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THE STATE TRANSPORT AND TRANSITION MATRIX IN THE GENERAL KEPLERIAN RELATIVE ORBITAL MOTION

Abstract

The paper presents a unified approach to the explicit computation of the state transition matrix (STM) associated to the relative orbital motion in Keplerian arbitrary orbits. The use of the hypercomplex universal variables allows the unified formulation of the STM, regardless the elliptic, parabolic or hyperbolic nature of the inertial trajectories. This approach is suitable not only for attractive-type potentials (like the case of the Keplerian motion) but also for Coulomb-like potentials. Last but not least, the universal variables approach is more natural, since it offers a parameterization of the geodesics in the constant curvature phase space on which the inertial motion takes place. The parameterization is made with the help of the generalized trigonometric functions c and s in a space of constant mean curvature (that also offer the natural parameterization for the aforementioned constant curvature metric). The state transition matrix is expressed in the context of the relative motion (in the Local-Vertical-Local-horizontal frame) through a simple change of reference frames. A state transport tensor is also presented, as a mean to propagate the full state of the Deputy spacecraft in the LVLH frame.