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English only

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
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Vienna, 29 January–9 February 2018
Item 8 of the provisional agenda*
Space debris

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

The present conference room paper contains submissions received by the Secretariat from:

(a) Algeria on 21 November 2017;

(b) Austria on 16 October 2017, and includes additional pictures and figures not included in document A/AC.105/C.1/113.

The document is issued without formal editing.

* A/AC.105/C.1/L.363.

Replies received from Member States

Algeria

[Original: French]

Given its recent space-related activities and the number of its satellites in orbit, Algeria has not yet adopted a national mechanism for space debris mitigation. However, that issue is of particular importance to Algeria because of the size of its territory, the density of its population and the growing number of space objects in orbit over its territory.

Consequently, Algeria has given consideration to the implementation of appropriate national solutions to address the problem. That consideration has resulted in the following recommendations in particular:

- The strengthening of cooperation between developed States and emerging economies through the transfer of expertise is essential in order to consolidate efforts to combat the creation and proliferation of space debris
- All operators in the area of space should actively participate in international scientific events relating to space debris mitigation, because the exchange of ideas leads to better results
- Those same operators should be held liable for any damage caused by a space object in the course of their space activities.

In that context, Algeria is working to identify a suitable site for a space debris observatory.

In addition, Algeria is aware that efforts should be made to minimize the risks posed by space debris, through cooperation and coordination with international partners. It strongly supports the efforts of the international community to reduce space debris and preserve the orbital and suborbital environment, and appreciates the efforts of the Office for Outer Space Affairs to promote collaboration and encourage progress in that area.

With regard to the safety of space objects with nuclear power sources on board, Algeria, which actively participates in the work of the Committee on the Peaceful Uses of Outer Space and its two subsidiary bodies and supports the principles related thereto, is concerned about the possible consequences of the use of nuclear power sources in outer space, which would undermine any form of long-term sustainability of outer space activities and the preservation of outer space as the common heritage of humankind for future generations.

For that reason, it recalls the provisions of article IV of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, which stipulates that “States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner”. Furthermore, it considers it essential that States pay greater attention to the potential consequences of the use of nuclear power sources, and supports all initiatives involving the transfer of expertise in that area, in order to enable all States that wish to make use of power sources in space to do so safely.

Lastly, Algeria, which is actively participating in the work of the Working Group on the Long-term Sustainability of Outer Space Activities, has also joined the initiative of Canada, Czechia and Germany to develop a compendium of space debris mitigation standards — which is regarded as an innovative document containing information from Member States on national measures to reduce space debris — by contributing information for inclusion in that compendium.

Austria

Since more than three decades, the Institute for Space Research of the Austrian Academy of Sciences has operated a satellite laser ranging (SLR) station at the Observatory Lustbühel in Graz. In addition to tracking more than 150 cooperative targets (equipped with laser retro-reflectors), space debris laser ranging is getting an increasing amount of attention. In the recent past, in Austria within research on space debris focus has been placed on three areas which are described below:

Single-Photon Detection, Alignment and Reference Tool

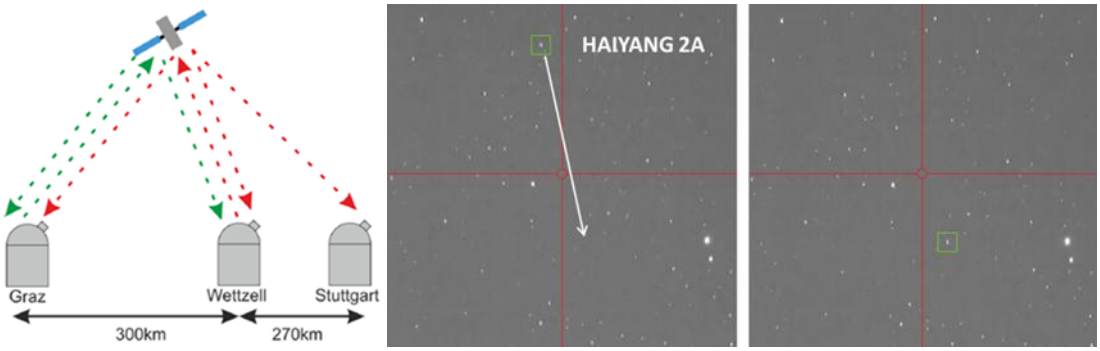
The SP-DART (Single-Photon Detection, Alignment and Reference Tool) developed in Graz works as a tiny mobile SLR station which can be installed at external telescopes. It consists of a transmitting module (15 µJ/ 1 ns/ 2 kHz laser, optics, mounted on the telescope) and a detection package (laptop, FPGA-based control unit, Riga event timer, GNSS unit, meteorological instruments). The major advantage of such a setup is the reduced alignment effort due to the avoidance of any Coude-path. The SP-DART system was successfully tested on a 70 cm astronomy telescope owned by Astrosysteme Austria. Overall, during two observation nights 17 different targets were tracked with maximum return rates ranging from >30% for LEO satellites to 0.2% for Compass-I5. This innovative approach was recently applied at Graz SLR station using a compact high power space debris laser directly mounted on Graz telescope successfully ranging to several space debris targets.

Multi-static experiments

Multi-static experiments are complex space debris laser ranging measurements involving at least three different stations measuring the distance to the same space debris target. Graz SLR station sends photons using its green high power (20W/100Hz) space debris laser, simultaneously Wettzell SLR station sends photons using their infrared space debris laser to the same space debris target. After diffuse refection at the space debris target the photons are spread across Europe. Graz green photons are now detected by Graz itself and by Wettzell SLR station. At the same time Graz, Wettzell and Stuttgart detect Wettzell's infrared photons. Analysing the data showed that such simultaneous measurements significantly increases orbit prediction accuracy compared to the same number of stations operating in mono-static mode.

Stare & Chase

"Stare & Chase" is a method to track and range to space debris targets of which no a priori orbit information is available by optically determining the pointing direction to these targets. An analogue astronomy camera is equipped with an off-the-shelf 50mm objective monitoring a field of view of approximately 7° of the sky. The camera system is piggyback mounted on our SLR telescope and roughly aligned with the optical axis. The telescope is then moved to an arbitrary position "staring" into the sky and displaying stars up to 9th order magnitude. From the stellar background utilizing a plate solving algorithm the equatorial pointing direction of the camera centre is determined with an accuracy of approximately 15 arc seconds. Once a sunlit space debris object passes through the field of view its equatorial coordinates and the current time are stored. From the pointing information a Consolidated Prediction Format (CPF) orbit prediction file is generated and used to immediately track the satellite within the same pass. The process from the first detection of the satellite until successful tracking can be completed within less than 2 minutes. As soon as tracking is established the SLR system starts "chasing" the target with a high power (20W/100Hz) space debris laser. Space debris laser ranging to several cooperative and uncooperative (without retroreflectors) targets was successfully achieved using such "Stare & Chase" predictions.



Left: The setup of the multistatic two colour space debris ranging experiment, including the SLR stations of Graz, Wettzell and Stuttgart. Right: Detection of the Haiyang 2A satellite moving by the “Stare & Chase” camera system.