Proposal for a Special Session at IEEE RO-MAN 2024

Human Robot Interaction for Space Robotics

Aim and Scope of the Special Session

A special session focused on space robotics, particularly featuring the three free-flying robots on the International Space Station (ISS), is novel, relevant, and has the potential to significantly contribute to the IEEE RO-MAN community for several reasons:

1. **Unique Environment and Challenges:**
    - Space robots, exemplified by free-flying robots such as NASA's Astrobee, JAXA's IntBall or ESA's CIMON aboard the ISS, operate in an environment vastly different from traditional terrestrial settings. The challenges of microgravity, close quarters, limited communication bandwidth, and the need for autonomous decision-making create unique considerations in human-robot interaction.
    - Understanding how ISS free-flyer robots adapt to and overcome these challenges provides valuable insights applicable to other extreme environments on Earth and space.
2. **Human-Robot Collaboration in Confined Isolation:**
    - Space missions often involve long durations of isolation for astronauts. Robots like NASA's Astrobee or Japanese company GITAI's robotic systems which are designed to assist and collaborate with crew members, provide a means to study the dynamics of human-robot collaboration in isolated and confined spaces, which will become even more critical for human exploration of Mars.
    - Insights from these interactions can inform the design of robots for use in isolated environments on Earth, such as research stations, submarines, or disaster-stricken areas.
3. **Interdisciplinary Research Opportunities:**
    - Space robotics inherently involves a multidisciplinary approach, including robotics, artificial intelligence, human factors, and space exploration technology. A special session on ISS free-flyers can foster collaboration and knowledge exchange among researchers from diverse backgrounds, contributing to the interdisciplinary nature of the RO-MAN community.
4. **Technological Innovation and Autonomy:**
    - ISS free-flyers utilize advanced technologies for autonomous navigation, task execution, and human-robot interaction in space. Presenting research on these technological advancements can inspire discussions on how similar innovations can be applied in terrestrial robotics.
    - Autonomy in space robotics has direct implications for applications on Earth, such as autonomous vehicles, smart infrastructure, and assistive technologies.
5. **Human Factors in Extreme Environments:**
    - The interaction with astronauts by ISS free-flyers involves consideration of human factors, including communication, trust, and collaboration. Studying these factors in space can

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offer insights into designing more effective and user-friendly robotic systems for various applications on Earth, especially in challenging environments.

6. **Space Exploration and Future Missions:**
    - As space agencies plan for future lunar missions, Mars exploration, and beyond, insights from space robotics become increasingly relevant. A special session on ISS free-flying robots can contribute to discussions on the role of robotics in upcoming space exploration endeavors and the evolving relationship between humans and robots in these missions.

Organizers

Andres Mora Vargas, Ph.D.
Astrobee Facilities Engineering Lead, NASA Ames Research Center, USA
E-mail: andres.moravargas@nasa.gov
Phone: +1-480-823-5555
Short Bio: Dr. Andres Mora Vargas is the Astrobee Facilities Engineering Lead Ames Research Center, NASA at Moffett Field, California. Dr. Mora Vargas builds maps of the International Space Station (ISS) to enable the autonomous navigation of the Astrobee free-flying robots inside various modules of the ISS and has developed software tools that evaluate the coverage quality of these maps. He has also worked on Astrobee's software development, hardware verification and is the point of contact for multiple Astrobee Guest Scientists such as JAXA and MIT. He also led the design, development, and deployment of the Gravity Offset System (GOS) to support the experimental evaluation of NASA Jet Propulsion Laboratory's MARS 2020 Helicopter, Ingenuity. Dr. Mora Vargas received his Ph.D. in Aerospace Engineering at Tohoku University in Sendai, Japan. Dr. Mora Vargas has worked in elite research centers such as Japan's Advanced Telecommunications Research Institute International, NASA's Johnson Space Center, Jet Propulsion Laboratory, and Ames Research Center. He holds a US patent, authored and co-authored book chapters, journals and conference papers, has served as reviewer for several publications and is an IEEE Senior Member.

Brian Coltin, Ph.D.
Department of Intelligent Systems, NASA Ames Research Center, USA
E-mail: brian.coltin@nasa.gov
Phone: +1-650-604-4226
Short Bio: Dr. Brian Coltin is the Astrobee Software Lead at NASA Ames Research Center, Moffett Field, California, where he has led the development of Astrobee's software to operate semi-autonomously on the ISS, including localization, navigation, and more. Dr. Brian Coltin received his Ph.D. in Robots from Carnegie Mellon University in Pittsburgh, PA. He has authored numerous conference papers and journal articles.

Tentative Speakers

1. Emily B. J. Coffey, Department of Psychology, Concordia University, Canada.
2. Kyouichi Arakane, JAXA, Japan.
3. Timm Roegler, Program Topic Coordinator Space Exploration and Robotics, DLR, Germany
4. Prof. Danielle Woods, MIT, USA.
5. Prof. Sayanti Roy, Purdue University Northwest, USA.