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In-situ manufacturing in route to space exploration

The surge of interest in space exploration to reach various planets in our galaxy would create opportunities for mankind to develop products and processes for low orbit and deep space long duration travels. In such cases, product malfunction in missions such as those to Mars may jeopardize the safety of the astronauts and termination of such missions. In this talk, a novel approach to develop *in-situ* manufacturing is developed in creating a workshop in orbit as a mobile repair and production center. The same workshop could be placed on the surface of a planet in preparation of establishing colonies of habitations. The approach taken in this study would require development of Modular Manufacturing Systems (MMS), where manufacturing process takes place in one and the astronaut as the supervisor will operate in the other in developing a solution for cost-effective placement of modular units in orbit for *in-situ* manufacturing. The self-contained modular units can be configured to meet payload transportation requirements, and to accommodate a wide range of space-based manufacturing needs. The MMS is designed to provide a safe *in-situ* environment for manufacturing and operational capabilities while meeting the challenges of outer space including radiation, temperature, and pressure contingencies. With current interest in long-term exploration of space including the creation of habitats on the Moon and Mars, MMS is designed to make all aspects of this endeavor possible cost effectively and safely. The MMS is constructed in the form of a cylindrical vessel that can be configured to contain one of many different sliding floor-mounted equipment assemblies. A functional manufacturing system consists of at least two such modules, one housing the astronauts with a sliding floor configured to provide the basic requirement of an astronaut such as life support system and environmental controls (temperature, pressure) as well as communications and control systems, and the adjoining modular to house a sliding floor containing the robotic machine fabrication equipment, raw materials and tooling. These two separate modules are connected such that the astronauts can safely supervise and control the manufacturing operation via visual through a viewing port as well as the cameras at various stages. This will allow astronauts to prepare set up, monitor and initiate automatic machining and fabrication of parts using tracked-robotic equipment. Since space-based manufacturing is a very new endeavor, astronaut safety must be a primary concern. The design of the MMS provides critical safety separation, override and supervision features. A modular manufacturing system could be configured to a variety of applications such as habitats for space travelers or a work/live environment for scientific/manufacturing space in providing a safe and sustainable habitat for deep space long duration missions.

Biography

Fred Barez is a Professor of Mechanical Engineering at San Jose State University (SJSU). His research involves smart vehicles, advanced transportation, machine learning, cyber security, smart home and energy efficiency. He is also involved in space exploration and developing self-contained habitation modules for use in orbit or on planets. He is also Director of the Hybrid and Electric Vehicle Technology Laboratory where he is engaged in research related to advanced transportation including electric drive propulsion system, collision avoidance sensors and application, smart and driverless vehicles, vehicle mobile connectivity, vehicle cyber security, virtual driving, distracted driving, and autonomous vehicles through collaboration with industry. He teaches dynamic systems vibration and control, electronics packaging and design, hybrid and electric vehicle fundamentals, he has authored over 60 journal and conference publications, four book manuscripts and two book chapters. He has supervised 180 graduate student projects and theses. He is an active reviewer for several national and international publications related to energy, battery storage, energy efficiency and management, and smart sensors and devices. Prior to joining San Jose State University, he worked in Disk Drive Storage industry and was Co-Founder and Founder of two successful start-ups. He is a Member and Fellow of the American Society of Mechanical Engineers (ASME), a Member of the Society of Automotive Engineers (SAE), and Institute of Electrical and Electronics Engineers.

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