Harmonics-Enabled Antenna Alignment for High-Efficiency Wireless Power Transfer

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Wireless implantable medical devices (IMDs) provide an opportunity to improve the patient health monitoring and treatment. To facilitate the miniaturization of IMDs and to extend the lifespan without incorporating a bulky battery, the wireless power transfer (WPT) technology plays an essential role. Typically, near-field resonant inductive coupling (NRIC) link was established through the magnetic coupling to transfer power wirelessly. However, it strictly requires an accurate placement between the transmitting (TX) and the receiving (RX) coils to avoid a severe power delivery efficiency decline. In addition, the NRIC only works in a short range due to its fast decay with respect to the distance. Far-field WPT has been developed rapidly as it provides longer operational distance. However, the wireless link efficiency of the far-field WPT antennas often suffers from antenna polarization and radiation direction misalignments.

In this presentation, an antenna alignment method using intermodulation is reported to address WPT antenna misalignment in a safe way. Two-tone waveform excitation is employed to enhance the rectification as well as to generate intermodulation. The intermodulation power is fed back via a magnetic resonant coupling link. Due to the monotonic relation between the intermodulation power and the degree of antenna misalignments, the RX antenna (in body) can be aligned with the TX one (outside body). Such a scheme has the advantages of less harm to human tissue and less interference between the two-tone waveform excitation and the magnetic resonant coupling link. The whole system is theoretically analyzed and experimentally validated.