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SPACE SYSTEMS SYMPOSIUM (D1)
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CONCEPTUAL DESIGN OF A MAGNETIC SHIELD FOR PROTECTING A MANED SPACECRAFT AGAINST SOLAR PARTICLE RADIATION

Abstract

Maned spaceflight bears many dangerous and risks for a spacecrafts crew. One of the greatest threats is the exposure to radiation when leaving the Earth's protective magnetic field for interplanetary missions. To ensure the crews safety it is imperative to find a way to protect it against cosmic radiation and even more dangerous Solar Particle Events (SPE), which triggered by Coronal Mass Ejections (CME) or Solar Flares inject large amounts of energetic particles into the interplanetary space. Consisting of protons, electrons and heavy ions with energies ranging from a few tens of keV up to GeV, they follow the interplanetary magnetic field lines and represent when hitting on a spacecraft a life-threatening risk to its crew.

Within the scope of this thesis the possibility of creating a magnetic field using a cluster of coils is elaborated and analyzed. Assembled in sufficient range outside the spacecraft and aligned perpendicular to the interplanetary magnetic field lines, it is used as an active protection against incoming energetic particles, capable of deflecting crossing ionized nuclei past the vessel and hence protect its crew. The work analysis different coil configurations and distances between coil cluster and spacecraft, in order to minimize system mass and necessary power to maintain the magnetic field. To further optimize the magnetic shield an Evolutionary Algorithm has been applied to the problem. Here, inspired by biological evolution using mechanisms as reproduction, mutation, recombination and selection, a population of different coil clusters are competing against each other with the objective to find a global system mass minimum.