Paper ID: 8440

ASTRODYNAMICS SYMPOSIUM (C1)
Guidance, Navigation, and Control (3) (7)

Author: Dr. Arturo Intelisano
Thales Alenia Space Italia, Italy, arturo.intelisano@thalesaleniaspace.com

REGULARIZATION TECHNIQUES IN LEO SPACECRAFT ORBIT CONTROL STRATEGIES

Abstract

From the Levi-Civita pioneeristic work on the regularization of the two-dimensional keplerian problem, many authors have studied this issue exploring the strategies and the possibilities to extend regularization techniques to the three dimensional case. Recently much effort has been produced in order to better formalize the theoretical basis of this subject and to identify the best strategies for a practical use of these interesting mathematical models. In this context, the quaternions, usually managed in their unitary form for attitude control of spacecraft, are used in all their general meaning to define a new orbit control strategy. Basically many of the works written on the subject have concentrated their efforts on the interpretation of the "not-intuitive" world depicted by these mathematical objects. Indeed the lack of intuition and the enhancement of the level of abstraction are re-paid by the relative simplicity and above all efficiency which these strategies show in the control theory related to the field of the orbit determination. The aim of this paper is to present one of the first complete orbit control strategy which makes use of regularization techniques. A simplified approach to the perturbed keplerian problem is studied starting from a "orbital " reference definition in a "regularized" space, in which the classical perturbation theory approach is substituted by a "higher dimension" model, easier to manage using a orbit control algorithm which can be implemented on board for autonomous orbit determination purposes. Such an algorithm can be used as the basic controller for autonomous orbit control strategies, whose importance is fundamental in many fields related to spacecraft navigation. In particular its use in the field of LEO spacecraft autonomous orbit control will be described, with special attention to the areas of formation flying, collision avoidance and autonomous orbit control areas. The shown results will have a double advantage; to analyze the problem from a new perspective (to give an additional inside to the exploration of this intriguing field) and to show how practical these models can be for Astronautics science. In the field of Robotics the use of similar techniques has gained enormous advantage, especially for the fact that the quaternion utilization is able to avoid a great number of problems deriving from singularities and numerical computation. The major hope is to stimulate the scientific community in the study of this challenging and interesting way of facing similar problems in the Astronautics world.