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Could introduction of space payload management be the next natural step to space traffic management?

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Significant initiatives on space traffic management have been recently taken, essentially by developing principles of outer space transparency and confidence building measures (TCBM) beneficial to a safer conduct of space activities. The need for improved practices in space traffic management is a consequence of the increasing number of space-faring nations allowing for more types of missions, growing number of space debris, new private entrants, and rising space content in running critical national infrastructures, to name a few. These expanding space activities underscore the society's dependency on space systems and henceforth its vulnerability vis-à-vis the latter, calling for an enhanced long-term sustainability of outer space activities. But the lack of information on the nature of some space payloads and their associated missions introduce a persistent flaw in succeeding to achieve a long sought stable and safer space environment. Indeed this noticeable weakness in the mentioned initiatives is not taken into account at this stage. To overcome this difficulty, a space situational awareness system (SSAS) based on a multinational organization, or under the purview of a UN steered agency, is proposed. It could be implemented promptly, provided there is a shared political will and a recognized urgent need to do so by major space-faring nations gauging their long-term interest while there is still time. The space deterrence postures by dominant space powers that have been identified during the past ten years, or so, argues in favor of broadening as soon as possible the scope of the current TCBM.

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Stabilizing satellite relative motion using low thrust nonlinear time-delay feedback control

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This paper describes the development of a stabilizing control method for the relative motion between two satellites using continues low thrust. The relative motion of two satellites is considered in the two body problem with J_2 perturbation and it is described by the Clohessy–Wiltshire equations. The satellites' orbits are considered to have slightly different periods and inclinations, thus the relative motion between them will not be bounded. To stabilize the relative motion, time delay feedback control is used. The time delay feedback control eliminates the necessity of having a pre-defined reference relative motion to be tracked by the follower satellite, by using the previous relative orbit as a reference for tracking. First we consider the stability in the sense of Lyapunov. Once the Lyapunov function is found, a first order sliding mode time delay feedback controller is developed to stabilize the relative motion, based on the free variable transformation, Lyapunov transformation and considering that the J_2 perturbation is bounded. Numerical simulations are used to compare the performance of the developed nonlinear time delay feedback controller with linear feedback time delay control as well as with PD controller. Also it is shown that by using the time delay feedback control one can design artificial reference relative orbits that can be tracked by using feedback control laws. Numerical simulation results prove the effectiveness of bounding the relative motion for long periods of time using the proposed stabilizing method.

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