3 February 2014

English only

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-first session
Vienna, 10-21 February 2014
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 submission received by the Secretariat from Germany on 14 January 2014. The document is issued without formal editing.

* A/AC.105/C.1/L.332.

V.14-00639 (E)

German research activities related to space debris issues carried out in 2013 cover various aspects.

At the Technical University of Braunschweig a study was performed in which the cost-effectiveness of active debris removal was investigated. A simple estimation was used to compile a list of in-orbit objects currently posing the highest risk to operational spacecraft. Long-term simulations of the future space debris environment were performed taking into account active debris removal as well as active deorbiting of spacecraft at their end of life in accordance with the Space Debris Mitigation Guidelines of the United Nations Committee on the Peaceful Uses of Outer Space. It was concluded that active debris removal missions would not be economically feasible if they are to be performed continuously over an extended period. It would, however, be feasible to use this approach as a bridge-over for removing high-risk objects until the great majority of newly launched spacecraft are equipped with a self-deorbiting capability.

Furthermore, an ongoing project is investigating an alternate definition of the criticality of high-risk objects. The new definition tries to capture the effects of the collision cascading process more accurately. In another activity, different disposal strategies for MEO (medium-Earth orbit) constellation objects are being analysed. Especially the long-term collision risk of disposed constellation spacecraft with other constellation and non-constellation objects is of interest.

At Fraunhofer Ernst-Mach Institute EMI, research was continued in view of better experimental characterization of a new gun accelerator facility available at the institute, the so-called “TwinGun”. The facility is capable of accelerating particles in the size range of 100 µm to 2 mm to hypervelocity. Purpose of this facility is to reach higher impact velocities compared to standard gun accelerator facilities, and at the same time reduce facility wear. This will result in improved performance with regards to laboratory-scale experimental impact testing of the survivability of spacecraft components in a space debris environment.

Based on a novel methodology for satellite vulnerability assessment developed at Fraunhofer EMI, a new vulnerability assessment code for satellites has been developed: the Particle Impact Risk and Vulnerability Assessment Tool (PIRAT) is a computational tool for calculating the statistically independent failure rates of spacecraft components from hypervelocity impacts of space debris and meteoroid particles.

Owing to the increasing number of spacecraft and space debris, the likelihood of collisions between satellites and large space debris fragments is increasing. The scientific and technical understanding of such collision processes is still very poor. At Fraunhofer EMI, preparatory research was performed to initiate systematic investigations of collisions and break up scenarios. Initial small-scale impact tests were performed on cubes, representing simplified satellites structures. Based on the initial findings of the tests, information about the collision scenarios and structure of the colliding objects can be drawn from the fragment ejection pattern.

The DLR (German Aerospace Center) Institute of Technical Physics is operating an optical space debris observation station in Stuttgart for scientific purposes. The station is equipped with a 17” Dall Kirkham telescope and various high-end camera systems. During spring and summer campaigns various object in low-Earth orbit down to a size of 0.5 m were passive optically detected and tracks

deduced from these objects were analysed relative to the star background. The activities are aimed to prepare the future implementation of a laser ranging equipment for acquiring ranging data in addition to angular information.

The collision avoidance system at the German Space Operations Centre (GSOC) — operating the German civil satellite missions — has been enhanced with various tools supporting the evaluation and analysis of critical conjunctions. Since beginning of 2011 (until August 2013), GSOC has analysed 51 critical events (17 in 2011, 20 in 2012 and 14 in 2013), for which Conjunction Summary Messages (CSM) have been received in 48 cases, and executed 8 (3 in 2011 and 5 in 2012) collision avoidance manoeuvres with the satellites controlled by GSOC. In 2013, the development of the new conjunction data message (CDM) was supported by GSOC within the CCSDS standard (Consultative Committee for Space Data Systems). International tests were performed. It is foreseen to replace the CSM by CDM in the next year.