

Preface

Lorentz spacecraft is a new conceptional space vehicle. It actively generates electrostatic charge on its surface to induce Lorentz force via interaction with the ambient planetary magnetic field. The induced Lorentz force could be used as propellantless magnetic propulsion for orbital maneuvering. Traditional spacecraft rely on the thrusters to perform such maneuvers, and the maneuvering capability is strongly restricted by the amount of the available propellant onboard. Differently, the conception of Lorentz spacecraft provides a propellantless means to solve this problem, thus greatly enhancing the maneuvering capability and extending the mission duration. Due to this compelling advantage in saving fuels, dynamics and control of this new vehicle have raised great research interests.

This book aims to investigate the dynamics and control of Lorentz-augmented spacecraft relative motion. It consists of three parts, including introduction, theoretical analysis, and applications. The first part (Chap. 1) gives a detailed review on the theoretical and experimental developments of Lorentz spacecraft. Also, this chapter introduces three types of typical space missions. That is, spacecraft hovering, formation flying, and rendezvous, which all belong to the category of relative orbital motion. The second part (Chap. 2) develops theoretical models of Lorentz-augmented spacecraft relative motion about arbitrary elliptic orbits in both two-body and J_2 -perturbed environment. Also, these models explicitly include the magnetic dipole tilt angle, which are more representative of the Earth's magnetic field, and are expected to derive more precise results. The third part (Chap. 3, 4, 5 and 6) proposes detailed relative navigation and control strategies for Lorentz-augmented space missions. Two navigation schemes for Lorentz spacecraft relative motion are introduced and compared in Chap. 3. The remaining three chapters elaborate the control schemes for Lorentz-augmented spacecraft hovering, formation flying, and rendezvous, respectively. Both optimal open-loop and closed-loop controllers are designed for these typical applications.

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