Design and Simulation of Miniaturized PIFA Antenna for Biomedical Sensors

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Dielectric properties (permittivity and conductivity) of biological tissues are interest for biomedical microwave imaging. These properties should be measured in vivo to provide correct images of the tissue. Although there is a significant research done on ex-vivo and in-vitro tissue measurements, the in-vivo measurements have been limited due to the need for surgery or implanted sensors.

There is good evidence that ex-vivo and in-vivo dielectric properties are different. These differences are due to several factors such as changes in blood circulation, water content and temperature. We propose an implantable sensor system that is embedded inside the tissue and is attached to a transmitter and a miniature antenna on the body (A. Sabouni, C. Hahn, S. Noghanian, E. Sauter, and T. Weiland, ISRN Biomedical Imaging, doi:10.1155/2013/894153). The wireless sensor is proposed in order to read the dielectric property in real time, without the need of surgery, to monitor the changes in dielectric property under different conditions.

Miniaturized antenna is a necessary part of the proposed system, as the antenna will be attached to the body of subject (e.g. laboratory animals). The challenges in designing such antennas are the effects of lossy tissue on the gain; and providing enough bandwidth while the efficiency and gain are reasonable. Small antennas are easily affected by surrounding and inherently have low gain and high crosspolarization. This paper focuses on the design and measurement of a miniature antenna and studies the effects of tissue layers on the antenna performance.

We chose a Planar Inverted F Antenna (PIFA). Although this antenna has been studied extensively, most of these works have been limited to the antennas without lossy tissue surrounding or implanted inside the lossy tissue. We attempted to reduce the antenna size while it was on the skin layer and surrounded by free space, and studied the tissue layer effects on the performance, using CST Studio simulation program.