The Stark Problem: An Overview of its History and Recent Applications to Space Trajectory Design

ABSTRACT

The Stark model governs Keplerian motion perturbed by a uniform force of constant magnitude and direction. German physicist Johannes Stark, first observed that this simple model describes the motion of charged particles in the presence of an electric field. This classic “Stark Problem” therefore has a rich history and literature in the physics discipline. Recently, the application of the Stark model to spaceflight mechanics has re-emerged with a primary emphasis on the low-thrust trajectory optimization problem. In this talk, a brief overview of the Stark problem will be presented, along with two new 3D solution methods: one is a closed-form analytic solution that relies on Jacobi elliptic functions while the other is a Taylor series solution that is analogous to the classic “F&G Series” of the Kepler Problem. Both presented techniques are useful for modeling space trajectories subjected to low-thrust propulsion, as well as time-varying perturbations that can be reasonably approximated as piecewise constants. In the context of preliminary design, the solution methods are demonstrated to be generally favorable when compared to conventional space trajectory propagation methods.

BIO

Ryan P. Russell (Aggie Class of ’98) is an Assistant Professor in the Dept. of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin. He began his professional career as a member of the Guidance, Navigation, and Control Section at NASA’s Jet Propulsion Laboratory where he was involved as mission designer and orbit determination analyst for a variety of space flight projects: including missions to Earth, the Moon, Mars, comets, asteroids, and the moons around Jupiter and Saturn. From 2007-2011, he was on the faculty at the Georgia Institute of Technology, creating a research program focused on a variety of theoretical and applied areas in astrodynamics. He has authored or co-authored dozens of technical publications; and has been a recipient of several NASA, JPL, AIAA, AAS, and other awards.

Drinks will be served at 3:45 p.m.