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EXOFORCE-1: A ROBOTIC EXOSKELETON SPACESUIT FOR MARTIAN EXPLORATION

Abstract

Humankind is on the verge of establishing a firm foothold on the red planet in the near future through colonization. However, colonization requires several industrious activities to be performed, the majority of which cannot be undertaken solely by humans or automated machinery separately. 'ExoForce-1' is a proposed robotic exoskeleton / space suit that will assist the future colonizers of Mars in setting up a base. This research paper focuses on the conceptual design and initial sizing of ExoForce-1, to create a man-machine amalgamation which would help perform heavy duty activities seamlessly. To set up a colony on Mars, various equipment are required, ranging from vital utilities including oxygen, power and water recycling to resource extraction equipment. Installation and utilization of these equipment can be made easier using the ExoForce exoskeletal system. Since conventional spacesuits are susceptible to damage in extreme conditions, the proposed design will provide better working conditions and protection with life support systems integrated within the exoskeleton. ExoForce-1 comprises a combination of hydraulic and pneumatic actuator systems which work in unison to lift and manoeuvre excessively bulky components, or even Martian samples. The human centric interface allows a greater ease of operation and comfort. The unique design allows for a variety of accessories to be affixed to the exoskeleton based on the required application. The structural integrity of the exoskeleton is achieved by using space grade aluminium alloys which facilitate the performance of activities in the unforgiving working environment on Mars. Aerogel is used as a medium between the human and the exoskeleton chassis for protection against cosmic radiation and will also act as a thermal insulation for the vehicle. The exoskeleton will consist of specialized rigs and equipment that will be able to carry out tasks that are specific to any given mission. The energy used will be purely electric and can be recharged using deployable solar arrays which double as backup sources during electricity blackouts. ExoForce-1 will also be equipped with state-of-the-art communication and navigation systems which will be of paramount importance not only while performing routine tasks, but also during the exploration of Mars. The onboard avionics would also include an advanced terrain radar system for geographical mapping, navigation and data gathering. We plan to model ExoForce-1 as a standalone system which can be used as a locomotive residence pod during long expeditions, which would make travel on the red planet more feasible.