IAF EARTH OBSERVATION SYMPOSIUM (B1)
Interactive Presentations - IAF EARTH OBSERVATION SYMPOSIUM (IP)

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STUDY OF AUTONOMOUS SATELLITE PLANNING METHODS USING ARTIFICIAL INTELLIGENCE TECHNIQUES

Abstract

With the prospect of a considerable increase in the number of satellites launched into orbit in the coming decade, the size of satellite constellations and the number of observation requests will make existing algorithms difficult to use in the daily mission planning and scheduling, given the computational requirements and the need for manual support from the operators. The need for the use of automatic techniques for satellite planning and for them to adapt to a complex environment such as space is therefore evident.

In order to answer this need, the following work explores the use of deep reinforcement learning (DRL) – an artificial intelligence (AI) technique belonging to the machine learning (ML) class – to solve the task planning problem for a constellation of three Earth observing satellites (EOSs), considering latency, weather conditions and tasks priority.

An online scheduling model is adopted to simulate onboard task planning, and a deep deterministic policy gradient (DDPG) algorithm is developed in Python together with a DRL environment for task planning. Following optimization, training, and subsequent testing, the algorithm proves to be a favourable alternative in terms of computational efficiency compared to its basic version. Moreover, it exhibits enhanced profitability in executing planned tasks when contrasted with a classic algorithm.

We simulated planning episodes for the three satellites, with 100 tasks to be scheduled by the algorithm in each episode, verifying that the algorithm is able to select for the planning the set of tasks that results in the greatest profit.