Soft Flexible Haptic Displays for AR/VR and Wearable Computing

Our Team

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There is a need for a glove for VR/AR that allows truly feeling and manipulating virtual objects.

The primitive or bulky state of Wearable haptic feedback today...

[Teslasuit.com]  [DextaRobotics – Dexmo]
[Manus VR]  [Gloveone]
For an effective haptic glove, we need to solve two levels of actuation challenge

- Hand kinesthetic
- Textile integration
- Arm kinesthetic
- Applications
- Hand cutaneous
- Sleeve cutaneous
- Tactile for AR

Our key accomplishments to date in this project

1. DextrES – kinesthetic glove
2. Tactiles – cutaneous glove
3. Pose sensing glove
1. DextrES: a low-power Wearable Electrostatic Clutch

dynamically blocks finger motion to give the impression of solidity to virtual objects
A light-weight glove that blocks finger motion (gen 1)

Kinesthetic Feedback

Flexible and thin

Lightweight (8 g per finger)

Low Power : 2 mW per finger

very slim form-factor
does not hinder finger motion when off

https://www.dextarobotics.com/

https://haptx.com/
How does the ES clutch block motion?

- No voltage: Finger is free
- High voltage: Finger is blocked

DextrES prevents object interpenetration

VR book

Electrostatic Clutch

Ø Finger is blocked

High friction

No sliding

Free sliding

No friction

0V
Now a new Textile version of the clutch:
10x higher force, 5x lower voltage, fully compliant

can block small joints and high force joints
power: less than 2 mW/cm²

Our gen. 2 textile ESclutch can block 2 kg/cm² at 300V

doesn't this unrivalled performance enables a broad range of haptics applications in exoskeletons and full-body haptics
2. **Tactiles**: arrays of fast small pins to provide detailed and realistic sense of touch on fingers and hand.
Designed for Notifications

[ Pece et al. MagTics ]

Designed for VR Touch

[TacTiles]

Render **realistic tactile** feedback for **extended periods** of time in a **light and conformal** interface

No further power necessary

- Latching Plates
- Electromagnetic Coil
- Damping Material
- Permanent Magnet
50% Size & Weight
1cm³ 1.8g

8x Less Power

2Hz Per second
Sustained

200Hz Per second
Burst

Modes and Applications

Contact

Pulse

Linear ↓
Linear →
Radial ↓
Radial ←
3. Pose Sensing glove

fully stretchable distributed strain sensor to provide continuous information on hand pose
Publications / Conferences

We publish in Conferences with acceptance rate of order only 20%

• UIST 2017
• UIST 2018
• IEEVR 2019
• Preparing submission to SIGGRAPH 2020

• ACM Transaction on Graphics
• Patent filing on the flexible clutch

Outlook

Our main challenges for next year:

1. Softer, higher density, more integrated cutaneous actuators
2. Efficient sizing of clutch for different body parts and for different people
3. Integration of both clutch and cutaneous actuators into one glove / sleeve /suit
New cutaneous actuators:
Soft hydraulically amplified dielectric actuators

- Actuator diameter of 3 mm
- Force of 400 mN
- Large displacement: 500 µm
- Fast and compatible with vibrations up to hundreds of Hz
- Scalable to array
- Can be extended to generate shear forces

towards a haptic sleeve
ES clutch: adapting it to block any joint on any body

Starting with a specific movement of the human body, we calculate the primary strain components and produce an optimal clutch design with a particular area budget.

Fabrication of complex ESclutch shape with large surfaces integrated onto skin to full-body haptics.

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Thank you for your attention!

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