

Democratizing Intelligent Soft Wearables

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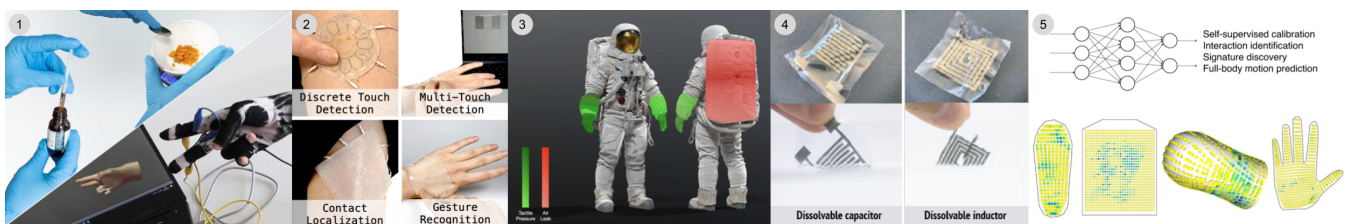


Figure 1: Illustrating the breadth of wearable research, from materials science (1), to energy harvesting (2), haptics for spacesuits (3), sustainable devices (4), to knitted neural networks (5).

ABSTRACT

Wearables have long been integral to human culture and daily life. Recent advances in intelligent soft wearables have dramatically transformed how we interact with the world, enhancing our health, productivity, and overall well-being. These innovations, combining advanced sensor design, fabrication, and computational power, offer unprecedented opportunities for monitoring, assistance, and augmentation. However, the benefits of these advancements are not yet universally accessible. Economic and technical barriers often limit the reach of these technologies to domain-specific experts. There is a growing need for democratizing intelligent wearables that are scalable, seamlessly integrated, customized, and adaptive. By bringing researchers from relevant disciplines together, this workshop aims to identify the challenges and investigate opportunities for democratizing intelligent soft wearables within the HCI community via interactive demos, invited keynotes, and focused panel discussions.

CCS CONCEPTS

• **Human-centered computing** → **Interaction devices.**

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KEYWORDS

Wearables, Applied Machine Learning, e-Textiles, Personal Fabrication, Sensing, Actuation, Materials Sciences, Energy Harvesting.

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1 INTRODUCTION

Recent developments in materials science, digital fabrication, and applied machine learning have enabled significant advances in intelligent soft wearables. At the intersection of wearable technology and applied artificial intelligence, these wearables seamlessly integrate functionalities with the human body, serving as conformal sensing and actuation interfaces, and unobtrusively extract information and generate optimal feedback combined with advanced computational techniques. Some research efforts have been prioritizing functionality over conformability, either for sensing [2, 7, 10, 24] or actuation [4, 22, 25], but we propose to further investigate soft interfaces that conform to the body. They have already served as interactive interfaces [1, 8, 19, 23, 28], behavior monitoring and learning systems [13, 27, 29, 30], assistive wearables [5, 11, 14], human augmentation [9, 12, 18, 21], and entertainment [3, 6, 16, 20, 26], demonstrating great potential in HCI, healthcare, AR/VR, robotics, and space, among other applications.

However, despite their significant potential, most current intelligent wearables are still localized to specific parts of the body, function for only short periods, and are tailored to specific users and scenarios (as in ElectroDermis [15] or SmartSleeve[17]). Additionally, the design, fabrication, and application of intelligent soft wearables generally require domain-specific knowledge and interdisciplinary integration. In this workshop, we aim to analyze the challenges and explore the opportunities in the democratization of such intelligent soft wearables, enabling them to be scalable, robust, customizable, and adaptive. The structure of the workshop is designed to maximize engagement through a combination of keynotes, interactive demos, group discussions, and expert panels.

2 SCOPE: GOALS & TOPICS

The democratization of intelligent soft wearables requires interdisciplinary efforts. In this workshop, we focus on the following research questions:

- How do we effectively customize the form factor and functionalities of intelligent soft wearables for diverse individuals with significant differences in perception and needs?
- How do we generalize the robust performance of intelligent soft wearables across diverse users and usage scenarios?
- How do we efficiently scale the design and fabrication of intelligent soft wearable interfaces so that they can serve a broader community?

The goal of our workshop includes:

- Bringing together researchers in the field to share their findings, practices, and insights.
- Understanding the grand challenges in democratizing intelligent wearables.
- Investigating the opportunities and potential in democratizing intelligent wearables from the design, fabrication, and computational perspectives.
- Fostering collaboration among researchers from various fields to enrich the development of intelligent wearable devices for HCI through diverse perspectives.

Topics of interest for the workshop include, for example:

- Accessible computational design
- Digital fabrication toolkits
- Scalable manufacturing processes for soft wearables
- Generalizable sensing and actuation interfaces
- Applied machine learning for wearables
- Multi-function multimodal wearable ecosystems
- Evaluating large-scale and long-term deployment
- Personalization VS generic one-for-all wearables
- Miniaturization for conformability

3 WORKSHOP PLAN

Opening Session. The workshop will commence with a brief opening session to introduce the agenda and objectives for the day.

Keynotes (1 hour). In the morning, we plan to invite 2 keynote speakers in the field to present for 30 minutes. They will talk about insights into the latest advancements and future trends in intelligent soft wearables. The keynotes will provide some background information for interactive discussion and panels in the afternoon.

Spotlight and Demo Session (2 hours). To prepare for this session, we will invite submissions of interactive demos from a diverse HCI community. During the session, participants will briefly introduce themselves, present their interests, and showcase their demo through a spotlight/lightning talk. After that, participants will be divided into subgroups for interactive demos. During these subgroup demo sessions, participants will present and demo their hardware or software prototypes, discuss the design process, and share any insights that arose during development. General attendees are encouraged to join any subgroup session to engage in discussion and explore the showcased demos. This format aims to promote collaboration, inspire new ideas, and facilitate networking among researchers, designers, and practitioners in the HCI field.

Panel Discussion (1 hour). To prepare for a group discussion on challenges and opportunities of intelligent wearables, organizers will invite a panel of 3-5 experts in the fields. During the panel session, participants will be encouraged to engage actively with the panelists. They will have the opportunity to explore in-depth the challenges and opportunities previously identified during group discussions. Organizers will moderate this dialogue by collecting questions from participants in advance through Slido, ensuring that the session addresses the most pressing issues and interests of the audience. By leveraging the expertise of the panelists and the input from attendees, the session aims to generate valuable discussions and actionable strategies for advancing the field of intelligent wearables.

Group Discussion on Challenges and Opportunities (1 hour). Participants will be divided into subgroups and engage in a collaborative discussion to identify and analyze the major challenges and opportunities in democratizing intelligent wearables. This session will facilitate the exchange of ideas and experiences from various perspectives. Organizers will provide example discussion topics and research questions that touch upon critical aspects of democratization. Building on the previous keynotes, this session will then focus on exploring opportunities and potential solutions in the design, fabrication, and computational aspects of intelligent wearables.

Closing Session (1 hour). The workshop will conclude with a summary of key takeaways and a discussion of the next steps for fostering ongoing collaboration and innovation in the field of intelligent soft wearables.

4 CALL FOR PARTICIPATION

We invite participants and interactive demos from the UIST community who are experienced in or interested in the democratization of intelligent soft wearables, from design and fabrication of various applications.

We particularly welcome researchers, designers, and practitioners in digital fabrication, wearables, toolkit development, embedded AI, computational sensing, and personalized modeling. We will advertise for participation not only within the UIST community but also within human-robot interaction and other AI venues. A webpage and repository were created to help promote, organize and document this workshop:

<https://SoftWearables.github.io/>

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