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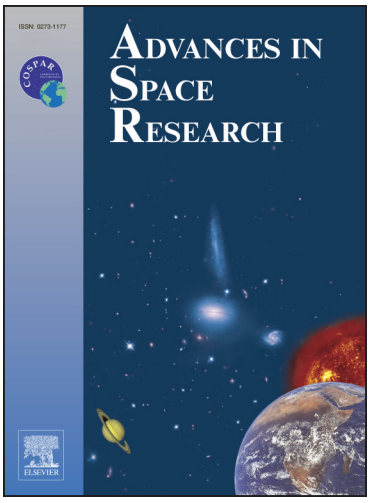

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Xiaogeng Chu, Yuning Chen, Yuejin Tan

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An Anytime Branch and Bound Algorithm for Agile Earth Observation Satellite Onboard Scheduling

Xiaogeng Chu, Yuning Chen*, Yuejin Tan
College of Information Systems and Management, National University of Defense Technology, Changsha, 410073, Hunan, China

Abstract

To fulfill the mission of targets recognition over sea, a bi-satellite cluster composed of an autonomous low resolution satellite (LRS) leading the formation for targets detection and a trailing agile high resolution satellite (HRS) for targets recognition is considered. This paper focuses on the development of a method that is able to generate a schedule plan onboard the HRS taking into account the information received from the LRS, which amounts to solving an agile earth observation satellite (AEOS) scheduling problem. The main contributions of this paper are two folds: a mathematical model for formulating the AEOS scheduling problem, and an anytime branch and bound algorithm for problem solution. Experimental results on a set of representative scenarios show that the proposed algorithm is effective which promotes significantly the bi-satellite cluster to improve the efficiency of targets recognition over sea as opposed to traditional methods where a large number of satellites are required to work coordinately. In particular, in a scenario over a 500kmX2000km sea area involving 25 targets, the performance of the bi-satellite cluster amounts to the coordination of 30 high resolution satellites.

Key words：targets recognition over sea, agile satellite onboard scheduling problem, anytime branch and bound algorithm

1. Introduction

The task of recognizing targets over sea is typically treated as an acquisition of a large area target with all interesting moving targets included inside. To realize a full covering of this large area, a large number of high resolution satellites are required to work coordinately. This is rather resource consuming and inefficient as a large portion of the area contains nothing interesting especially when the moving targets are sparsely distributed. With the development of satellite autonomy techniques, the efficiency of targets recognition over sea can be greatly improved. This can be realized by, for instance, a bi-satellite cluster, composed of a low resolution satellite (LRS for short) leading the formation for targets detection and a trailing high resolution satellite (HRS for short) for targets recognition. The LRS detects the precise locations of the moving targets when it flies over the sea area and then sends the information to the trailing HRS which generates onboard a plan to be executed in a timely manner. This avoids observing uninteresting areas and enhances the utilization efficiency of the rare satellite resources.

* Corresponding Author
E-mail address: cynnudt@hotmail.com (Yuning Chen)

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