HELMET-MOUNTED RADIATION ATTENTUATION FOR ASTRONAUT BRAINS

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Introduction: The UC Davis Human/Robotics/Vehicle Integration and Performance (HRVIP) Lab is part of the NASA REVEALS SSERVI. The objective of the current research is to perform mechanical design, effectiveness trade studies, computational modeling, and quantification of operational constraints for the design of a helmet-mounted radiation-attenuating layer to be added to existing Extravehicular Activity (EMU) helmets.

Near-future astronauts on the Lunar or Mars surface are well beyond the Earth's magnetosphere, and so will be subject to radiation from both solar mass ejections and from Galactic Cosmic Rays (GCR's). Although true shielding from highly-energetic GCR's is unlikely, concerns about cognitive degradation from even low-dose-rate radiation prompts research into radiation attenuation/scattering for astronauts performing EVA's on Lunar and Martian surfaces.

The REVEALS SSERVI is designing and testing novel formulations for surface-conductive high-density polyethylene (HDPE) for radiation attenuation. The current research is exploring the promise of these novel materials to design attenuation layers of HDPE when added to existing NASA EMU helmets.

HDPE layers for radiation attenuation may be added to the internal volume of the EMU helmet, and this is likely to be implemented as a skull-conforming flexible layer added to the communications cap currently worn by EVA astronauts. Design challenges include designing a flexible shell constructed of modular rigid HDPE segments, and limiting thickness to allow head movement within the existing rigid EMU helmet.

HDPE layers may also be added to the external surfaces of the existing EMU helmet design. Although maximum HDPE is desired for maximum radiation attenuation/scattering, large helmet dimensions become a safety hazard for EVA operations in volume-limited environments, such as egress/ingress operations from/to the airlock. If an astronaut's airlock operations are mechanically impeded by a helmet made too large by HDPE layers, the net safety status of an astronaut could be reduced. Thus, a cost/benefit analysis for adding HDPE to the EMU helmet (inside and/or outside) must be performed.

The proposed presentation will include a detailed project plan for addressing the design, mechanical modeling, radiation analysis, and operational cost/benefit analysis for adding internal and/or external HDPE to the existing NASA EMU helmet.

Current NASA EMU helmet.