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IAF SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies and Application (2)

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VALIDATION OF NANOSATELLITE DESIGN FOR HIGH-POWER BEAMING TO RURAL OFF-GRID LOCATIONS

Abstract

Since the advent of space technology, beginning with the Space Race and culminating into the rise of risk-tolerant nanosatellite architectures to replace monolithic large satellites with the capability to perform a plethora of operations with an even wider expanse of applications, ranging from Earth Observation, Communication, Internet, and Navigation, to list a few. There are also new upcoming applications such as Debris Mitigation and Cryptocurrency. One such novel application bound to be a necessity in the future is high power satellites capable of operating payloads and even deliver power considered beyond the capabilities of conventional satellites. Through the strategic and innovative infusion of current advancements in Satellite and Power technologies, the design of a baseline model for such a satellite capable of power beaming using LASER and MASER along with frequency-tuned solar arrays has raised the TRL of this technology from impossible to possible. This project has evolved the baseline architecture to serve purposes requiring higher power handling capabilities. With upgraded AI-operated control architecture, increased size, upgraded subsystems, the inclusion of a microvascular thermal control system utilizing the rear side of solar panels for heat dissipation and increased power storage. Thermal, structural, and flow simulations were performed on ANSYS to validate the developed system architecture. Along with the systems architecture, the mission design and architecture have also been performed by utilizing the satellite in a LEO Sun-synchronous Polar Orbit for a constant solar operation to beam power to the ground at remote power reception facilities located at regions with minimal access to ground-based electricity resources. The constellation simulation was validated successfully for a five-year duration for viable commercial operation with the eclipse and solar exposure feasibility, mission life, and contact opportunities to each station for power beaming using GMAT. The same orbit may also be considered for future projects in the scientific community for internet service provision to these rural areas. With most components being Commercial-off-the-shelf, the nanosatellite opens a plethora of possibilities by fitting such a system within a small size and drastically reduces technology development and launch costs, which would revolutionize space operations and exploration in terms of what mankind has imagined and defined it to be, advancing the vision of every global citizen with a passion for the space domain, to be part of a spacefaring world unlimited by distance and time.