Optimization of Net & Whipple Shield-Based Space Debris Removal

Doan, BanAnh (School: Gwinnett School of Mathematics, Science, and Technology)

Space debris cleaning has yet to see a viable solution that would effectively remove debris while staying in good condition. Of the active methods of debris removal proposed, tether nets have proven to be the most promising method of debris removal, but are limited to only larger, moderate to low-velocity objects that won't tear the net and damage the spacecraft. Passive methods aim to protect space technology from debris, and as a spacecraft that targets debris-dense areas, service crafts need to be protected from hypervelocity impacts. Whipple shields are a popular choice for debris shielding, but without consistent maintenance, traditional whipple shields would fail over an extended period of time. By developing a tether net service craft enforced with stuffed, strong whipple shields, the improved tether net would be a more practical and efficient option in comparison to other removal methods. Origami folding would be utilized, turning the net into a circular envelope capable of opening and closing securely around debris of irregular shapes. The energy produced by the enforced net collecting debris is modeled using NASA's General Mission Analysis Tool and compared to the energy a whipple shield made of Nextel fiber could sustain before fracturing. The current model shows that with Whipple shield enforcing, the proposed tether net service craft can feasibly optimize Low-Earth-Orbit debris removal without sustaining long term damage and costs. The dynamic size and shape of the shield would collect resultant debris clouds and permit multiple removal trips.

Awards Won: