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Master Thesis

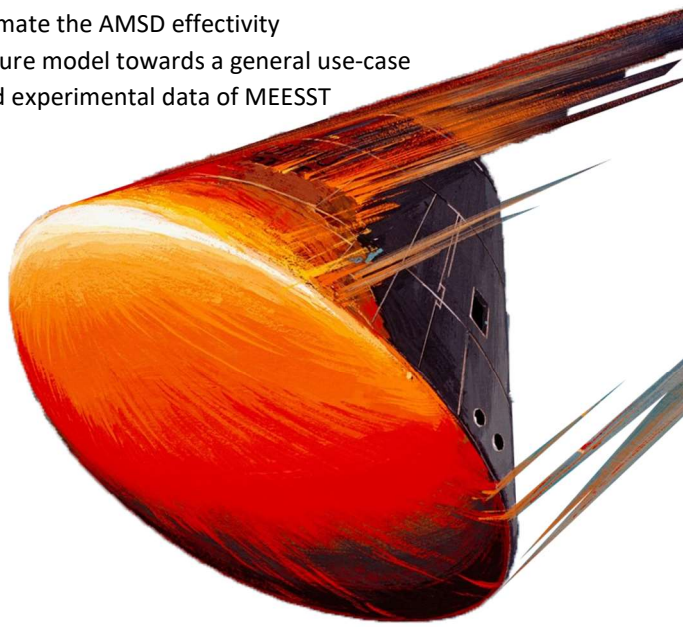
Enhancement and Validation of the Parametric Model for System Requirement Estimations of an Active Magnetic Shielding Device for High Enthalpy Earth Entry

Motivation:

As part of the international EU project MEESST (Magnetohydrodynamic Enhanced Entry System for Space Transportation), research on magnetohydrodynamic (MHD) air plasma systems is performed. The project aims to study the feasibility of an active magnetic shielding device (AMSD) for high elliptical or hyperbolic re-entry trajectories into the Earth's atmosphere. On a macroscopic scale, the Lorentz force arising from the applied magnetic field in the plasma sheath is exploited by an AMSD to mitigate both thermal loads and blackout during space re-entry. In the MEESST project superconducting magnetic coils will be utilized as a magnetic field source with significant demands in cooling and operating power. Therefore, it is of great interest to enhance and validate the existing parametric system architecture model to estimate and evaluate power and cooling margins for an AMSD with respect to known mass ratios of typical re-entry spacecraft. The enhancement should allow for the model to be able to iterate new margins with new experimental and numerical results and a comparison to conventional thermal protection system designs should be made. Additionally, an academically simplified model to estimate the effectivity of the AMSD throughout the re-entry face should be implemented. Correspondingly, a projection of the achieved results shall form the point of departure for attempts to estimate mass, power and volume budgets for a flight-capable system.

Task description of the Master thesis work:

- Literature review on spacecraft design, thermal and power management, relevant MHD experiments
- Recognition of the requirements and boundary conditions of the AMSD
- Development of an academically simplified model to estimate the AMSD effectivity
- Enhancement of the existing parametric system architecture model towards a general use-case
- Validation of the model with literature and numerical and experimental data of MEESST
- Documentation in English



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