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Committee on the Peaceful Uses of Outer Space

National research on space debris, safety of space objects with nuclear power sources on board and problems relating to their collision with space debris

Note by the Secretariat

Addendum

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II. Replies received from Member States

Armenia

[Original: Russian]

[2 November 2009]

Project to detect and catalogue natural and man-made near-Earth objects (Byurakan Astrophysical Observatory)

According to the most crude estimates several million man-made objects, commonly referred to as space debris, have accumulated in near-Earth orbits. Their number is constantly rising, thereby increasing the danger for active space stations and also for jetliners and ocean-going vessels. Hence, the current situation demands that, at the very least, space debris that poses a real threat in terms of size should be catalogued.

Over a period of 20 years the research facilities at the Byurakan Astrophysical Observatory have catalogued artificial satellites and carried out rapid analysis of their orbits. High-precision astronomical cameras and the United Kingdom Schmidt Telescope were used for this purpose as they have a sufficiently wide field of view.

At present the research facilities are not operational, although observational capacities can be used both for the aforementioned purpose and for detecting asteroids crossing the orbit of the Earth and posing a potential threat to humanity. The Byurakan Astrophysical Observatory has proposed the Near-Earth Objects Revealing and Observing Stations (NEOROS) project to equip the facility for new research goals.

The following goals could be part of the NEOROS project:

(a) Development of effective methods for detecting and identifying low-flying space objects (<1000-2000 km);

(b) Practical observations and classification of information received on the distribution of detected space objects;

(c) Definition by size of the distribution of space debris (clearly the threat depends on the size of the debris). The following are possible size bands:

Object size (cm)	*Altitude (km)*
5-10	100-200
15-20	500
25-30	1000
40-50	2000

Large-scale debris (such as in the last categories) can be detected at an altitude of up to 100,000 km. It should be noted that the observation threshold depends on many parameters, in particular the albedo.

The project could be implemented with the cooperation of several countries interested in this research. The research may be of interest to major airlines, nuclear

power stations, telecommunication companies and others. The project could be part of more general programmes on the peaceful uses of outer space and the applications of astronomy to this end.

Spain

[Original: Spanish]

[19 November 2009]

As has been mentioned earlier, Spain is currently participating in the Space Situational Awareness programme of the European Space Agency (ESA), aimed at guaranteeing the safe operation of European space assets.

The initiative includes activities such as the detection of space debris and its monitoring, as well as warnings of probable collisions with space debris.

This programme, directed towards improving safety in the space environment, does not include, however, specific activities concerned with studying the problems of nuclear power sources in space.

Besides being the member country making the largest contribution to the programme within ESA, Spain possesses a large number of installations for the implementation of this programme.

United Kingdom of Great Britain and Northern Ireland

[Original: English]

[9 December 2009]

1. Introduction

The United Kingdom, through the British National Space Centre (BNSC), maintains an active role in addressing the space debris problem by encouraging coordination at national and international level to reach agreement on effective debris mitigation solutions. Central to this is BNSC membership of the Inter-Agency Space Debris Coordination Committee (IADC), which is an important forum for achieving international consensus on space debris mitigation. BNSC contributes to IADC by participating in cooperative research activities and working with other member space agencies to formulate debris mitigation solutions and guidelines. In April 2009 the United Kingdom participated in the 27th IADC meeting, which was hosted by ESA in Darmstadt, Germany.

Another key area in which the United Kingdom is actively involved is the development of a series of spacecraft engineering standards for mitigating space debris. Contributions have been provided by United Kingdom experts in BNSC, industry and academia to the International Organization for Standardization (ISO), where the United Kingdom chairs a working group tasked with coordinating all space debris mitigation standards under development within ISO. In drafting the standards, care has been taken to align them, as far as possible, with the IADC space debris mitigation guidelines.

To meet its obligations under United Nations outer space treaties, the United Kingdom operates a licensing scheme to permit the launch and operation of United Kingdom satellites in outer space. BNSC, as licensing authority, is responsible for issuing the licenses. The conformance of satellites and launch vehicles with debris mitigation guidelines and standards is an important consideration in the decision to grant a license.

The United Kingdom's space debris community has continued to make notable contributions to measure the debris population and model its long-term evolution, improve impact protection on spacecraft and develop debris mitigation solutions. A selection of this work is summarized below.

2. Observation of space debris

The United Kingdom participated in the re-entry prediction campaign in 2009 organized by IADC. The technical lead for risk object re-entry prediction in the United Kingdom is Space Insight Ltd., which provides support to BNSC on a range of activities related to space situational awareness. This operational support provides among other things, information on anticipated re-entries of risk objects and (using the Starbrook system) monitoring of platforms licensed under the United Kingdom's Outer Space Act in order to ensure compliance of licensees' activities with the obligations of the United Kingdom under the United Nations outer space treaties. In addition to its national regulatory role, Starbrook is also used to take observations which form the United Kingdom's contributions to the IADC debris population measuring campaigns.

3. In situ measurements of space debris

The research group at the University of Kent at Canterbury is continuing to work on impacts in space using its in-house light gas gun. Much of the current work has focused on understanding capture of dust and residues by the Stardust mission of the National Aeronautics and Space Administration (NASA) of the United States of America in collaboration with other United Kingdom groups (i.e. the Natural History Museum, Imperial College London and the University of Leicester) and United States laboratories.

4. Debris environment modelling

Working with delegates from other agencies in IADC Working Group 2 (Environment and Databases), BNSC has helped to define the parameters for a new study to assess the benefits of active debris removal (ADR). The University of Southampton's Debris Analysis and Monitoring Architecture for the Geosynchronous Environment (DAMAGE) evolutionary model is used to investigate the stability of the current low-Earth orbit debris environment and addressing the issue of ADR. Researchers at the University of Southampton are also developing an empirical model of the thermosphere using satellite drag data, with the aim of understanding and forecasting long-term density changes.

5. Spacecraft debris protection and risk assessment

The United Kingdom continues to participate actively in IADC Working Group 3 (Protection). The focus of effort within the group during the past year has

been the production of a report, under the United Kingdom's leadership, to assess the feasibility and options for implementing impact sensor networks on a variety of spacecraft. The purpose of such a system would be to provide operators with real-time data on the occurrence of impacts and their association with spacecraft anomalies or failures.

6. Debris mitigation

During the past year, the United Kingdom has chaired IADC Working Group 4 (Debris Mitigation) and contributed to the activities of this group.

Research is continuing at Cranfield University's Space Research Centre to develop engineering solutions for disposing of spacecraft at end-of-life. One project is currently studying a drag sail concept to de-orbit spacecraft from low-Earth orbit. This involves developing a hardware prototype and computational tools to calculate aerodynamic forces for arbitrary spacecraft configurations. Another project focused on the design of a space tug satellite to inspect, service and re-orbit spacecraft in geosynchronous orbit. Spacecraft health monitoring is also being studied to support the development of disposal phase operations and design.

Finally, technical experts within the ISO Space Systems and Operations Subcommittee, under a United Kingdom project leader, have developed a top-level space debris mitigation standard (designated ISO 24113) for publication. This standard defines the high-level quantitative requirements applicable to all elements of unmanned systems launched into or passing through near-Earth space, including launch vehicle orbital stages, operating spacecraft and any objects released as part of normal operations or disposal actions. The requirements contained in the standard aim to reduce the growth of space debris by ensuring that spacecraft and launch vehicle orbital stages are designed, operated, and disposed of in a manner that prevents them from generating debris throughout their orbital lifetime. Methods and processes to enable compliance with these requirements will be provided in a series of lower level implementation standards.