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# Cross-Surface: Challenges and Opportunities of Spatial and Proxemic Interaction

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**Abstract**

In this workshop, we will review and discuss open issues, technical challenges and conceptual models for multi-device spatial or proxemic interaction. We aim to bring together researchers, students and practitioners working on technical infrastructures, studies and designs of spatial interfaces, or domain specific multi-device applications that use space as a unit of analysis. We focus specifically on analysing how such interfaces, tools and tracking technology can be deployed “in the wild”. The workshop will facilitate knowledge exchange about the current state of spatial and proxemic interactive systems, identify application domains and enabling technologies for cross-surface interactions in the wild, and establish a research community to develop effective strategies for successful design of cross-device interactions.

**Keywords**

Cross-surface interaction, ubicomp ecologies, multi-surface interactions, multi-device interactions, spatial reconfigurations of displays, spatially distributed interfaces, multi-screen workplaces, wearable devices, proxemic interaction, configuration

**ACM Classification Keywords**

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

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*ISS '16*, November 06-09, 2016, Niagara Falls, ON, Canada  
ACM 978-1-4503-4248-3/16/11.

<http://dx.doi.org/10.1145/2992154.2996360>

## Introduction

People increasingly carry more interactive and interconnected devices that operate as a portal into their personal or shared information space. These devices are primarily general-purpose devices such as tablets, phones and laptops but recently we have also seen many new wearable devices, such as smartwatches or head-mounted displays, being introduced into people's device ecology. This expanding device ecology provides new opportunities for better collaboration, ad hoc information exchange, or data representations. However, this *device multiplicity* and the changing *context of use* lead to increasing more complex configuration problems associated with (i) discovering and pairing devices, (ii) tracking existing device ecologies, (iii) security and privacy in device ecologies, and (iv) creating stable distributed information and data representations that transcend the individual device.

Prior work has introduced a range of systems, techniques and tools aimed at facilitating cross-surface interaction. Examples include sensing of nearby devices [11, 15] device pairing [2,5, 7, 14, 15], information exchange [13, 15] and configuration of cross-device ecologies [6]. On common denominator in most of these approaches is the either implicit or explicit use of *space* and *spatial relations between devices and people* (Proxemics) as a way to create multi-device multi-user configurations [1]. Most of this technology has been successfully designed, deployed and evaluated in lab conditions, but a large number of open issues around its wider applicability to handle known multi-device problems [3,4] is unclear. We need a more in depth understanding of the role of space and proxemics as mediator in cross-surface interaction on a technologic, social and domain-specific level.

## Objectives

This workshop is the third instalment in a series of workshops around interacting with multi-device ecologies in the wild with previous editions at ITS 2015 [8] and CHI 2016 [9] ([cross-surface.com](http://cross-surface.com)). This workshop series is aimed to tackling fundamental issues and challenges in cross-surface interaction in the wild. This third Cross-Surface workshop aims to provide interaction designers, researchers, students and practitioners with an open, creative and structure forum to discuss the current state of the art in spatial and proxemic interaction and tackle open issues and challenges. The central goal of this workshop is to *map out a design space, interaction vocabulary and conceptual models for spatially-aware cross-surface systems*. The workshop will be structured around three main topics:

### **Conceptual Models For Spatial Interactions**

How can we conceptualize, describe and model multi-device interaction within a space? Which social, spatial or psychological theories and frameworks can be employ to help characterize spatial interactions? How do we translate such theories to interaction design, system research and multi-device representations?

### **Spatial Tracking "in the wild"**

Which tracking technologies and tools can be used to support "in the wild" spatial interfaces and designs? How can these technologies be deployed, democratized and shared with a broader audience?

### **Control and Intelligibility**

How do people make sense of spatially aware cross-surface ecologies? How can we support discoverability and learnability of interactions, inform users of action possibilities and provide feedback about cross-surface connections?

## Participants

We aim to bring together 10-20 participants from academia and industry that are working on cross-surface systems. Participants will be selected based on the position papers and their relevance to the scope and goal of the workshop. We will solicit position papers of up to 7 pages in the ACM SIGCHI EA format that describe original research and outline a person's interest and experience in the topic of the workshop. Selected papers will serve as introductions for discussions and will be made available to the participants on the workshop website. Submissions will be reviewed by the organizing committee based on originality and relevance.

## Workshop Format

As indicated in Table 1, we propose a one-day, 8-hour workshop focused on a combination of brainstorming, discussions and design activities in groups of 4 or 5 people.

Time	Activity
09:00	Madness session
09:30	Keynote by TBC
10:00	Brainstorm in 3 subgroups + design brief
10:30	Coffee break
11:00	Continue brainstorm Sketch/storyboard/prototype designs
13:00	Lunch
14:00	Present ideas + map out design space
16:00	Coffee break
16:30	Group reflections
17:30	Close

**Table 1.** Timeline of the workshop day

## Publication Venue

The results of the workshop will be communicated to the larger HCI community by submitting an article to a magazine (e.g., *ACM interactions*). In this article, we hope to define future design spaces for cross-surface interactions in Ubicomp ecologies based on the collage of topics discussed and challenges identified in the different breakout groups. We will also invite all workshop participants to submit an extended article of their submission for a special issue on “*Interacting across Surfaces: Multi-Device Ecologies in the Wild*” in the Personal and Ubiquitous Computing journal that will appear mid-2017. This information and call for papers will also be shared on the website and will be open to the community.

## Organizers and Program Committee

**Steven Houben** is a Research Associate at University College London. He works at the ICRI-Cities and UCL Interaction Centre on projects related to multi-device environments, physical computing and sensor-based systems.

**Jo Vermeulen** is a Postdoctoral Fellow in the InnoVis research group at the Interactions Lab of the University of Calgary. He is interested in addressing interaction challenges within ubicomp spaces, including providing intelligibility, discoverability, feedback and feedforward for proxemic interaction and cross-device interactions.

**Clemens Klokmoose** is an Associate Professor at the Computer Science department at Aarhus University and is associated with the center for Participatory Information Technology. His main interest is human-computer interaction that goes beyond personal computing.

**Johannes Schöning** is Professor of computer science at Hasselt University working at the Expertise centre for Digital Media (EDM). His main research interests lie at the intersection between human-computer interaction (HCI), geographic information science and ubiquitous interface technologies.

**Nicolai Marquardt** is a Lecturer at the University College London. At the UCL Interaction Centre he works on projects in the research areas of ubiquitous computing, interactive surfaces, toolkits, and physical user interfaces.

**Harald Reiterer** is Professor at the Computer and Information Science Department of the University of Konstanz. His main research interests include different fields of Human-Computer Interaction, like Interaction Design, Usability Engineering, and Information Visualization.

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