Ultrasonic Communication and Power Links for High-Bandwidth Micro-Implantables Operating at Depth

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Highly miniaturized minimally invasive implants with wireless power and communication links have the potential to enable closed-loop treatments and precise diagnostics. For example, a retinal implant to cure blindness in a closed-loop system records a large array of neural signals at cellular resolution to classify cell types, informing an effective stimulation pattern for accurate reconstruction of the visual image. Such a task requires heavy external data processing and therefore high speed communication links. To minimize surgical complications and enable long term implantation, we propose wireless ultrasonic links for power and data communication inside the body. However, robust wireless communication between implants and external transceivers presents challenges and tradeoffs with miniaturization and increasing depth. Both link efficiency and available bandwidth need to be considered for communication capacity. We'll review circuits and systems for robust bi-directional links, and explore opportunities in achieving high-rate ultrasonic data communication with deep tissue implants using available spatial degrees of freedom to overcome the limited bandwidth of ultrasound compared to RF.