AbstractID: 81 Title: Real Time Tumor Localization using an Inductively Coupled Transmitter and a Superconducting Quantum Interference Device (SQUID) Magnetometer System

Abstract

Real-time, three-dimensional localization of the prostate for intensity modulated radiotherapy can be accomplished with passively charged, radio frequency transmitters and superconducting quantum interference device (SQUID) magnetometers. The overall system design consists of an external dipole antenna as a power source for charging a microchip implant transmitter and SQUID magnetometers for signal detection. An external dipole antenna charges an on chip capacitor through inductive coupling in the near field region through a small implant inductor. The charge and discharge sequence between the external antenna and the implant circuit can be defined by half duplex, full duplex, or sequential operations. The resulting implant discharge current creates an alternating magnetic field through the inductor and is detected by the surrounding magnetometers to calculate the location of the implant transmitter. Problems associated with this system design are interrelated to the signal strength at the detectors, detector sensitivity, and charge time of the implant capacitor. The physical parameters required for optimizing the system for real-time applications are the operating frequency, implant inductance and capacitance, the external dipole current and loop radius, the detector distance, and mutual inductance. Consequently, the sequential operating mode is the best choice for real-time localization for constraints requiring positioning within 1 second due to the mutual inductance and detector sensitivity. We present the theoretical foundation for designing a real-time, 3-D, prostate localization system including the associated physical parameters and demonstrate the feasibility and physical limitations for such a system.