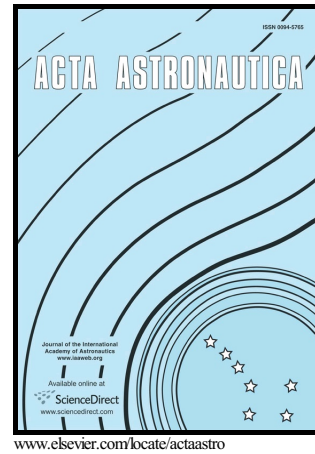


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Leonard Felicetti, M. Reza Emami



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A Multi-spacecraft Formation Approach to Space Debris Surveillance

Leonard Felicetti^a, M. Reza Emami^{a,b,*}

^a *Division of Space Technology, Luleå University of Technology, Kiruna, 98128, Sweden*

^{a,b} *Institute for Aerospace Studies, University of Toronto, Toronto, M3H 5T6, Canada*

This paper proposes a new mission concept devoted to the identification and tracking of space debris through observations made by multiple spacecraft. Specifically, a formation of spacecraft has been designed taking into account the characteristics and requirements of the utilized optical sensors as well as the constraints imposed by sun illumination and visibility conditions. The debris observations are then shared among the team of spacecraft, and processed onboard of a “hosting leader” to estimate the debris motion by means of Kalman filtering techniques. The primary contribution of this paper resides on the application of a distributed coordination architecture, which provides an autonomous and robust ability to dynamically form spacecraft teams once the target has been detected, and to dynamically build a processing network for the orbit determination of space debris. The team performance, in terms of accuracy, readiness and number of the detected objects, is discussed through numerical simulations.

I. Introduction

SPACE debris is turning into one of the critical issues that can strongly burden the design and the operation of current and future space missions. In fact, the increasing number of uncontrolled fragments, spent launch stages and decommissioned satellites is conditioning the mission operations of currently in-orbit satellites, forcing them to perform collision avoidance maneuvers regularly [1]. The trend is so concerning that the space activities can be compromised in the future, a phenomenon sometimes referred to as the Kessler Syndrome [5], amongst other names. Recent studies have shown that the number of uncontrolled objects orbiting the Earth is still increasing [2], despite the adoption of some space debris mitigation guidelines established by the United Nations [3] or those recommended by the Inter-Agency Space Debris Coordination Committee (IADC) [4]. Indeed, even if all the future space missions could be suspended, the debris population would continue to increase, due to the possible collisions

*Corresponding author at: Division of Space Technology, Luleå University of Technology, Kiruna, 98128, Sweden.
E-mail address: reza.emami@ltu.se (M.R. Emami).

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