Wireless Power Transfer with Multi-Sine Excitation for Bio-implants

Yong-Xin Guo
Department of Electrical and Computer Engineering, National University of Singapore
Email: yongxin.guo@nus.edu.sg

Implantable medical devices (IMDs) have been regarded as a promising technique for future early diagnostics and therapy. Among the various implantable biomedical devices, wirelessly-powered implants feature many advantages over the traditional ones with transcutaneous wire and bulky batteries. By replacing the wires and batteries with a high efficiency wireless link, the technique of wireless power transfer (WPT) efficiently reduces the patients' risk to infections and eliminates the frequent surgeries intended for battery replacement. Besides, the removal of battery also makes it easier to miniaturize the IMD design and implant it with smaller incisions.

It is crucial to design a high-efficiency WPT system for bioimplants to meet the safety requirements. To improve its overall efficiency, many research efforts have been focused on the optimizations of the coil pairs and the receiving circuits, which are mainly based on a single-frequency, continuous-wave (CW) sine signal. The optimization of excitation waveform configurations had drawn attention in recent years. The "multi-sine" waveform, which represents the in-phase, multi-tone signals, is characterized by a synthesized waveform with high peak-to-average power ratio (PAPR). The high PAPR multi-sine waveform would always face the challenge to easily cause the rectifier to early breakdown with high input power, which severely limits its potential applications.

In this talk, a WPT system with multi-sine excitation by using a reconfigurable rectifier will be presented to solve the early breakdown problem and further demonstrate the efficiency improvement in the comparison with traditional single CW signals.