Paper ID: 25838
student

SPACE DEBRIS SYMPOSIUM (A6)
Poster Session (P)

Author: Mr. Alaa Hussein
University of Sussex, United Kingdom

Prof. Chris Chatwin
University of Sussex, United Kingdom
Dr. Rupert Young
University of Sussex, United Kingdom
Dr. Phil Birch
University of Sussex, United Kingdom

LEO SPACE DEBRIS MITIGATION USING LASER ABLATION

Abstract

Since the first spacecraft was launched in 1957 a great number of spacecraft have been put into orbit and a significant fraction of these are still orbiting the Earth as inert vehicles or space debris. Major collision events between large satellites in Earth orbits have broken-up spacecraft systems for about half century; this has created a massive quantity of space junk – most of which are small particles. The number and quantity of debris items is increasing and as a result the probability of catastrophic collisions is growing progressively.

Objects in space, whatever their size, are potentially hazardous and can cause considerable damage, which may disable a space system and producing numerous secondary fragments as a result. Low Earth Orbit (LEO) requires particular attention because this band contains large masses of material orbiting at high relative velocities, up to 14 km/s. At this hypervelocity, even small debris, 5-10 cm, can produce extensive damage to any operation satellite and destroy any small satellites. Collision with smaller debris, 1-5 cm, could disable any space system. Therefore, our space assets in LEO are threatened by this large quantity of space junk, which may lead to collision cascading in the future.

Small orbital debris stays in LEO for a very long time (100s years) before re-entering the atmosphere, so it poses a great threat to any operational spacecraft. However, the debris lifetime can be reduced significantly by slowing the debris velocity slightly and lowering its perigee. This can be achieved by using the unique property of laser propulsion to generate thrust remotely on the orbital debris by beaming the necessary power from the ground. So, this paper assesses and simulates the engagement of laser beam pulses with space debris. It also calculates and simulates the required time and number of interactions for de-orbit and also simulates the required change in orbital velocity (ΔV) of the debris to lower its altitude and cause it to change orbit and eventually fall into the upper atmosphere, where it will burn up.

In conclusion, space debris mitigation is now essential to protect existing space systems and maintain the sustainable use of outer space. That is why the space debris problem is now a very significant environmental issue. As this technique does not require launching space vehicles, we believe that this clearing strategy is an achievable and cost effective method to deflect and mitigate the effect of space debris.