Cutting the Cord: Using Inductive Coupling and Litz Coils to Wirelessly Power and Retrieve Data From Implanted Batteries & Sensors

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Millions of patients worldwide require the use of implanted medical devices (IMDs) to treat chronic illnesses. These devices use non-rechargeable batteries, requiring invasive and possibly dangerous surgeries to replace, introducing extensive patient discomfort, hospital expenses, risk of infection, and potential heart complications. This makes the non-invasive recharging of these devices a critical forefront of research for long-term patient health. Utilizing wireless power transfer (WPT) for IMDs, specifically through inductive coupling principles and Litz wire coils, this project tests the wireless recharging of implanted batteries (using pacemakers as the IMD of focus). To simulate real-world in-vivo conditions, a human body model was constructed, measuring factors such as power transfer efficiency, voltage requirements, skin temperature increase, and overall safety of use to determine biocompatibility. This project also explored On-Off Keying (OOK) modulation, allowing for data retrieval from implanted sensors (allowing metrics such as blood pressure, oxygen saturation, and pH levels to be measured) through binary encoded data. This modulation is contained within the powering system and requires no significant extra space within the patient. The model required only 8 hours of charging time for an advanced bi-ventricular pacemaker to be operational for 2 years. The skin temperature increase from the inductive coupling system was also estimated to only be a negligible 0.3 degrees Celsius. The testing of the OOK modulation system was also successful in transmitting a short sequence of binary data. Overall, this project's model was able to demonstrate the wireless charging of an implanted battery and simulate the binary data retrieval from an implanted sensor.

Awards Won: