THE UNIVERSITY OF ARIZONA
College of Engineering

Aerospace and Mechanical Engineering Seminar

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A Robotic Space Station for the 2020s

Abstract: What is a space station? It is a destination where multiple space vehicles arrive and depart, delivering or retrieving cargo or humans. While it is a satellite (or at least all space stations have been to this point in history), it differs from most satellites in being highly adaptable, having a configuration and payload that are not static. A space station is a multi-mission, multi-purpose entity, providing electrical power, orbit maintenance, attitude control, and protection from the space environment, communications, and other services to its users. To date, those services have included human life support.

Historical examples of space stations (Skylab, Mir, the International Space Station, and Tiangong-1) have supported functions such as scientific research, physiological experiments, instrument support, and nanosatellite deployment. The need to support human life and safety has dominated their system requirements, operational constraints, and costs. Here we consider the question: can a space station be useful if it has no provisions for human presence? We conclude that an unmanned, robotically-enabled space station would have tremendous utility. It could enable the development of new capabilities for scientific and engineering applications, facilitate the hosting of experiments and instruments, prove out technologies that will be required later for human planetary exploration, and support revenue-producing applications for private sector participants.

On Earth, the use of industrial robots is growing exponentially. The first robotic servicers for low Earth and geostationary orbits are expected to launch in the next two to three years. Leveraging these technologies, a robotic station in low Earth orbit could fulfill a variety of missions. Robotic technologies needed to prepare the way for in-space telescope assembly and human exploration could be matured there. Like ISS, a robotic station could support nanosatellite deployment, acting as one node of a multi-orbit logistics infrastructure. It could also host materials research and Earth-staring scientific sensors. And since ISS is approaching the end of its life, a robotic space station could provide continuity for the many valuable services and experiments that ISS currently supports in LEO, other than a pressurized volume and human life support. Removing human support requirements will provide cost savings.

This talk will explore the range of missions that could be supported by a robotic space station, but will focus on one mission: hosting external payloads as currently performed on ISS. Based on a generic design, a high-level cost estimate is developed. Then, a business case model that results in a “win-win” for the operator and clients is suggested, and some considerations for operations will be presented.

Bio: Dr. Gordon Roesler is a nationally recognized authority in the application of robotics technologies to space missions. At the Defense Advanced Research Projects Agency, he created and led the Robotic Servicing of Geosynchronous Satellites (RSGS) program, which will result in the first operational multi-mission robotic servicer when it launches in 2022. During his previous term at DARPA, 2002-2006, he originated the Spacecraft for the Universal Modification of Orbits (SUMO) and Front-End Robotics

Enabling Near-term Demonstration (FREND) programs. Gordon has authored articles in The Space Review, the European Space Journal, Aviation Week and Space Technology, and Aerospace America. He is a co-author of the multi-organization Commercial Lunar Propellant Architecture study and NASA's In-Space Assembled Telescope study. He provides advisory services in space infrastructure and business concepts to industry, government and academia, and is a consultant to the Defense Innovation Unit. Gordon received the Ph.D. in Physics from MIT in 1992 and is a 1975 graduate of the U.S. Naval Academy.

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Zoom link email: eperumala@arizona.edu