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IAF SPACE POWER SYMPOSIUM (C3)
Space Power System for Ambitious Missions (4)

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A MULTIPHYSICS MODEL TO SIMULATE LASER POWER TRANSMISSION, EXPERIMENTS DRIVEN AND TRAINED

Abstract

The rising space sector is incrementing the number of satellites currently operating in Earth's orbit. This is driven by the lower costs for orbital launches and it can be sustained by lowering also the launching masses and specializing further in the system. This can be obtained by innovative infrastructures capable of decoupling the energy production sub-system from the spacecraft, exploiting laser technology for wireless energy transmission to partially avoid the energy sub-system limitations.

In order to do so comprehensive studies should be performed, including the creation of a model capable of predicting the multiphysics outputs to manage the design of the generation, transmission, and conversion of the overall system. Such a tool could allow engineers to forecast the system behavior for different environments.

This numerical model describes:

- The physics of lasers their space propagation and losses, the associated optics and mirrors to ma-

nipulate the direction of the beam;

- The electrical components of the receiver and their response to single-frequency off-nominal impinging power;

- The heat transfer thermodynamics of the receiver and how it is related to the energy conversion outputs.

To obtain a solid result capable of adequate prediction this model needs to be trained via laboratory tests to estimate and learn the state and its cross-correlation in the numerical model for all the different physical fields.

The result of the paper is to provide a robust numerical model definition to allow the characterization and prediction of the efficiency and power chain for different environments where tests are impossible or hardly feasible. This model aims to allow the design of wireless energy transmission through laser technology in a space environment.