Electrically Coupled Loop Antenna as an Implanted Antenna

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There are many challenges involved with the implanted antenna designs including but not limited to the miniaturization of a wideband antenna and reducing the specific absorption rate, SAR, of a miniaturized antenna. Most of the proposed antennas for implanted applications are electric antennas such as planar inverted-F antenna, PIFA. By miniaturizing the size of an electric antenna the electric field intensity in the antenna near zone will increase resulting in higher SAR. This work is trying to design a miniaturized magnetic type antenna to overcome the SAR limitations for small implanted antennas.

The proposed Electrically Coupled Loop Antenna (ECLA) is design to respond to the challenges in the previous works. ECLA consists of a metallic loop parallel to a distributed capacitor, fed by an electrically coupled prob. Since the main radiating element is an electric current (magnetic field) induced on a metallic loop, ECLA is a magnetic field antenna. Therefore, spherical modes excited by the antenna have a relatively low wave impedances resulting in low electric field intensity and strong magnetic field intensity in the near zone. The low electric field intensity helps to reduce the SAR. Also because human body mostly contains electrical materials (σ and ε_r) ECLA is less sensitive to the detuning effect of the human body. The proposed antenna is designed at the MICS band with dimensions (5x5x3) mm. Using High Frequency Structure Simulator (HFSS) and XFDTD simulation the proposed antenna is analyzed inside, one layer model of the human body, human head, and inside the human body. From the simulation results, the proposed antenna inside the human body has 5 MHz -3 dB bandwidth, -14dB gain and radiation efficiency 0.525 %. The 1g average value of SAR inside the human body for 1w input power is about 100 w/kg which is seven times lower than the patch antenna of the same size.