Low-Profile Wireless Power Receivers for Pediatric Circulatory Blood Pumps

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Abstract: Heart failure (HF) affects approximately 12,000-35,000 children each year in the United States. The development of blood pumps that provide circulatory support for many adults suffering with HF has allowed them to survive until they receive a heart transplant. However, while the development of blood pumps for adults has led to fully-implantable devices, blood pump technology for children has lagged significantly behind. One area for improving the implantability of blood pumps for children is the use of wireless powering systems. These systems eliminate the power cord connecting the implanted blood pump to the external power supply. In adults, wireless power systems have decreased the number of power cord-related infections and have improved patient outcomes after pump implantation. Unfortunately, the components of these wireless systems are too large for children. We propose the development of low-profile wireless power receivers to improve the implantability of blood pumps for children. In this research students will study the feasibility of using flexible printed circuit boards and thin-film magnetic alloys to design implantable receivers for wirelessly powering a child-specific blood pump (Jarvik 2000 Child). This research will require students to use finite element modeling software to predict the magnetic interaction (mutual inductance and coupling) between transmitting and receiving coils and to design, fabricate, and test various coils. Students will use modeling software like Finite Element Method Magnetics (FEMM) and printed circuit board layout software like Eagle to design transmitters and receivers. Coils will be fabricated using basic etching procedures.

Students: This project requires 2-3 students with strong interest in both the electrical engineering and biomedical engineering fields. Basic knowledge of linear circuits and electricity and magnetism are required. Knowledge of nonlinear circuits (diodes, transistors, voltage regulators) are encouraged.

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