SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Engineering - Methods, Processes and Tools (1) (4A)

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INTEGRATING LIFE CYCLE ASSESSMENT OF SPACE SYSTEMS INTO THE CONCURRENT DESIGN PROCESS

Abstract

Recent commitment by national and international bodies towards environmental problems has allowed a range of mitigation measures and key sustainability issues to filter down and become embedded in a variety of sectors. Despite this, space industry operations have often been omitted from key legislation or regulatory requirements, with the result that the environmental impact of industry activities were often overlooked or ignored. Over the last few years this has begun to change.

Important within this context is an environmental management tool called Life Cycle Assessment (LCA) which is increasingly being adopted by the space industry to assess the full environmental impact of their products and practices over their entire life cycle. The European Space Agency (ESA) began work on this topic in 2009 by employing an internal concurrent design study called ECOSAT to consider the life cycle impact of the design, manufacturing, launch and operations of a satellite. One of the key findings of this study revealed that existing terrestrial focussed LCA databases lacked the scope and capacity to conduct such advanced assessments due to the unique and specialist nature of space sector operations.

To overcome this, ESA has continued to develop LCA methodology within the space sector to the point where it is now looking at introducing elements in the design of future spacecraft and space systems. This indicates the manner in which the design and execution of European space missions will likely proceed. Running alongside this green movement, the New Space trend is predicted to introduce large numbers of small satellites into the space environment which will substantially alter environmental and societal impacts.

This paper presents an open-source LCA platform currently under development at the University of Strathclyde, outlining its integration into the concurrent design process of next generation green space systems. The LCA platform includes extreme scale systems from large constellations of nanosats to solar power satellites. Both extremes have in common the need of massive production cycles. The integration of LCA into the design process allows one to minimise the environmental impact and define new optimality criteria for the space system.