Ensures Stable Energy Transfer from Chargers to Implants Even When Misaligned

This transmitter array configuration efficiently transfers energy to biomedical implants no matter the alignment between the charger’s transmitter coils and the implant’s receiver coils. Biomedical implants are devices that either replace a biological structure or monitor a certain biochemical state in a patient. These implants range from glucose monitoring patches to artificial heart valves and all require a power source to function. With biomedical technology expanding exponentially, there is an increasing demand for wirelessly powered implants, as they eliminate any need for battery replacement surgery. However, the development of these implants is limited because available transmission configurations fail to provide adequate power transfer efficiency. This is primarily due to the use of a singular transmitter coil, matching the size of receiver coil, that requires exact alignment with the implant’s receiver coil in order to achieve optimal power transfer efficiency. While perfect alignment yields high efficiency, the patient’s tissue combined with the implant’s small dimensions increase the difficulty of achieving perfect alignment. A much larger singular transmitter coil that can overlap the small receiver coil is a solution to relax alignment, but the mismatch of sizes results in lower power transfer efficiency.

Researchers at the University of Florida have developed a transmitter array that yields high power transfer efficiencies at different orientations. Even when misaligned, this device maintains constant energy transfer to the implant, guaranteeing successful implant operation and patient compliance.

Application

Wireless power array that improves transfer of energy to small-scale biomedical implants and sensors

Advantages

- Uses multiple transmitter coils surrounding a singular excitation coil, amplifying the range at which electromagnetic waves travel from the device
- Yields a large coupling coefficient between transmitter and receiver, securing communication between transmitter array and receiver coils at different distances
- Provides a reliable wireless power source for biomedical implants and sensors, eliminating the need for larger implant sizes with robust internal batteries
- Supports different geometric arrangements, accommodating to various implant dimensions
Technology

This wireless power array consists of a series of resonant transmitter coils organized around a single excitation coil. The excitation coil emits radio waves at the resonant frequency. As the excitation coil transmits these waves, the surrounding resonant coils amplify the signal, enabling it to cover a wider area. This maintains high power transfer efficiencies as the array geometry compensates for any possible misalignment. The device installs within a charger, which a patient places close to the location of his medical implant. Since the array is relatively larger than conventional configurations, it provides stronger energy coupling between the transmitter and the receiver. Because the device has a large coupling coefficient, patients are free to position the device in a comfortable orientation of their choosing.

Inventors

Jenshan Lin, Ph.D., is a professor in the Department of Electrical and Computer Engineering at the University of Florida. Dr. Lin earned his master’s degree and Ph.D. in electrical engineering from the University of California at Los Angeles. He was appointed as an honorary chair professor of National Taiwan University of Science and Technology and served as the Editor-In-Chief for IEEE Transactions on Microwave Theory and Techniques. He has published more than 260 technical papers and holds 16 patents. His research interests include sensors and biomedical applications of microwave and millimeter-wave technologies, wireless energy transfer and conversion, RF system-on-chip integration, and integrated antennas. Dr. Lin has been serving as a program director in U.S. National Science Foundation since October 2016.

Lawrence Fomundam earned a bachelor’s degree in computer engineering from University of Maryland, Baltimore County, a master’s degree in electrical engineering from Georgia Institute of Technology, and a Ph.D. from the University of Florida. Previously, he worked as an electronics engineer at Northrop Grumman on inertial measurement sensors for space applications. Mr. Fomundam’s research interests include on-chip wireless power transmission and power management circuits for biomedical implants, low power radio frequency identification tags, broadband tissue equivalent phantoms, and printed antennas for medical implants.