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SYSTEMS ANALYSIS MODELING OF NOVEL SPACE SOLAR POWER CONCEPTS

Abstract

Among other important options, space solar power (SSP) remains one of the most-promising, but as yet largely undeveloped options to accomplish the goal of large-scale sustainable energy for markets globally. During 2008-2011, the International Academy of Astronautics (IAA) accomplished the First International Assessment of Space Solar Power, involving diverse subject matter experts (SMEs) from some ten (10) countries. The IAA assessment found that SSP is technically feasible and that it might be realized in as little as 10-15 years. Following on those results, in 2011-2012 an international team, working under the auspices of NASA's Innovative Advanced Concepts (NIAC) program examined a novel, more practical hyper-modular approach to realizing SSP: "SPS-ALPHA" (Solar Power Satellite by means of Arbitrarily Large Phased Array), invented by the author. Together, the IAA and NIAC studies framed the foundation of an integrated treatment of the topic, "The Case for Space Solar Power" (published in 2014), which presented the first single-volume, integrated and detailed discussion of the topic in some 20 years.In the past several years, new ideas for SSP in general and improvements in the SPS-ALPHA concept in particular have emerged. These include related developments in space and terrestrial technologies (e.g., reusable launch systems), new SSP activities internationally (e.g., new commercial efforts), as well as innovations in how SSP might be accomplished (e.g., in-space fabrication). However, evaluating this or any novel space concept requires timely and verifiable modeling of the new SSP concept in an integrated and verifiable fashion in which key assumptions concerning supporting infrastructure or technology performance may be evaluated independently. This paper will review recent advances in space solar power concepts, particularly the SPS-ALPHA approach, and will focus on a review of the methodology, the modeling details and the results of recent analysis efforts. It will high-light how spreadsheet based modeling may be used to examine through sensitivity studies the potential impact of new technologies and resulting concept evolution on the technical feasibility and economical viability of space solar power.