

PDC2025
Stellenbosch, Cape Town, South Africa

Please submit your abstract at <https://iaaspace.org/pdc>.

(please select the topic that best fits your abstract from the list below)
(you may also add a general comment - see end of this document)

- Ongoing and Upcoming Mission Highlights
- Apophis: T-4 Years
- Hypothetical Asteroid Threat Exercise
- Key International and Policy Developments
- Near-Earth Object (NEO) Discovery
- NEO Characterization
- Deflection / Disruption Modeling & Testing
- Space Mission & Campaign Design
- Earth Impact Effects & Consequences
- Disaster Management & Impact Response
- Public Education and Communication
- The Decision to Act: Political, Legal, Social, and Economic Aspects

**Mission Planning Methods for Space-Based Monitoring of
Hazardous Near-Earth Objects**

Peiran Mu⁽¹⁾, Rui Xu⁽¹⁾, Zhaoyu Li⁽¹⁾, Shengying Zhu⁽¹⁾, Tao Nie⁽¹⁾

⁽¹⁾*Institute of Deep Space Exploration, Beijing Institute of Technology, Beijing
100081, China*

Keywords: *near-Earth objects monitoring, mission planning, space-based system*

Near-Earth objects (NEOs) pose significant threats to human survival due to their potential for Earth impact. This necessitates the development of monitoring and early-warning technologies for hazardous NEOs. Current monitoring systems rely primarily on ground-based observation networks, which lack the capability for all-day, all-sky monitoring. Consequently, space-based monitoring systems, characterized by broad coverage and prolonged tracking capabilities, are required for collaborative observations in the future.

Space-based monitoring missions for hazardous NEOs must address challenges such as mission complexity, the heterogeneity of deep-space orbits, and imaging constraints, which enable the planning of monitoring activities over a specific period. This study proposes a mission planning method to multi-satellite space-based systems to optimize resource utilization and fulfill mission requirements.

First, the celestial sphere is divided into observation zones that can be covered by a single sensor pass, and a multi-satellite survey strategy is designed to achieve all-day,

all-sky coverage. Each satellite captures images of assigned zones based on pre-planned schedules. Considering constraints such as solar exclusion, imaging requirements, and satellite resources, the problem is formulated as an optimization model.

Then, a dynamic time-domain optimization method (DTDOM) is proposed. The monitoring activities of spacecraft are represented as integers, and a hierarchical encoding strategy is designed to meet the requirements of sky region coverage and parallel computing. Additionally, a stochastic factor update method for dynamic time domains is proposed, which adjusts the time domain dynamically based on the number of observation zones and observable time intervals. Random perturbation factors are introduced to update neighborhoods within the time domain. This approach enhances the resource utilization of the space-based system and improves the mission execution rate.

Finally, a simulation experiment is conducted using a multi-satellite system distributed across Venus-like and Earth orbits. DTDOM is applied to a 14-day monitoring mission, generating detailed monitoring activities schedules for each satellite. Results indicate that the system achieved over 98% sky coverage while ensuring balanced and efficient utilization of satellite resources. Furthermore, the method reduced satellite attitude adjustments, thereby conserving resources.

Comments:

Either oral or poster presentation is fine.

I am a student. I am interested in the student competition.