Paper ID: 10147
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SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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ROBOTIC SPACE SUITS: A TECHNOLOGY TO ENABLE LEGGED ROBOTS DEVELOPED FOR EARTH'S ENVIRONMENT TO BE USED FOR EXPLORATION PURPOSES

Abstract

One of the main design drivers in space engineering is the adaptation to specific environmental demands. High radiation exposure, the vacuum of space respectively low-density atmospheres as well as the thermal environment prohibit technologies developed on Earth to be directly used in space. This paper will introduce a concept to change this and allow the utilization of unmodified technologies: a robotic space suit. Much like they enabled the Apollo astronauts to walk on the Moon, space suits shall be adopted to provide an Earth-like environment for an enclosed robotic system. As proof-of-concept, a six-legged robotic system, in development at the FZI Karlsruhe, was chosen as baseline: LAURON, an autonomous robot intended for search and rescue missions in the wake of natural disasters as well as for research on volcanoes. While not being used for current planetary exploration, advanced mission profiles will require resorting to leg-based robots in the near future. In contrast to their wheel-based counterparts, legged robots have a higher adaptability to uneven terrain, can overcome obstacles and have redundant hardware components. This makes them particularly suitable for the exploration of lunar/planetary craters and gorges. The paper will analyze how LAURON would have to be altered in the classic sense (e.g. using space-qualified motors and materials) to weigh it against a space suit augmented but otherwise unaltered configuration. Besides 'mass', the comparative values also include 'cost' and 'complexity', emphasizing how the use of a robotic space suit affects these important design criteria. By externalizing the environmental protection, the two elements (in- and exterior) can be handled separately, thereby avoiding a solitary, more complex solution. In case of legged robots, for which the level of complexity is already high on Earth, the intricacy of an all-inclusive solution can be seen as one answer to why such a system has not been used in space so far.