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ENHANCING 5G GLOBAL CONNECTIVITY VIA SATELLITE CONSTELLATIONS: PRELIMINARY
SIZING OF PHASED ARRAY ANTENNAS USING A HEURISTIC SOLVER WITH GENETIC
ALGORITHMS

Abstract

Satellite 5G connectivity to handheld devices is a critical technology that has significant benefits in various areas, such as remote healthcare, emergency response, and global connectivity. Achieving this requires state-of-the-art satellite constellations that can provide high-speed, reliable, and low-latency connections. Phased array antennas are a key component of these constellations, providing directional, high-gain signals, and beamforming capabilities to enable the delivery of high-speed and reliable data transfer. In this paper, we propose an approach to preliminary sizing of phased array antennas for 5G satellite connectivity accounting for stakeholders' requirements and use cases constraints.

To optimize the configuration of phased array antennas, we explore the tradespace of feasible design configurations using a heuristic solver approach leveraging genetic algorithms. The tradespace exploration has been constrained with link budget limit, launcher mass and volume, launch capacity, and minimum system performance. Building on this information, the solver identifies the near-optimal configurations that meet design specifications while maximizing satellite throughput.

The results stemming from the application of the method and related tool, demonstrate the potential of our approach to build systems that deliver high-speed and reliable connectivity to handheld devices from space, enabling remote healthcare, emergency response, and global connectivity. Overall, this paper presents a novel and efficient approach to optimizing the configuration of phased array antennas for satellite 5G connectivity, and our findings offer opportunities to enhance the design and performance of satellite constellations by quickly converging to a preliminary sizing of a viable option eventually refined in later stages of design and development of the spacecraft system.