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ULTRA MICROGRAVITY PLATFORM WIRELESS POWER TRANSFER WITH IMPROVED EFFICIENCY BASED ON TRANSFORM OPTICS AND METAMATERIALS

Abstract

On many satellites and spacecraft, a common method to provide the hyper-quiet environment for some sensitive payload or optical devices is to use electromagnetic levitation or electrostatic levitation technology for isolating the payload from the vibration environment on the spacecraft. For supplying electrical energy, the wireless power transfer (WPT) is proposed. Electromagnetic(EM) field is ubiquitous in life, the manipulation of which is a popular topic in optics, electromagnetic and engineering. Since the foundation of Maxwell equations, scientists have proposed several schemes to control the EM field. Transform Optics is an emerging approach to manipulate EM field in recent years, which is valid from DC to optical frequency. The metamaterials(MM), designed by transform optics, have been applied in antenna system and demonstrated their good performance.

As wireless power transfer delivers energy essentially based on magnetic coupling in space, the efficiency could be improved by proper approach for EM manipulation. In this paper, the new magnetic concentrator designed by coordinate transformation is proposed. The idea is to map the magnetic field near the transmitting coil to the spherical region encircling receiving coil. By numerical computing in near field, the concentrator is proved to make the magnetic field in the vicinity of receiving coil could be increased and mutual inductance and efficiency could be enhanced. Compared with traditional EM concentrator, the new magnetic concentrator has a simpler structure and takes less space, which could ameliorate the flux distribution near the receiving coil. In this way, a more compact emitter to charge electronic devices in a wider and longer range.