Sustainable Haptic Design: Improving Collaboration, Sharing, and Reuse in Haptic Design Research

Oliver Schneider
oliver.schneider@uwaterloo.ca
University of Waterloo
Waterloo, Ontario, Canada

Bruno Fruchard
bruno.fruchard@inria.fr
Univ. Lille, Inria, CNRS, Centrale Lille, UMR 9189 CRIStAL
Lille, France

Dennis Wittchen
dennis.wittchen@htw-dresden.de
University of Applied Sciences
Dresden, Saxony, Germany

Bibhushan Raj Joshi
b3joshi@uwaterloo.ca
University of Waterloo
Waterloo, Ontario, Canada

Georg Freitag
georg.freitag@htw-dresden.de
University of Applied Sciences
Dresden, Saxony, Germany

Donald Degraen
donald.degraen@dfki.de
Saarland University & German Research Center for Artificial Intelligence (DFKI), Saarland Informatics Campus
Saarbrücken, Germany

Paul Strohmeier
paul.strohmeier@mpi-inf.mpg.de
Sensorimotor Interaction,
Max Planck Institute for Informatics
Saarland Informatics Campus
Saarbrücken, Germany

ABSTRACT

Haptic devices have been around for decades, providing critical information, usability benefits and improved experiences across tasks from surgical operations to playful applications in Mixed Reality. We see more and more software and hardware solutions emerging that provide design tools, design approaches and platforms, both in academia and industry. However, we believe that designers often re-invent the wheel, and must spend an inordinate amount of time doing their work, which is not sustainable for long-term research. This workshop aims at gathering people from academia and industry to provide a common ground to discuss various insights on and visions of the field. We aim to bring together the various strands of haptics—devices, software, and design—to assess the current state-of-the-art and propose an agenda towards haptics as a united design discipline. We expect the outcome of the workshop to be a comprehensive overview of existing tools and approaches, along with recommendations on how to move the field forward, together.

CCS CONCEPTS

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

KEYWORDS

haptic design, encoding, design tools, sustainability

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1 BACKGROUND

Haptic technology faces a crisis of reuse. Haptics research has produced a breadth of artifacts, starting with actuators and continuing to special purpose controllers, design tools, and workflows. Actuators serve in special purpose scenarios [2] and have been used in everyday commercial devices for gaming [11], VR [6, 13, 16], mobile scenarios [7] or support more commonly available approaches [1] (for more extensive reviews, see [5, 10]). Design tools are aimed at novices or experts, workflows adapt to the tools used or the usage scenario. And yet, even though such a plethora of artifacts exist, haptic design research does not take advantage of this. More often than not, when starting a new haptic research project, hapticians must create a new platform specific to the research question or domain [9]. In consequence, many researchers spend a significant amount of time implementing, tuning, and perfecting sub-systems which others have already created. We see limitations transferring research ideas into practice, and limited scope of research projects; hapticians must spend an inordinate amount of time overcoming these issues to do their work, which is not sustainable.

This is not because hapticians are not familiar with related work, but rather because of the complexity of haptic design. Control signals for driving force feedback devices are not compatible over most commonly used actuator types. Design approaches such as iconic tacton design [3] or embodied material rendering appear incommensurable while applications range from basic physiological assistance [14], to transfer of high level information [15]. In vision, designers of digital content have generic devices and even the most radically different approaches share underlying structures (such as RGB or CMYK). In haptic design, such shared resources and general purpose devices appear impossible to achieve.

While it may currently not be possible or desirable to achieve a similar level of standardization of technology as we experience with visual design, any step in this direction will allow researchers and practitioners to focus on the problems they wish to address, and remove overhead in how to address these problems. This will also improve the potential of devices and experiences to scale across context, be reproduced by others, and move towards a long-term goal of sharing of experiences across device types by means of encoding the underlying experience in a device-agnostic way.

The goal of this workshop is two-fold: First, we wish to **foster exchange between stakeholders in the field of haptic design** from both industry and academia. In recent years the interest of companies and founders in haptic feedback has dramatically increased, today a large number of companies are producing cutting edge haptic feedback design intended to be used in products. Research in academia often appears to operate in isolation of these efforts. We believe identifying places where these research efforts intersect can benefit all research communities.

Secondly, we wish to **identify paths going forward which allow haptic design artifacts, tools, and methods to work together synergistically**. While the breadth of artifacts in haptic design can be explained by the complexity of the domain, there are clear drawbacks to this – one might even argue that hapticians tend to re-invent the wheel. If we design our tools differently, might we minimize this? Are there any design choices we make which discourages re-use? Is there something we do not do, which needs to happen to support generalization of our work?

We will address these two goals by facilitating keynote presentations of researchers from both industry and academia and enabling discussions around their design approaches. Additionally, the workshop will provide two breakout sessions. In the first session participants take stake of the research landscape, while in the second participants analyze key challenges towards unified, integrated haptic design workflows.

2 ORGANIZERS

Oliver Schneider is an Assistant Professor, human-computer interaction researcher, and haptician at the University of Waterloo in the Faculty of Engineering (Department of Management Sciences). His research aims to enable anyone, anywhere to work with haptic technology as fluidly as we work with any other media.

Paul Strohmeier leads the Sensorimotor Interaction group (senSInt) at the Max Planck Institute for Informatics. His research focuses on tactile and kinesthetic perception, sensory augmentation, and on-body systems.

Bruno Fruchard is a postdoctoral research fellow at Inria in the Loki team in Lille. His research focuses on interaction techniques for various levels of expertise and support customization and design processes. He has been building haptic design tools with various granularity to support quick design cycles.

Georg Freitag is a Professor for User Interface Design at the University of Applied Sciences Dresden. His research focuses on the feasible integration of tactile systems into protective equipment and workwear. Another focus is on the prototyping of multidimensional tactile displays and the representation of complex data formats in these displays.

Dennis Wittchen is a PhD student at the Technical University Dresden and an research assistant at the University of Applied Sciences Dresden. His research focuses on human motion analysis and data-driven technologies to synthesize realistic motions. He is also highly interested in human-computer interaction and particularly in vibrotactile feedback systems and haptic design tools.

Bibhushan Raj Joshi is a PhD student at University of Waterloo. His research focuses on understanding the steps/processes followed in the product development cycle of haptics. He is also passionate about software development, product management and creative research involving human computer interaction.

Donald Degraen is a PhD candidate at Saarland University, Germany. His ongoing work explores the intersection of haptics, fabrication and virtual reality to provide methods and tools for designing haptic experiences.

The organizers of this workshop are actively involved in haptic design research and teaching in their respective universities. They have successfully organized related workshops in the past: Dennis, Georg, Bruno, and Paul recently hosted a workshop sketching tactons at TEI'21 called TactJam [17]. Also, Paul co-organized Shape Changing UI workshops at CHI'16 [12] and ACE'14, Oliver co-organized the Workshop on Haptic Experience Design at World Haptics 2015 [8], Donald was part of the organization comittee of the 'Everyday Proxy Objects for Virtual Reality' at CHI'21 [4].

3 PRE-WORKSHOP PLANS

This workshop's goal is to gather stakeholders in the field of haptic design from various backgrounds. We propose to reach out to experienced haptic researchers focusing on designing and building hardware devices, to rising startup CEOs focusing on design tools, to established company members selling haptic products worldwide, and researchers studying haptic design for novice hapticians. We are building a website available at https://tactilevision.github.io/chi2022-sustainablehapticdesign/ that includes a call to action, a schedule for the workshop, the list of speakers that will present their vision, and eventually a summary of the outcome from the workshop. We will connect with possible participants through mailing lists (e.g., the HCI french mailing list), online networks (e.g., the Canada Haptics ("CanHaptics") slack group), and by personally contacting people of interest in research labs and companies focused on haptic design.

The workshop will be guided by accessibility and inclusion. Participant selection, if it exceeds capacity, will include diversity of

applicants as a guiding principle. All sessions and recorded sessions will include captioning. A remote workshop will enable more people to take part.

4 KEYNOTE SPEAKERS

We are delighted and honored to announce four speakers will present their work and vision of the field of haptic design at the workshop. Each presentation will last about 20 minutes and introduce a variety of insights on haptic design. Our aim is to stimulate following-up discussions by laying out an heterogeneous panel of ideas for participants to appropriate or confront. We list the speakers in alphabetical order in the following.

Vincent Hayward is a professor at Sorbonne University in Paris (France) at the Institute of Intelligent Systems and Robotics (ISIR) where since 2008 he leads a team dedicated to the study of haptic perception and the creation of tactile stimulation devices. In 2020, he was elected to the French Academy of sciences. Vincent currently spends part of his time contributing to the development of a start-up company in Paris, Actronika SAS[1], dedicated to lowering the accessibility barrier of haptic technology.

Vincent Levesque is an assistant professor in the Department of Software and IT Engineering at École de technologie supérieure (Montréal, Canada) and the director of the Haptic User Experience (HUX) research group. He was previously a research scientist at Immersion Corp.[2] (Montréal, Canada) from 2011 to 2016 where he explored applications of haptic technologies for consumer electronics. Vincent owns a PhD from McGill University (USA).

Hasti Seifi is a tenure-track assistant professor in the Department of Computer Science at the University of Copenhagen. She owns a PhD from the Department of Computer Science at the University of British Columbia. Her research is at the intersection of human-computer interaction, programmable touch technology (haptics), and social robotics.

Eric Vezzoli is a haptics enthusiast breaking the barriers impeding haptics to scale. He designed the haptics architecture of Interhaptics[3], led a team of engineers and product-marketing to the launch of the Interhaptics Haptics Composer: the first multiplatform Haptics Design tool on the market. He co-founded Go Touch VR[4] exploring skin indentation technologies for haptics applications in VR. Eric owns a PhD from the University of Lille 1 Sciences and Technologies in France.

5 IN-PERSON, HYBRID OR VIRTUAL-ONLY

This workshop will be held in synchronous, virtual-only sessions to enable a greater number of participants to take part, recording of all materials, and less variability for planning. We do not anticipate limitations from having no in-person sessions given the planned discussion topics.

6 WORKSHOP STRUCTURE

The workshop will last a full day (~6 hours) and be split in two similar sessions, see Table 1. We plan on scheduling the event based on the time zones of the participants to reach a maximum of person for this unique session (see tentative timelines on Table 2). A session consists of 2 keynotes of approximately 20 minutes each (including 5 minutes for Q&A) by the invited speakers to present their past experience in haptic design and their vision to move the field forward. After a short break, we will present a list of topics to discuss in breakout sessions, ask participants to extend the list if they wish to, and split them in groups of 3 to 4 persons. Participants will briefly present the outcome of their discussions at the end of a breakout session to all attendees.

Table 1: Detailed schedule of the one-day virtual workshop.

	Duration	*Description*
Open	**25 minutes**	**introducing the workshop**
	5 minutes	on-boarding
	20 minutes	participant introductions
Talks	**40 minutes**	**keynote talks from invited experts**
	20 minutes	*Hasti Seifi* (including Q&A)
	20 minutes	*Eric Vezzoli* (including Q&A)
Break	5 minutes	
Setup	**10 minutes**	**introduce topics and setup groups**
BS #1	**80 minutes**	**first breakout session**
	60 minutes	discuss topics in breakout rooms
	20 minutes	present intermediate results
Break	30 minutes	
Talks	**40 minutes**	**keynote talks from invited experts**
	20 minutes	*Vincent Levesque* (including Q&A)
	20 minutes	*Vincent Hayward* (including Q&A)
Break	5 minutes	
BS #2	**80 minutes**	**second breakout session**
	60 minutes	discuss topics in breakout rooms
	20 minutes	present intermediate results
Break	5 minutes	
Close	**15 minutes**	**synthesize and conclude**
	10 minutes	overview of existing resources
	5 minutes	what needs to be done next

Each breakout session will have a specific framing. During the first, participants will discuss about the *past* and map the haptic design landscape to identify possible re-uses and primary challenges. The second session will offer the opportunity to analyze key challenges towards unified, integrated haptic design workflows. Topics discussed within the two sessions will refer to (a) design tools, (b) language, mappings, and encodings, (c) devices and controllers, and (d) accessibility and communication of haptic experiences.

7 POST-WORKSHOP PLANS

The breakout sessions will be structured in such a way to encourage systematic documentation in writing. The topics which participants will chose as relevant for discussion will then have a written overview of the state of the art, including commentary by experts. For each topic this overview will be supplemented with identified

[1] https://www.actronika.com/
[2] https://www.immersion.com/
[3] https://www.interhaptics.com/
[4] https://www.gotouchvr.com/

Table 2: Workshop schedule considering different time zones.

San Francisco PDT (UTC-7)	***New Orleans*** **CDT (UTC-5)**	*New York* EDT (UTC-4)	*Berlin* CEST (UTC+2)	*New Delhi* IST (UTC+5:30)	*Hong Kong* HKT (UTC+8)	*Melbourne* AEST (UTC+10)
Sat, Apr 30	**Sat, Apr 30**	Sat, Apr 30	Sat, Apr 30	Sat, Apr 30	Sat, Apr 30	Sat, Apr 30
5:00 – 11:00	**7:00 – 13:00**	8:00 – 14:00	14:00 – 20:00	17:30 – 23:30	20:00 – 2:00	22:00 – 4:00
Sat, Apr 30	**Sat, Apr 30**	Sat, Apr 30	Sat, Apr 30	Sat, Apr 30	Sat, Apr 30	Sun, May 1
7:00 – 13:00	**9:00 – 15:00**	10:00 – 16:00	16:00 – 22:00	19:30 – 1:30	22:00 – 4:00	00:00 – 6:00

problems and open research questions, as well as strategies how to move haptic design research towards a more sustainable practice.

These written reports will serve as the basis of an essay which we intend to publish. The essay will serve as an opinion piece on the state of the art of haptic design, with a summary of open research questions. The essay will be aimed at junior researchers searching for PhD topics, and guiding grant proposals by more senior researchers. All workshop attendees will be invited to co-author. Depending on how systematically the topics cover the space we will decide for a venue to submit to.

The published essay as well as supplementary material will be made available on our website. This website will also serve as an archive of sorts, linking to existing haptic design libraries, toolkits and other resources.

8 CALL FOR PARTICIPATION

This workshop aims at bringing together hapticians working in academia, industry and beyond to discuss current challenges in the domain of haptic design. We recognize that, in our own research practice, we often tend to start projects from scratch, rather than building on top of the work of others. We believe that similar patterns can be found throughout the research field. Reflecting on factors which cause this figurative *re-inventing the wheel* and identifying strategies to mitigate these will help the field grow harmoniously. To this end, we will host an open discussion on the history and state of the field of haptic design, interleaved with invited keynotes to further stimulate discussion.

The workshop is open to anybody with experience in haptic design such as hardware design, building design tools, encoding haptic experiences, or user-centered design approaches for interactive and playful experiences. It will be held online with possibilities for conference attendees to join from the conference site.

** **Important Dates** **

Submission Deadline: February 24th, 2022
Notification: March 10th, 2022

** **Invited Speakers** **

Vincent Hayward – Sorbonne University
Eric Vezzoli – Go Touch VR
Vincent Levesque – École de technologie supérieure
Hasti Seifi – University of Copenhagen

If you are interested in participation, please submit a two to four page position paper using the *publication* version of the ACM Master Article Template[5]. Please use this form to upload your manuscript https://tinyurl.com/mv3enf5f.

Your position paper should clearly link to at least one of the areas suggested for breakout sessions – *(a) design tools, (b) language, mappings, and encodings, (c) devices and controllers, and (d) accessibility and communication of haptic experiences* – or should present another area you believe should be discussed.

The paper should briefly introduce yourself or your team, provide an overview of what you believe important works in your chosen area are and present your own work in this context. You might highlight where and how your own work was able to build on that of others, as well as where and why this was difficult to do.

These position papers will form the basis of the discussions during the breakout sessions. Ideally these discussions will lead to an opinion piece on the state and future of haptic design in HCI, which these position papers will also serve as a basis for. Finally, those authors who wish to do so will have their accepted position paper published on the workshop website. At least one participant from a group that submitted an abstract must attend the workshop.

For more information on the workshop and on submitting position papers, please visit: https://tactilevision.github.io/chi2022-sustainablehapticdesign/.

9 WEBSITE

Information about the workshop will be available online at https://tactilevision.github.io/chi2022-sustainablehapticdesign/ before, during, and after the workshop. Attendees will have the option to have their position papers published here, and reports on results from the workshop will also be made available through the website.

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