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IAF SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems (1)

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FUTURE SPACE SYSTEMS AND THE ROLE OF HUMAN-CENTRED DESIGN IN DECISION-MAKING AND TRUST

Abstract

As future space missions increase in remoteness and the astronauts' profile broadens, the development of future space systems will require novel transdisciplinary approaches. Emerging technology innovations, such as machine agents and robotic capabilities, will enable the shift towards multi-agent Cyber-Physical-Human (CPH) teams collaborating to achieve mission objectives, opening a pathway to crew autonomy and transition to earth-independent decision-making. The scope of this transformation towards an astronaut-machine teaming will need to be envisioned from multiple perspectives in order to optimize the effectiveness in pursuing mission goals. To maximize the synergetic effects of this human-machine crew collaboration, a new CPH-teams-oriented system architecture is required. Increased emphasis on building-in trust and trustworthiness is essential in planning human-machine interactions within the system. Involving a wider range of stakeholders and implementing human-centered design methodology from the early stages of the system design could play a crucial role in system safety and minimize mission risks and costs. This paper discusses three layers of trust and trustworthiness within future space systems, considering both pre-mission system configuration for the mission context and the specification of during-mission physical-digital-interaction components. We consider backstage data flow, real-time data architecture, as well as the a-posteriori analysis. Three-dimensional trust relationships between human¿agent, agent¿human, and agent¿database are presented. We outline the opportunities within including diverse a priori data source integration, key considerations for crucial system component identification for pre-mission system configuration, novel approaches to mission risk visualization to system participants, and new approaches to human-centered requirement specification.

Keywords: future space systems, design for safety, future human spaceflight, astronaut-machine teams, trust, human-centered design