United Nations A/AC.105/C.1/115/Add.1

General Assembly

Distr.: General
23 November 2018
English
Original: Arabic/English

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-sixth session
Vienna, 11–22 February 2019
Item 7 of the provisional agenda*
Space debris

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

Contents

* A/AC.105/C.1/L.373.

II. Replies received from Member States

Brazil

[Original: English]
[22 November 2018]

Research on space debris involves two major areas: (a) atmospheric re-entry (where and when debris is generated and can re-enter) and (b) the prediction of collision in orbit (the probability of collision in orbit) and methodologies to avoid the generation of space debris, such as forcing its controlled or natural re-entry (deorbit).

Regarding studies and research on space debris at the National Institute for Space Research (INPE), there is not much to add in relation to the last year's report. Some analyses of collisions with space debris were made at the INPE Centre for Satellite Tracking and Control, based on a collision risk alert received from the Xian Satellite Control Centre, as reported last year. The analysis consisted of generating reports for a future period of one week for the China/Brazil Earth Resources Satellite 4 (CBERS-4). To achieve that, the satellite tool kit (STK) software was used, since its close-approach module allows the generation of this kind of report. The orbital elements of the debris and other objects in orbit that were necessary for the analysis data were obtained via the North American Aerospace Defense Command (NORAD) website (www.space-track.org). Owing to the results obtained from these analyses, the possibility of periodically generating the same kind of report for all the satellites operated by INPE (SCD-1, SCD-2 and CBERS-4) is being considered.

In addition, a software system for predicting the collision of space debris, which is being developed in-house, is in the testing phase at the INPE Centre for Satellite Tracking and Control. Under the code name CHKDEBRISSGP8, the software provides data on the probability of collision of any object available through NORAD, which currently has almost 17,000 objects in its catalogue (16,695 objects as of 29 September 2017), against satellites under the responsibility of Brazil (OSCAR-17, SCD-1, SCD-2, CBERS-1, SACI-1, CBERS-2, NANOSAT-C-BR1 and CBERS-4, as well as others that are going to be released, including CBERS-4A and AMAZONIA/PMM). Another software application that employs numerical modelling, under the code name CHKDEBRISNUM, performs a more accurate forecast when the results from CHKDEBRISSGP8 indicate a probability of collision greater than 1 per cent. The alerts are evaluated three times a day and the results are sent to specialists. The whole operation is automated.

A doctoral thesis in the field of engineering and management of space systems entitled "Trajectory and Attitude Modelling and Propagation for Re-entry Debris with Fragmentation" was concluded in April 2018. The thesis compares the results of its model with those of the software applications Orbit Survival Analysis Tool (ORSAT) and Debris Assessment Software (DAS) of the National Aeronautics and Space Administration (NASA) and Spacecraft Atmospheric Re-entry and Aerothermal Break-up (SCARAB) of the European Space Agency (ESA). In the study, simulations of re-entry conditions and correct interpretation of results provided by NASA/DAS are also presented.

Finland

[Original: English]
[22 November 2018]

National space situational awareness strategy

A national strategy for space situational awareness (SSA) is under preparation, in collaboration with research, industry and administration partners. The current national space strategy, adopted in 2013, does not address SSA activities, which have

been steadily increasing in Finland over the past several years. The new SSA strategy is aimed at setting several objectives and recommendations to enhance research and education in the field, strengthen SSA capabilities and clarify the roles of different actors. The strategy is expected to be approved by the end of 2018.

Space surveillance and tracking activities in Finland

Before 2017, there were no nationally operated satellites, therefore the need for and interest in national space surveillance and tracking (SST) activities has remained rather low, except for the occasional re-entry cases involving the potential risk of the object falling into Finnish territory. Nevertheless, there is existing SST-capable instrumentation, unique expertise on relevant observational techniques, both radar (European Incoherent Scatter Scientific Association (EISCAT)) and optical (satellite laser ranging (SLR)), and several seminal studies on the observation of debris have been carried out, e.g., for ESA. The situation in the country is now rapidly changing, with the first Finnish small satellites in orbit.

In SST observations, the SLR system has been available nationally for measuring accurate distances to satellites since 1978. The Finnish Geospatial Research Institute (FGI) operates the Metsähovi Geodetic Research Station, which is one of the core stations in the global geodetic network, providing observations for maintaining global terrestrial and celestial frames of reference, precise determination of the orbits of navigation and Earth observation satellites, and Earth orientation in space. One of the major instruments available at the station is a modern SLR telescope system. With the newest, state-of-the-art SLR system expected to be operational in 2019, Finland will also have the possibility of contributing to the main endeavour in SST: the mapping of space debris. The system will be one of the cornerstones of the Finnish SST facilities.

EISCAT radars have been used in several satellite and debris observation campaigns and have proved to be the best radars in Northern Europe for studying space debris and making accurate orbit determinations.

In SST research, efforts have been focused on exploiting the unique capabilities of the nationally available observational systems. For example, FGI has carried out several projects in the period 2016–2018, including on the feasibility of using the Metsähovi SLR system for space debris observations, and on the characterization of debris objects by means of SLR observations by developing methods and software for spin-state determination and coarse classification. In addition, FGI has further studied the optimal strategy and SLR instrumentation for debris observations and produced an upgrading plan for improving the feasibility of tracking non-cooperative targets.

A project being carried out by FGI and the University of Helsinki is aimed at measuring Earth radiation pressure by means of very high-precision observation of satellite orbits. This provides information on all the forces acting on an orbiting object, and supports the tracking of satellites and debris.

The Finnish Centre of Excellence in Research of Sustainable Space combines science, technology and new commercial space activities into one programme. The Centre, led by the University of Helsinki, plans to build and launch small satellites, with the goal of understanding the Earth’s radiation environment holistically and developing de-orbiting technologies and next-generation radiation tolerance.

For satellite re-entries, FGI and the Finnish Meteorological Institute provide expertise to the Ministry of Interior Affairs by monitoring satellite orbit predictions provided by international services such as the ESA re-entry service. This was successfully demonstrated in 2013 with the re-entry of the Gravity Field and Steady-State Ocean Circulation Explorer (GOCE). There are plans to establish a permanent national service that uses SST and space weather capabilities, together with information obtained from ESA and the re-entry service of the European Union Space Surveillance and Tracking (EUSST) framework.

Provisions related to space debris in the national Act on Space Activities

One of the objectives of the national Act on Space Activities, which entered into force in 2018, was to stress the importance of the sustainable use of outer space and the avoidance of space debris.

Under the Act, avoidance of unnecessary environmental harm and space debris is one of the conditions for authorization of space activities, which is complemented by a specific section on the topic. According to the Act, the operator shall, in accordance with recognized international guidelines, seek to ensure that the activities in outer space do not generate space debris. The operator shall in particular restrict the generation of space debris during the normal functioning of the space object, reduce the risks of breakage and collision of the space object in outer space and strive to move the space object from its orbit to a less crowded orbit or into the Earth's atmosphere after it has completed its mission.

Myanmar

[Original: English]
[12 November 2018]

As one of the States attending the UNISPACE+50 high-level segment held on 20 and 21 June 2018, Myanmar expressed congratulations for and noted the participation in the historic anniversary of the first United Nations Conference on the Exploration and Peaceful Uses of Outer Space, supported by the Office for Outer Space Affairs. Myanmar will remain a participant in the international space community, with the aim of strengthening the use of space towards achieving the Sustainable Development Goals.

As a developing country, the Government of the Republic of the Union of Myanmar is still formulating a space programme aimed at embedding the space-related aspirations of launching a national satellite and gaining control over strategic national communications and broadcasting. While operating the satellite system, Myanmar will emphasize space science, technology, law and policy for the benefit of regional and multiregional communities and will also contribute the achievement of global initiatives, such as the 2030 Agenda for Sustainable Development.

As the national satellite project is in the planning stage, Myanmar has not faced the issues of space debris and nuclear power sources and related problems. Although Myanmar still has not considered conducting research on those issues, in the course of developing its own satellite system, it will focus more attention on implementing cooperation efforts with the international community, including international organizations, in developing space debris mitigation measures as an important element in securing a peaceful space environment.

Saudi Arabia

[Original: Arabic]
[31 October 2018]

Space debris

King Abdulaziz City for Science and Technology has adopted the voluntary Space Debris Mitigation Guidelines, endorsed by the General Assembly, with a view to reducing the debris resulting from the satellites it manufactures and launches by taking tangible measures to improve the design of space vehicles and extend their operational life.

The organization is committed to the registration of space objects, pursuant to the Convention on Registration of Objects Launched into Outer Space, as a means to limit the generation of space debris.

It reaffirms the importance of detecting, tracking, removing and reducing space debris, which should be dealt with in a way that does not adversely affect the development of the capacities of developing States or impose unnecessary burdens on their programmes. The organization believes that the development of such applications will greatly contribute to achieving the goals of the 2030 Agenda for Sustainable Development.

Use of nuclear power sources in outer space

The Kingdom of Saudi Arabia does not have any use for nuclear power sources in outer space. However, it supports the relevant resolutions and recommendations of the Scientific and Technical Subcommittee and the Working Group on the Use of Nuclear Power Sources in Outer Space.

Saudi Arabia intends to draw up legal and regulatory instruments governing the safe use of nuclear power in outer space, taking into consideration the Principles Relevant to the Use of Nuclear Power Sources in Outer Space and the Safety Framework for Nuclear Power Source Applications in Outer Space.

It reaffirms the importance of implementing the voluntary Safety Framework to avoid the risk of potential collisions, accidents or emergencies involving space objects with nuclear power sources on board while those objects are in orbit or when they re-enter the atmosphere. Greater attention should be paid to these issues through the formulation of appropriate strategies, long-term plans and regulations and the implementation of the Safety Framework, in coordination with the Scientific and Technical Subcommittee and the Legal Subcommittee.

Slovakia

[Original: English]
[15 November 2018]

Development by Slovakia of an optical sensor for the cataloguing of and research on space debris objects

The Department of Astronomy, which is part of the Faculty of Mathematics, Physics and Informatics of Comenius University in Bratislava, was awarded funding for a Slovak project within the framework of the ESA Plan for European Cooperating States with the main goal of transforming a 0.7-metre Newton telescope (AGO70) dedicated to amateur astronomical observations into a professional optical system for ongoing support of space debris tracking and research. The development started with the installation of a telescope at the Faculty of Mathematics, Physics and Informatics Astronomical and Geophysical Observatory in Modra, Slovakia, in September 2016. It was necessary to adapt the low-level telescope control to the needs of space debris tracking. For the image processing software, a modular design has been chosen. It contains several individual elements that perform tasks such as searching for objects on the frames, centroiding, astrometric reduction and tracklet-building. The planning of observations has been carried out in accordance with the AGO70 system's hardware limitations, with a focus on geostationary Earth orbits, geostationary transfer orbits and Global Navigation Satellite System-like orbits. The outputs produced by the system are astrometric positions in international formats (the tracking data message format of the Consultative Committee for Space Data Systems and the Minor Planet Center format), light curves and relative colour indices obtained by using Johnson-Cousins UBVRI filters. The fully operational AGO70 system will support the cataloguing efforts of the Astronomical Institute of the University of Bern, which maintains its own internal space debris catalogue for research purposes. In case of contingencies during ESA satellite missions, for example, when the spacecraft is

not responsive, a dedicated observation operation can be performed using AGO70 to examine the status of the affected spacecraft's integrity, monitor its attitude motion state and improve information on its orbit.

Application of the Slovak all-sky meteor network for the monitoring of re-entry events

Currently, the Department of Astronomy is investigating the possibility of using its Automatic Meteor Orbit System (AMOS) to perform space debris re-entry measurements. AMOS is currently used for automatic detection of meteors, determination of their orbits and spectrum extraction. The Faculty of Mathematics, Physics and Informatics has developed and is now operating 15 AMOS cameras in total, of which 5 are situated in the Slovak Republic, 3 in the Canary Islands, Spain, 3 in Chile and 3 in Hawaii, United States of America. AMOS can support the modelling of re-entry events by monitoring the trajectories of fragments in the atmosphere and performing spectral analyses of the fragments.

The above information was obtained from the report on selected results of space research in Slovakia and related activities and plans for the future, prepared by the Slovak National Committee of the Committee on Space Research, available at http://nccospar.saske.sk/REPORT20162017/SPACERESEARCHINSLOVAKIA2016 2017.pdf.

United Arab Emirates

[Original: English]
[2 November 2018]

1. Reports on research on space debris

The United Arab Emirates recognizes the increasing risks posed by space debris. As a result, efforts have been made to conduct a detailed comparative study on how other Member States are implementing relevant international space debris mitigation guidelines and best practices in their national legislation. The purpose of the study is to develop the first United Arab Emirates regulatory instrument on space debris mitigation. The study is focused on the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space, as well as international best practices, such as those identified by the Inter-Agency Space Debris Coordination Committee (IADC) and the International Organization for Standardization. The scope of the study includes the establishment of measures for and best practices in the design and operation of a space system that will avoid or minimize the generation of space debris during the in-flight, operational decommissioning and post-decommissioning phases of the satellite life cycle.

Moreover the United Arab Emirates Space Agency recognizes the importance of space traffic management, the importance of which is internationally recognized. This recognition was a driver to conduct a study to define the main elements of space traffic management for the development of relevant national regulations and processes. Moreover, the United Arab Emirates is keen to contribute to the development of a suitable international regulatory framework for space traffic management.

Furthermore, the Al Yah Satellite Communications Company (Yahsat) has made efforts to provide support to research by the United States Air Force in regard to geostationary orbit debris and avoidance manoeuvring, based upon Yahsat's operational experience. In addition, Yahsat has made efforts to present and participate in different space debris workshops and conferences in order to raise awareness of the importance of mitigating space debris collisions, as well as implementing mitigation measures.

2. Safety of space objects with nuclear power sources on board

The United Arab Emirates draft Federal Law on Regulating the Space Sector addresses matters of national cooperation with other federal and national government entities, including joint regulations on issues related to the use of nuclear power resources in outer space with the Federal Authority for Nuclear Regulation. In addition, the United Arab Emirates Space Agency, in cooperation with concerned government entities, has defined the United Arab Emirates space sector-related risk scenarios and emergency response plans regarding the falling of space objects with nuclear power sources on board into inhabited areas.

3. Problems relating to the collision of space objects with nuclear power sources on board with space debris

The United Arab Emirates draft Federal Law on Regulating the Space Sector addresses space debris through a set of obligations imposed on operators and owners of space objects and their space activities. Those obligations are mainly related to compliance with space debris mitigation regulatory instruments adopted by the United Arab Emirates Space Agency. Efforts were made by the United Arab Emirates Space Agency to conduct a comparative analysis and to develop a first draft of the Space Debris Mitigation Guidelines, which are currently undergoing a round of consultations with stakeholders. Moreover, the article of the federal law related to space debris mitigation obliges the operators and owners of space objects to notify the Space Agency about any space-related risks or incidents, in addition to periodic reporting on space debris.

In addition, the United Arab Emirates Space Agency is currently utilizing the agreement with the United State Strategic Command to share space situational awareness services. The agreement is aimed at enhancing awareness and increasing the safety of spaceflight operations through the sharing of information crucial for launch support and the planning of satellite manoeuvring, support for in-orbit anomalies and in-orbit conjunction assessments.

4. Information on practices that have proved to be effective in minimizing the generation of space debris

In addition to the ongoing work related to the development of the United Arab Emirates Space Debris Mitigation Guidelines, which will be followed by operators and owners of space objects, national satellite operators in the United Arab Emirates have been voluntarily following a number of practices that minimize the generation of space debris, such as the following:

- During the procurement phase in commissioning a new satellite, national satellite operators specify that a detailed space debris mitigation plan that limits the release of debris must be provided by the satellite manufacturer. This is accomplished in part by testing the new satellite at the unit and system levels to confirm its ability to withstand the space and launch environment (for example, vibration thermal, vacuum and acoustic tests).
- Continuously monitoring the integrity of the satellite elements to ensure anomalies do not lead to catastrophic failure.
- Performing detailed orbital analysis using software that uses satellite configuration and orbital elements to limit low Earth orbit satellites' natural lifetime to under 25 years.
- Implementing a strategy to avoid space debris by setting up processes and procedures required of engineers in carrying out their manoeuvre analysis.
- Coordinating Yahsat satellite frequencies and orbital data with other satellite operators during relocation and co-location events.

- Improving the accuracy of information on the position of United Arab Emirates satellites by periodically requesting third-party tracking of the satellites and using the resulting data in equipment calibration.

5. Ways in which debris mitigation guidelines are being implemented

National telecommunications operators in the United Arab Emirates are voluntarily complying with space debris mitigation guidelines. For instance, Yahsat has confirmed its implementation of the existing international guidelines on space debris mitigation (e.g., those of the Committee on the Peaceful Uses of Outer Space and IADC and the European codes of conduct). In addition, the draft Space Debris Mitigation Guidelines being developed by the United Arab Emirates Space Agency are based on the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space and selected international best practices.