

Integration of Electric Propulsion Systems with Spacecraft – An Overview

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Electric propulsion systems are increasingly being used onboard spacecraft for scientific, exploration, commercial, and military missions. Recent high-profile missions that have made use of electric propulsion include NASA's Dawn, ESA's GOCE (Gravity field and steady-state Ocean Circulation Explorer), and JAXA's Hayabusa. Around the world, various electric propulsion systems are currently being developed – ranging from high-power (i.e., >10 kW) systems to support robotic and human solar system exploration efforts to low-power (i.e., <10 W) systems to provide nano-satellites with primary propulsion and station-keeping capabilities.

Together with the increased pace of electric propulsion technologies being infused into space missions, a growing need exists for spacecraft designers and space systems engineers to understand the interactions between electric propulsion systems and the other subsystems onboard the host spacecraft. The proposed paper seeks to help address this need by presenting a discussion of key spacecraft integration issues associated with electric propulsion systems, utilizing the electric propulsion development and testing experience at the Georgia Institute of Technology's High-Power Electric Propulsion Laboratory and an extensive review of published literature. Specifically, the proposed paper seeks to provide an overview of the following topics:

- **Electric propulsion interactions with spacecraft:** What are the key spacecraft-thruster interactions (e.g., plume effects, thermal effects, electromagnetic interference, etc.) that must be evaluated for space missions utilizing electric propulsion? What are the key spacecraft interactions due to other (i.e., non-thruster) electric propulsion subsystems (i.e., power processing units, propellant management, etc.)?
- **Electric propulsion integration case studies:** How do all these interactions with electric propulsion systems impact the host spacecraft's design, qualification, and operations? What special efforts have been taken by spacecraft designers and developers to be accommodating to electric propulsion? Are there best practices to emulate and common pitfalls to avoid based on lessons learned from government and commercial missions?
- **Additional considerations for electric propulsion technologies under development:** How does the preceding discussions change in the context of high-power electric propulsion? In the context of electric micro-propulsion systems to be used on small satellites? In the context of direct-drive electric propulsion?

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