A Novel System for Long-Range Wireless Power Transmission

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Wired power transmission necessitates costly infrastructure. Wireless power transmission could be an alternative, but is limited by substantial energy loss. This project develops a novel Wireless Power Transmission system (WPTS). The WPTS was designed to deliver power wirelessly through 2.4GHz EM waves. Using a self-developed optimization algorithm in Excel, a novel Fresnel Lens with concentric rings and angles specific for EM was created to phase-align and collimate waves into a beam, maximizing energy transmission. A Phased Array Transmitter (TX) was added to magnify and beam-steer the EM waves to the Fresnel Lens. Finally, the Rectenna Receiver converted the EM waves back into DC power. The new WPTS was simulated with HFSS software (EM field-simulator). After designing the components in HFSS, energy outputs were compared. A WPTS prototype was built from scratch to validate HFSS simulation data in real-world conditions. The prototype consists of a self-designed Phased Array Transmitter (Printed Circuit Board), 3D-printed Fresnel Lenses, and hand-made Rectennas. Simulations show the new WPTS transmits potential energy over 10m, with minimal loss. The WPTS prototype validated simulation results by providing a 31dBm increase in power, versus a single antenna. Furthermore, the novel Fresnel lens collimates EM waves, leading to more efficient energy transmission. Adding the Fresnel Lens leads to greater power transmission efficiency, showing a 9X power increase vs a single antenna and a 21X increase vs a phased array. Overall, the new system successfully transmits power wirelessly as EM radio-waves, an important first step in harvesting clean energy from distant sources.

Awards Won:
Qorvo: Qorvo Innovator Award - 1st Place
NASA: 2nd Prize