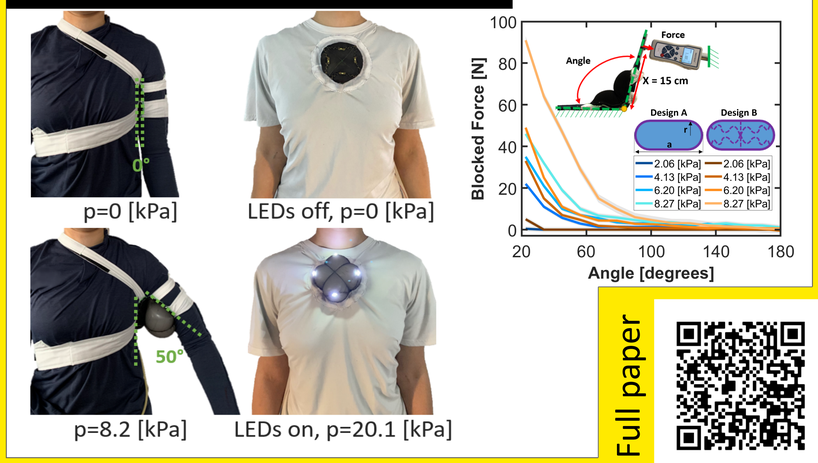
MODELING

Inflation of HYFARs can be expressed as a minimization problem over a domain $\Omega \in R^3$ as described in the finite element theory. We seek to find the displacement field $u: \Omega \rightarrow R^3$ that minimizes the total Helmholtz free energy Π in the admissible function space H that satisfies boundary conditions.

$$min_{u \in H} \Pi, \Pi = \int_{\Omega} \psi(u) dx - PV \qquad (1)$$

$$\psi = C_1 \sum_{i=1}^{5} \alpha_i \beta^{2i-1} (I_1^i - 3^i) \qquad (2)$$

DEMONSTRATION



Full paper

[1] Systems Science and Engineering, Cornell University.
[2] Reality Labs, Meta.