NASA SBIR/STTR Technologies

Advanced Particle-in-cell (PIC) Tools for Simulations of Electrodynamic Tether Plasma Interactions

PI: Sudhakar Mahalingam / Tech-X Corporation, Boulder, CO

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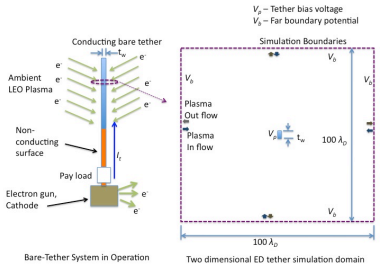
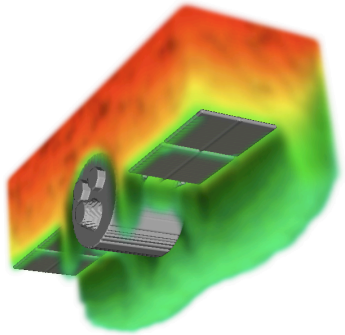
Identification and Significance of Innovation

Electrodynamic tethers are optimally suited for use in Low-Earth-Orbit (LEO) to generate thrust or drag to maneuver satellites. Advanced PIC tools can perform self-consistent 2-D and 3-D ED tether simulations to study the plasma interactions and improve the understanding of the self-induced magnetic field effects on the current collection ability of these ED tethers. These tools once validated using tether ribbon tape experiments can help NASA researchers to analyze various tether geometries in efforts to optimize tether design for space missions on a wide range of operating conditions.

Expected TRL Range at the end of Contract (1-9): TRL 4



Tether PIC simulations of self-induced magnetic field effects on tether current collection.



Advanced tools like 3-D VORPAL / 2-D OOPIC Pro can advance state-of-the-art in ED tether modeling.

Technical Objectives and Work Plan

Objectives:

- Accurate and high-resolution PIC tether simulation which include self-induced magnetic field effects.
- Demonstrate the tools to support optimum tether design and development for future space missions.
- Commercial tether PIC tools to support wider space research community

Tasks:

- Benchmark Tech-X's PIC tools on 2-D Bare ED tether problems
- Demonstrate the 2-D modeling of self-magnetic field effects on the current collection abilities of bare ED tether system
- Investigate the effects of different tether geometry configurations for space applications via simulations
- Perform electron collection experiments to positively biased tether geometries in LEO like plasma to validate simulations

NASA and Non-NASA Applications

NASA Application: Tether plasma simulation tools will allow NASA researchers to determine the optimum tether design for space operations. Similar tools are already being used for electric propulsion systems like ion and Hall thrusters.

Non NASA Application: Accurate plasma modeling of ED tether can benefit other government organizations such as DoD's satellite applications as well as the commercial satellite corporations such as Boeing, Lockheed Martin and Northrop-Grumman, etc.

Firm Contacts

Tech-X Corporation
5621 Arapahoe Ave Suite A
Boulder CO 80303

www.txcorp.com
Tel:303-448-0727
Fax:303-448-7756