

HCAI4IDS: Human-Centered AI Support for Immersive Data Sensemaking

Veronica Sundstedt
veronica.sundstedt@bth.se
Blekinge Institute of Technology
Karlskrona, Sweden

Chaoming Wang
chaoming.wang@bth.se
Blekinge Institute of Technology
Karlskrona, Sweden

Ilir Jusufi
ilir.jusufi@bth.se
Blekinge Institute of Technology
Karlskrona, Sweden

Christoffer Johansson
christoffer@healthygaming.info
HealthyGaming, Stockholm, Sweden

Ka I Ip
kaip@umn.edu
University of Minnesota
Minneapolis, Minnesota, United States

Abstract

The “Human-Centered AI Support for Immersive Data Sensemaking (HCAI4IDS)” workshop aims to bring together researchers and industry from areas in human-computer interaction (HCI), artificial intelligence (AI), visualization, and cognitive science to explore current and future challenges and opportunities in the development of these systems. The workshop consists of three main parts: (1) extended abstract presentations by participants, (2) collaborative theme-based group work, and (3) discussions and synthesis of a research agenda and a joint article following the workshop. The XR+AI combination has been the focus of several recent workshops and research initiatives. Our workshop aims to explore the topic from a human-centered perspective. A key outcome of the workshop is also to build a network for the area and foster future collaborations.

CCS Concepts

• **Human-centered computing** → **Human computer interaction (HCI)**; *Collaborative and social computing*; • **Hardware** → **Emerging technologies**; • **Computing methodologies** → **Artificial intelligence**.

Keywords

Human-Centered AI, Immersive Analytics, XR Data Visualization, Human Factors, Immersive Sensemaking, Embodied Interaction

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1 Introduction

Immersive analytics (IA) [8] uses extended realities (XR) and embodied interactions to present data visualizations to users, enabling them to explore complex data interactively, derive insights, and make decisions. From this perspective, IA is inherently human-centered, as its goal is not only to present data information but to support human sensemaking. Recent developments in artificial intelligence (AI) have brought greater autonomy in data visualization and analysis. Integrating AI into chart reasoning [26], data narrative generation [19, 25], and suggesting analytical steps or insights in visual analytics (VA) workflows are key emerging subtopics. Related communities have shifted such integrations in IA scenarios to maximize the benefits of AI+XR for data visualization. These integrations are beneficial, but they also challenge the central role of users in IA, as immersive data sensemaking (IDS) is shaped by spatial navigation, visual attention, embodied interaction, and collaboration. Therefore, we focus on human-centered AI (HCAI) support for IDS, where maintaining user control over interpretation and decision-making is the central requirement. The workshop aims to bring together researchers and practitioners together from human-computer interaction (HCI), AI, visualization, and cognitive science to explore three main objectives: (1) establishing a common understanding of “when” and “how” questions in HCAI4IDS (2) exploring novel interaction design approaches in the area, and (3) discuss opportunities and challenges with increased automation and what it means to users. Existing research and workshops cluster into five major related directions: AI for XR, AI for visualization, agentic AI for analysis, general human-AI collaboration, and human factors in IA. Since 2023, one early workshop at the Symposium on User Interface Software and Technology (UIST) has focused on XR and AI [21]. In 2025, Suzuki et al. [22] organized a CHI workshop on the future of AI-in-the-loop everyday AR experiences. A recent IEEE VR workshop, GenAI-XR [4], examined how generative AI and XR can be combined to create immersive, personalized experiences across domains. SHAPEXR 2026, to be held at ACM Intelligent User Interfaces (IUI) in July 2026, focuses on embodied, gesture-enhanced communication [6]. The SHIFT workshop at IEEE MetroXRINE 2026 will focus on shaping human-centered interaction for future technologies, with synergies between XR, AI-driven personalization, and adaptive systems, as well as non-AI-based approaches for inclusivity. Hirzle et al. [13] presented a scoping review on the

combination of XR and AI, and XR devices that support chatbots using large language models (LLMs) have been explored [5]. Li et al. [15] developed XR Blocks, a cross-platform framework to accelerate human-centered AI+XR innovation. XR and AI have also been explored in visualization [11, 14] and IA [10, 17, 23, 24]. The VisMeetsAI [12] workshop has also been running since 2020. Another workshop has focused on human factors in IA [16]. A recently proposed Dagstuhl seminar, to be held in Nov-Dec 2026, will focus on IA and AI.

1.1 Workshop Motivations

The directions above highlight timely and clear opportunities, but also raise potential concerns about users taking a step back in AI-supported IA systems, which is underdiscussed. One example is an AI that takes over the IDS process through agentic visualization reasoning. Here, users may receive useful outputs but lose part of the analytical engagement, making sensemaking meaningful. Therefore, HCAI4IDS should not solely provide faster answers or automated insights. It also needs to help users identify relevant patterns, improve the questions to ask, compare alternatives, and decide when assistance is needed. Design issues, such as personalized IA systems targeting different user groups, user agency, trust, cognitive load, over-reliance, collaboration, and evaluation, also require further discussion. Therefore, this workshop aims to initiate a discussion of these issues to help answer *when* and *how* HCAI could support IDS. Taken together, the objectives of the workshop are to provide a focused venue for researchers and practitioners to map current challenges, compare design approaches, and develop an initial research agenda for HCAI4IDS. In Table 1, we distinguish our focus in relation to the other five emerging directions.

2 Planned Activities and Preliminary Schedule

We plan a half-day (3.5 h), including a 30-min coffee break. The workshop begins with an HCAI4IDS introduction, followed by presentations of accepted extended abstracts, each accompanied by a Q&A session. A theme-based group-work session will be held to discuss relevant themes, opportunities, and challenges. To document group work feedback, an online platform (e.g., Miro) will be used. The outcomes will contribute to a research agenda, and the participants will be invited to work on a joint publication following the workshop. The workshop is influenced by the conference theme: Pulse - exploring the energy that drives us, by focusing on the rhythm of who leads when humans and AI co-analyze data in XR, how shifts are initiated, how trust is negotiated turn by turn, and how flow breaks and recovers. The workshop takes place on the 3rd or 4th of October 2026. The preliminary schedule is shown below:

- 09:00 - Workshop Introduction:** Opening and introduction to the workshop theme, goals, and agenda.
- 09:15 - Presentations:** Participants with accepted extended abstracts present their work.
- 10:00 - Coffee Break:** Break with networking, in which potential demos are showcased.
- 10:30 - Theme-Based Group Work:** Discussion in smaller groups (2-3 people).

11:30 - Group Work Outcomes: Shared discussion and group feedback around the themes.

12:00 - Future Work: Wrap-up with workshop synthesis and future roadmap.

12:30 - Lunch: Networking continues over lunch.

3 Workshop Outcomes

The workshop outcomes, including extended abstracts, presentation slides, and photographs, will be made available on the workshop website. In addition, we aim to synthesize the theme-based group work into an extended article focusing on the workshop outcomes, to be published in a venue to be determined after the workshop. Another key objective is to foster new Nordic and international networks and opportunities for future collaborations, including new research project initiatives and joint publications.

4 Call for Participation

We welcome submissions from research students, academia, and industry. The call welcomes a wide range of related topics to encourage exploration of the diverse aspects of HCAI4IDS. The areas below serve as a starting point with contribution types including applications, theoretical discussions, prototypes, and system designs.

- **Design perspectives of HCAI4IDS:** How do we design to support joint IDS for single/multiple users and AI agents in shared immersive spaces?
- **Theoretical HCAI guidelines in IDS:** How can we support novel design guidelines for varying levels of AI integration?
- **Multimodal human-AI understanding:** How can multimodal techniques (speech, gesture, gaze, etc.) be used to understand users' emotions and intent in IDS?
- **Adaptive AI collaborators:** How can AI systems be adapted and personalized to support different stakeholders, user groups, and user experiences?
- **Initiative and agency:** When should AI lead, follow, or step back in IDS, and how should control shift between users and systems?
- **Trust calibration:** How can immersive systems support calibrated rather than amplified trust, helping users align reliance with actual AI reliability?
- **New HCAI4IDS applications:** What novel scenarios can HCAI-integrated IDS contribute to?
- **Evaluation approaches:** Should we rethink how to evaluate HCAI-supported IDS systems?

5 Promotional Strategy

The call for papers will be distributed via relevant email lists, social media, special interest groups, and the workshop website. Participants interested in joining are encouraged to submit an extended abstract (2-4 pages, excluding references) in the ACM standard single-column format. A demo accompanying the submission is encouraged if available. The accepted abstracts will be made available on the workshop website. The abstracts need not be anonymized but must include all authors. The submissions will be received by the organizing committee and assigned to external reviewers. Speakers will be selected based on topic relevance.

Table 1: Positioning of the proposed workshop in relation to other emerging directions, with recent example workshops and research. ✓ indicates a primary focus, while △ indicates a secondary or related focus, and – indicates a non-explicit focus.

Direction	XR experience enhancement	VA automation	Agent/Assistant interfaces	Human factors in IA	IDS	Embedded AI support	Examples
AI for XR	✓	–	△	△	–	△	[4, 6, 21]
AI for Visualization	–	✓	△	△	△	△	[3, 12, 14, 26]
Agentic AI for Analysis	–	✓	✓	△	△	△	[1, 9]
General Human–AI Collabora- tion	–	△	△	✓	–	△	[2, 7, 18]
Human Factors in IA	△	–	–	✓	✓	–	[16]
Proposed workshop	△	△	△	✓	✓	✓	

6 On-Site Requirements

The workshop needs a screen and a projector for the presentations. Due to the opportunity of bringing an XR demo, an empty corner of approximately 3m x 3m will be used. The flexible seating arrangement, with four to five tables and chairs, will facilitate theme-based group work. The room also needs to be equipped with an Internet connection, a monitor for potential demos, power outlets, and group-work materials, such as larger sketch blocks.

7 Organizers

Veronica Sundstedt is a Prof. in Computer Science at BTH. Her research focuses on human-centered visual and interactive computing, contributing to interdisciplinary research at the intersection of computer graphics, visualization, HCI, and AI. She is leading the HINTS research project [20] and has expertise in human factors/user studies relevant to advancing human-centered approaches in intelligent immersive environments. She has organized courses at SIGGRAPH/SIGGRAPH ASIA and workshops at SIGCHI/CHI PLAY.

Chaoming Wang is a Ph.D. Student in Computer Science at BTH. Her work focuses on IA, XR, and the integration of AI into interactive data analysis systems. She has contributed research on AI-supported IA, including publications exploring how generative AI can enhance data exploration and visualization in virtual and augmented environments. Her work closely aligns with the workshop theme of HCAI support for IDS.

Ilir Jusufi is a Docent (Assoc. Prof.) at the Department of Computer Science, BTH. His research lies at the intersection of Information Visualization, VA, and HCI, with recent work on trust calibration in visualization and on XR and AI for upper-limb rehabilitation. He has co-supervised PhD work on VA for explainable and trustworthy machine learning. His expertise in human-AI trust and VA of multivariate data directly supports the workshop’s focus on HCAI for IDS.

Christoffer Johansson is a former world-champion gamer, advisory board member, entrepreneur in healthcare and education, and CEO of HealthyGaming (partner of EEF/AESF, governing Europe/Asia Esports). He runs a globally renowned development, education, and well-being program. He led talks/workshops for governing bodies, with 25+ country representatives simultaneously. He provides unique perspectives on SLM/LLMs and AI in innovative, human-centered psychological and mental health industries.

Ka I Ip is an Ass. Prof. with the Institute of Child Development at the University of Minnesota - Twin Cities and HealthyGaming’s Chief Scientific Officer. He brings diverse expertise and an integrated industry-academia perspective, with a focus on emotion regulation, cognitive development, developmental neuroscience, and stress, providing unique perspectives on how data sensemaking varies across individuals. He has hosted psychology talks/workshops across the United States, Europe, and Asia, researches AI Dependency, and directs the D.A.N.C.E. (Developmental Affective Neuroscience, Culture, and Environment) Lab.

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