

Advancing Human-Computer Interaction for Space Exploration

SpaceCHI 2025, June 23–24, 2025,
European Astronaut Centre (EAC), Cologne, Germany

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Preface

This volume contains the proceedings of the 4th SpaceCHI Conference on Advancing Human-Computer Interaction in Space Exploration, which was held at the European Astronaut Centre in Cologne, Germany on June 23–24, 2025.

SpaceCHI aims to bring together researchers and practitioners who draw on tools and methodologies from the field of Human-Computer Interaction (HCI), extending their use to the rapidly evolving domain of space exploration.

To understand the significance of HCI's potential in this new frontier, it is useful to reflect on its past impact. Following their emergence in the 1940s, electronic computers were typically confined to a handful of military facilities and government research centers, accessible to only narrow groups of users. It was not until the 1970s that computers began entering the mainstream consumer market, with the Altair 8800 personal computer released in 1975, and models from Apple, Commodore and IBM following soon after. HCI played an instrumental role in this transition, pioneering new interaction paradigms and embracing user-centered design principles, which ultimately enabled computers to permeate nearly every profession and aspect of modern society.

Space exploration is now undergoing a similar democratization. High costs and limited economic utility of space travel have historically made it a domain monopolized by a small number of governments. Today, innovations such as reusable rocketry are lowering barriers to entry, opening new markets, and fueling a global surge of private companies developing space-based technologies and services. Space exploration is, if you will, experiencing its own *Altair 8800 moment*. With a focus on designing and adapting technologies for diverse user needs, HCI is, once again, uniquely positioned to help lead this transformation.

The convergence of HCI and space exploration holds potential that extends far beyond shaping how humans interact with technologies in orbit. Space, with its distinct resource constraints, has consistently inspired ingenious design solutions that later reshaped our everyday life on Earth, giving rise to technologies such as digital photography, LED lighting, and renewable energy systems that now drive the green tech revolution.

SpaceCHI seeks to catalyze this potential by providing researchers from HCI-related disciplines a platform to share their work, explore future directions, and maximize the value of space technology for the many, not the few. Beyond advancing the exploration of distant worlds, its ultimate vision is thus to shape space innovations that create lasting benefits for life on our home planet, contributing to a better future for society as a whole.

While the first three editions of SpaceCHI were held as workshops at the MIT Media Lab in the USA, the 2025 edition marked a significant milestone, establishing SpaceCHI as a full conference and expanding its global presence by relocating to Europe. The move proved successful, with the conference growing over threefold from its previous iteration, attracting 70 attendees from diverse academic and industry backgrounds representing 19 nationalities. A total of 34 full papers were accepted, covering a broad spectrum of topics with significant real-world applicability, from additive manufacturing to AI-driven support systems.

This would, of course, not have been possible without the support and dedication of numerous individuals. We extend our gratitude to the MIT Media Lab team, particularly Joe Paradiso, Dava Newman, and Cody Paige, for endorsing our vision of hosting SpaceCHI 2025 in Europe. We are equally grateful to the European Space Agency for providing the opportunity to host the conference at the European Astronaut Centre, offering the perfect backdrop for the event. Special thanks go to Matthias Maurer, Frank De Winne, Andreas

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Mogensen, Aidan Cowley, and Lionel Ferra for their steadfast support, even amidst the challenges of German bureaucracy. We are also deeply indebted to our external reviewers, whose expertise ensured a high-quality conference program, and to our numerous colleagues in the HCI research community for their encouragement, guidance, and support throughout this journey. Finally, we would like to express our gratitude to all the authors who submitted their work to the conference – thank you for helping to lay the foundation for a community bold enough to imagine, design, and shape humanity’s future among the stars.

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