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Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems (2A)

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SPACE DEBRIS: THE STOCK GEO MATERIAL FOR RE-UTILIZATION AND RECYCLING SPACE MISSIONS.

Abstract

The issue of orbital space debris is well known, but it continues to be a significant challenge to find economically viable approaches to reducing existing debris. The concept of treating debris objects as a resource, to be collected and reused or recycled into useful new spacecraft parts, is an emerging idea that could address this challenge. Currently, there are more than 1,200 satellites in GEO of different types and architectures, and composed of a wide range of materials. Around 57% of these satellites are already inactive or dead that potentially can be re-utilized and recycled.

The main objective of this paper is to present an analysis of the space debris population in GEO by considering it as a potential resource to be re-utilized and recycled. The aim is systematically to classify the different types of materials and components, quantify their availability and map their distribution in the GEO region to build a sort of "GEO resources map" for the future exploitation and re-utilization of recycled resources in space. The so-obtained dataset will be based on the analysis of current inactive resources in GEO, but it will be further expanded with predictions of future availabilities, accounting for eventual satellites that will reach their end of life in the next decades.

This map will allow for identifying patterns in the distribution of materials and components in GEO, also accounting for the similarities in technology, satellite architectures and buses. A number of basic components are potentially subject to be recycled, like structural elements, solar arrays, batteries, engines, and payload equipment. However, for active components the operational wear and exposure to the space environment may cause degradation and drastically reduces the chances for re-utilization or more straightforward recycling for use on other active spacecraft. To have an adequate evaluation of the state of the components and materials, they are also analysed according to the position they have been orbiting while the satellite was active and the position they have now and will have in the next 20 years, and the time they have spent within an active or inactive satellite.

The information presented in this paper is intended to be taken as a starting point and reference source for the future development of new technology and mission concepts. The end goal is to foster a sustainable space ecosystem and guarantee the proper utilization of space for the next decades to come.