Humans in Aerospace Field Exam

Aerospace Biomedical Engineering Elective

Context: As an aerospace engineer, your first job at NASA is to help design, test and analyze a Lunar Electronic Flight System for the lunar lander. Once successfully completed, you are then given an assignment to investigate lunar astronaut performance during multiple 14-day extravehicular activities (EVAs).

I. Consider a portable "Lunar Electronic Flight System" (LEFS) to be used during lunar landing on the new Crew Exploration Vehicle, Orion. The LEFS has a 5"x7" color display that can show checklists, the pilot's operating manual, charts, and real-time updated moving maps showing spacecraft position, planned route, landmarks and lunar terrain and landing sites. The EFB can call up emergency checklists and procedures in case of an emergency. The pilot can use the EFB through a touch screen and voice control commands.

Propose and defend and experiment to evaluate the LEFS for normal and non-normal conditions during lunar landing (i.e., thruster failure and emergency lunar landing). Briefly discuss what issues are important to study, and develop and experimental protocol to test those issues. Describe as completely as possible your experimental design, including but not limited to subject selection, independent and dependent variables, and the tasks the subjects are to perform.

II. Now turn your attention to lunar exploration. You are the lead human factors engineer to evaluate astronaut and rover/robot teams during their lunar surface exploration mission.

IIA. Describe the challenges of lunar exploration for a 14-day human-robot mission (i.e., environmental effects, terrain, habitat, spacesuit, life support systems, autonomy for crew and the robots, etc.)

IIB. For the astronaut explorers, what physiological systems promise to be the most challenging during long-duration lunar missions (6 months to 1 year), and potential "show stoppers" for successful lunar exploration? (Qualitative and quantitative answers are sought.) Also, suggest 2-3 possible countermeasures to the physiological deconditioning.