

## FOREWORD

Since the beginning of space flight some 56 years ago more than 4,900 successful launches have shaped the volume and composition of the currently known, cataloged space objects in Earth orbits. According to the public USSTRATCOM catalog, some 17,000 man-made objects with a total mass of approximately 6,800 tons are populating the orbit regions from very low LEO up to super-GEO altitudes. About 40% of these objects are intact spacecraft (22%), rocket bodies (11%), or mission-related items (7%). The remainder of 60% consists of break-up fragments, mainly caused by explosions, but also by recent collision events. Only 6% of the catalog population comprises operational spacecraft. The intercept of FengYun-1C in Jan. 2007 together with the collision between Iridium-33 and Cosmos-2251 in Feb. 2009 led to almost 5,600 additional catalog entries, increasing the catalog size by about 50%. All of these fragments were released at LEO altitudes between 780km and 870km, into orbits of very long lifetimes, further aggravating the already critical concentration of high-risk objects at those altitudes.

With 75% of the catalog population and 36.5% of the on-orbit mass the highest concentration of objects is in the LEO region, below 2,000 km altitude. All of these objects have sizes larger than 10cm, and they are capable of causing catastrophic break-ups of even large, intact objects in the case of a collision. Initial studies by NASA, which were recently confirmed in a joint study by the Inter-Agency Space Debris Coordination Committee (IADC), confirmed that the debris concentration at some LEO altitudes has reached a critical level, with a high risk of entering into an uncontrollable collisional cascading effect that is known as the *Kessler Syndrome*. It is common understanding today that the only way to prevent collisional cascading to set in within a few decades is active mass removal, particularly from the LEO region. With these findings in mind, the 6<sup>th</sup> European Conference on Space Debris devoted special sessions to the topic of space debris environment remediation, augmenting the classical sessions on debris mitigation, debris measurements, debris protection & shielding, debris environment modeling, and debris risk assessments with regard to on-orbit collisions and atmospheric re-entries.

There were several key messages that emerged from the technical discussions:

- (1) there is an identified need to implement future space missions with a view on the sustainability of the orbital environment, through a rigorous implementation of internationally agreed debris mitigation measures;
- (2) there is a consensus among debris researchers that the present orbital debris environment is at the rim of becoming unstable within a few decades (known as the *Kessler Syndrome*), and that only the active removal of 5 to 10 large objects from critical orbit regions per year can reverse that process;
- (3) there is an urgent need for research and development activities to facilitate pilot debris removal missions, ideally within the next decade; and
- (4) there is a consensus that active debris removal addresses an environmental problem of global dimensions that must be assessed in an international context, including relevant bodies of the United Nations. These findings were also presented and discussed at a press briefing at the end of the conference.

Within four days the 6<sup>th</sup> European Conference on Space Debris provided a technical forum for the presentation of the current state of space debris research, covering the major disciplines of measurements, modeling, risk assessment, protection and mitigation, while adding debris environment remediation and active mass removal as a new theme. The conference was attended by some 355 participants from 26 countries, making this the largest dedicated conference on this topic worldwide. In 13 technical sessions, 100 oral presentations, and about 90 poster presentations experts from a wide range of space debris disciplines communicated recent and often innovative results of their research.

On behalf of the European Space Agency, the members of the Program Committee, and the co-sponsors ASI, BNSC, CNES, DLR, COSPAR and IAA I would like to thank all chairpersons, authors, and participants for making this 6<sup>th</sup> European Conference on Space Debris a great success. - We look forward to see you again in Darmstadt at the 7<sup>th</sup> European Conference on Space Debris in 2017.

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(Conference Chairman)