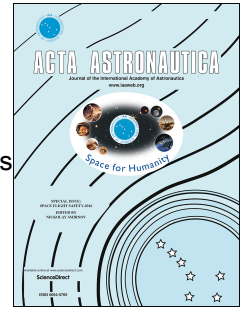


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OPTIMIZATION OF SATELLITE CONSTELLATION DEPLOYMENT STRATEGY CONSIDERING UNCERTAIN AREAS OF INTEREST

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This paper presents an integrated framework to design a flexible multi-stage telecommunication satellite configuration deployment strategy considering the uncertainties in the evolution of the areas of interest over time. The constructed stochastic demand model considers multiple possible scenarios for the evolution of the areas of interest with probabilities based on the market share growth in each area. The optimization aims to find each stage's design with minimum expected lifecycle cost considering all possible scenarios. Each stage of the constellation, assumed to be Flower constellation with circular orbits, provides a regional coverage of the current area of interest as well as additional coverage for the potential future areas of interest. The proposed multi-stage satellite constellation enables the constellation designer to react flexibly and efficiently to the uncertain future expansion of the areas of interest. A case study reveals a reduction in the expected lifecycle cost for an optimized system compared with the all-in-single-stage system and global coverage constellation.

INTRODUCTION

Recently, many plans have been proposed to provide global broadband services with hundreds and even thousands of satellites in non-geostationary orbit (NGSO) beyond the conventional satellite services. OneWeb has proposed to set up a constellation with 720 satellites in low Earth orbit (LEO) and aims to provide a low latency broadband access as early as 2019. Moreover, SpaceX and Boeing have filed a frequency licensing with the Federal Communications Commission (FCC) for their planned telecommunication services with 4,425 and 2,956 satellites, respectively. In the traditional approach, system engineers aim to deploy mega-constellations to provide a global coverage and meet a predicted demand. However, this strategy requires having tremendous financial resources and can reveal risky, as the conceptualization and the development of satellite constellation system usually extend for a long period of time, increasing the likelihood for the market and the business to undergo changes. As seen in the cases of Iridium and Globalstar, which each filed for bankruptcy in 1999 and 2002, respectively, deploying for the full-operational-capability configuration for a global coverage within a relatively short period of

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