

# Immersive Analytics Spaces and Surfaces

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Figure 1: This workshop will focus on the use of immersive interactive spaces and surfaces to support sensemaking activities. We will explore, among others, the benefits and challenges of using the body as interactive surface [14], the embodied exploration of immersive data [15], or the spatial dimensions of interactive visualisations [19].

## ABSTRACT

Immersive Analytics has now fully emerged as a research topic in the Visualisation and Human-Computer Interaction research communities. While evidence of its benefits has been accumulating, we have still attained only a basic understanding of the extent to which they can support human sensemaking. This workshop aims to define a roadmap for new directions in leveraging the benefits of spatial interaction to support sensemaking. In particular the main goal of this workshop will be to focus on understanding the benefits and applications of immersive interactive spaces and surfaces (e.g. body, walls, smartphones or other interactive surfaces such as tabletops) for enhancing human sensemaking.

## CCS CONCEPTS

• **Human-centered computing** → **Visualization**; **Virtual reality**; **Mixed / augmented reality**.

## KEYWORDS

Immersive Analytics, Sensemaking, Spatial User Interfaces, Embodied Interaction

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## 1 INTRODUCTION

Immersive Analytics refers to the use of immersive interface technologies for data analysis applications. Immersive Analytics has now fully emerged as a research topic in the Visualisation and Human-Computer Interaction research communities. The research published in the past several years in Immersive Analytics has provided initial evidence that Virtual Reality (VR) and Augmented Reality (AR) have benefits for certain types of data exploration: for instance, the use of unlimited space around users [8, 10, 15, 18], spatial memory [12], 3D spatial interaction [11, 16, 19], collaboration [9], etc. While evidence of these benefits has been accumulating even prior to the establishment of Immersive Analytics, we have still attained only a basic understanding of the extent to which they can support human sensemaking, and reliance on such assumptions is prevalent in the exploration of applications.

It is now time to take the next steps to extend both the depth and breadth of Immersive Analytics. This includes diving deeper to answer questions around the underlying motivations about spatial interaction, as well as broadening the potential of Immersive Analytics towards new research areas and applications. These efforts will also help us clarify where Immersive Analytics stands and will provide convincing arguments to adopt immersive technologies

to tackle complex data analytics scenarios. This workshop aims to define a roadmap for new directions in leveraging the benefits of spatial interaction to support sensemaking.

## 2 WORKSHOP GOALS

This workshop builds on a previous series of workshops in Immersive Analytics beginning with a NII Shonan Seminar (2015), a Dagstuhl seminar (2016), and workshops at ACM ISS 2016 [3] and IEEE VIS 2017 [1], which focused on establishing Immersive Analytics as a new research field and building a research community. Three more recent workshops at ACM CHI 2019 [2], ACM CHI 2020 [5] and ACM CHI 2022 [7] were focused on further engaging members of the CHI research community in this new field, and establishing several Grand Challenges for Immersive Analytics that have emerged after several years of effort [6].

The main goal of this workshop will be to focus on understanding the benefits and applications of immersive interactive spaces and surfaces (e.g. body [14, 17], walls, smartphones [13] or other interactive surfaces such as tabletops) for enhancing human sensemaking. The goal is to create a research community who will collaborate toward this focus in the future to define, for instance, key research questions, new application areas, and novel evaluation methods.

## 3 RELEVANCE OF THE WORKSHOP FOR THE ISS COMMUNITY

Immersive Analytics makes use of wearable AR displays to visualise data within the world around us. The spatial dimension is therefore key in the definition of Immersive Analytics, and one of the five main topics underlined in the Grand Challenges for Immersive Analytics [6]. The main challenges related to the spatially situated aspect of the data visualisation include how to place visualisations accurately in space; how to model spatially situated interaction [4]; how to design guidelines for spatially situated visualisations; understanding the human senses and cognition in situated contexts; or applying spatial visualisation ethically. All these aspects are tightly related to the research on emerging interactive surface and spaces, and hence of interest for the ISS community. For instance, ISS 2021 included research papers on VR and visualisation, data physicalisation and gestures in immersive AR.

## 4 ORGANISERS

The workshop organisation team draws from leading expertise in the fields of Immersive Analytics, data visualisation, and user interface for VR and AR. These include organisers from previous Immersive Analytics workshops, a mix of senior, mid-career and early-career academics, who have expertise in the areas of spatial user interface design and immersive data visualisation. The organisers have substantial experience publishing and reviewing publications in these areas.

**Marcos Serrano** is an Associate Professor leading the ELIPSE group, at the IRIT Lab, University of Toulouse, France. His research is dedicated to designing novel interaction techniques in the field of mobile and ubiquitous computing, including augmented and mixed reality systems. Serrano was co-organizer of the Immersive Analytics workshops at CHI 2019 and CHI 2020.

**Kadek Ananta Satriadi** is a Postdoctoral Research Associate at the Australia Research Centre for Interactive and Virtual Environments, University of South Australia. His work focuses on immersive analytics and geovisualisation. He was co-organiser of the Immersive Analytics workshop at CHI 2022.

**Yalong Yang** is an Assistant Professor in the Department of Computer Science at Virginia Tech. He was a Postdoctoral Fellow of the Visual Computing Group at Harvard University, and a Ph.D. student at Monash University, Australia. In his research, he designs and evaluates interactive visualizations on both conventional 2D screens and in 3D immersive environments (VR/AR).

**Barrett Ens** is a Senior Lecturer at Monash University in Melbourne in the Data Visualisation and Immersive Analytics research group. Ens led Immersive Analytics workshops at CHI 2019, CHI 2020, and CHI 2022, as well as the follow up paper on Grand Challenges in Immersive Analytics [6], presented at CHI 2021. His research overlaps HCI with augmented reality, spatial information layouts, and data visualisation.

**Arnaud Prouzeau** is a Researcher in the French Institute for Research in Digital Science and Technology (Inria) in Bordeaux in the Potioc team which focus on multimodal interaction. Prouzeau was a co-organizer of the Immersive Analytics workshop at CHI 2022 and the Energy Data Visualisation workshops at the E-Energy conference in 2020 and 2021. His research focus on interaction with data visualisation in immersive environments.

**Stefanie Zollmann** is an Associate Professor for Computer Science at the University of Otago in New Zealand. She is leading the Visual Computing Otago research group. Her main research is in the field of Visual Computing, which describes the combination of traditional Computer Graphics, Computer Vision, Machine Learning, Visualization and Human-Computer-Interaction. Her research focus is on eXtended Reality (XR) for sports and media, visualization techniques for Augmented Reality and novel methods for capturing content for immersive experiences.

## 5 WORKSHOP STRUCTURE

The workshop will make use of both asynchronous and synchronous sessions with virtual and in-person sessions to provide a number of opportunities for participants to contribute. The format of this workshop will adapt to an in-person/virtual hybrid style.

### 5.1 Online Engagement

The main workshop will focus on interleaved *world café* sessions and lightning talks, including both in-person and virtual attendees. Remotely located participants will be invited to join in either the morning or afternoon sessions. To limit 'Zoom fatigue' and to accommodate people from different time zones, remote participants will only be required to join one of these two session. Ample breaks will be scheduled between sessions and during long discussion sessions.

### 5.2 Main Workshop Activities

**Introductions and Overview** — In the morning session, organisers will kick off by introducing themselves and the motivation for the workshop. They will provide an overview of the activities, and the plans for managing hybrid participation. Then participants will

take turns giving a brief overview of their work and interest on the workshop topics.

**Morning Session: Theme Organisation and Discussion** – Following the introductions, participants will work *en masse* to categorise the examples given during the workshop. The categories produced will be added to the initial set of themes developed in advance of the workshop. These categories will be grouped into a set of topics to be included in the first round of discussions. These discussions will focus on identifying the key principles, theories, and evidence that support the proposed benefits of spatial and embodied interaction in each case, as well as identify gaps in existing research.

These discussions will follow a *world café* format, in which each topic is designated its own ‘table’ (in-person, online, or hybrid). Every 30 minutes, participants will rotate between different tables to engage in short, focused discussions on topics of their choice. Each table will have a designated host (primarily workshop organisers) who will take notes and guides the discussion flow from one each to the next. The morning session will conclude with a series of lighting presentations by table hosts to summarise each of the discussions.

**Networking Lunch** – An off-site networking lunch break will provide participants with an opportunity to learn more about one another and engage in focused discussions on topics of interest. Online participants will be invited to an optional, shorter online social discussion during the break.

**Afternoon Session: Theme Refinement and Discussion** – The second session will mirror the first, accommodating the inclusion of newly-joined remote participants whose time zones are not accommodated the morning session. As in the first round, new participants will give a lightning talk to introduce themselves and present their prepared examples. Following the introductions, a second *en masse* session will revisit the topics from the first session to reorganise these as needed, taking into account results of the first session and any additional themes introduced by new online participants.

A second round of *world café* discussions will ensue, however with a new focus on sketching out a research agenda for each topic, including key opportunities, immediate steps, long-term aims, and potential barriers. Discussions will conclude with a final set of lightning presentations, summarising the outcomes.

**Closing Session** The final workshop session will focus on summarising the workshop events and defining next steps. First, organisers will provide a recap of events, including topic definitions during pre-workshop activities, and a summary of the outcomes of the morning and afternoon sessions. A final group discussion will be held around action items for further developing and implementing the roadmap initiated during the sessions. This discussion will include options for follow up publications, and future workshops or other events to continue building the community, including a draft proposal for a Dagstuhl or Shonan workshop.

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