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HUMAN SPACE ENDEAVOURS SYMPOSIUM (B3)
How Can We Best Apply Our Experience to Future Human Missions? (2)

Author: Mr. Anthony R. Gross
National Aeronautics and Space Administration (NASA), United States

MAN-MACHINE INTEGRATION FOR FUTURE SPACE EXPLORATION MISSIONS – A PERSPECTIVE

Abstract

From the earliest days of space exploration both humans and machine systems have been necessary to the implementation and achievement of mission goals and objectives. From Apollo to present day planning for missions to the moon, near-Earth asteroids, and Mars, there has been a continual evolution in the roles of humans and intelligent machines, as well as the allocation and division of tasks associated with those missions. Current planning for human missions to Mars, for example, involve long stays on the planet, multiple extended sojourns from a base station, and complex exploration procedures. At the same time, both our understanding of the details of human performance capabilities and the development of machine system capabilities in the environments of planetary and space exploration has greatly increased. This has necessitated a continual review of prospective mission architectures such that they best accommodate these new developments and facilitate the achievement of optimal mission designs. As a result, even greater emphasis must be placed on the development of effective human-machine interfaces, task allocations, and interactions, both to maximize overall system performance and to reduce the risk of mission failure through human or system errors. The principal objective of these integrated human-machine systems is to effectively leverage and support human intelligence and flexibility with the power and capabilities of increasingly sophisticated machine systems. This perspective promises a new balance of work between humans and machines, along with new task allocation strategies, that will result in far more capable and safer missions.

This paper will provide a perspective on human-machine integration for future missions of exploration by first discussing current and planned future intelligent machine system capabilities, as well as an outline of our current level of understanding of human capabilities and performance as they apply to such missions. Key issues of human behavior, capabilities, and performance, critical to space exploration, will also be considered. Next will be a discussion of some of the major opportunities and challenges for effectively-integrated human-machine systems both to maximize their discovery potential and to minimize their associated risks. Finally, the research and technology development activities currently being implemented, or planned, by NASA in the several areas appropriate to these missions will be presented. These include elements of the Human Research Program (HRP), advanced automation and robotic research and technology development, and research specifically focused on human-machine integration issues.