Electrical Properties of Nude Rat Skin and *In Vitro* Verification of Implantable Antennas

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Antennas have major role in implantable systems since they provide communication of the implant with the outside environment. However, designing antennas for implantable systems is quite challenging due to antenna size, impedance matching, low-power requirements, and biocompatibility with the body's own physiology. A small size dual band implantable antenna for MICS (402 MHz–405 MHz) and ISM (2.4 GHz-2.48 GHz) bands was designed and *in vitro* tested in (*T. Karacolak and E. Topsakal, North American Radio Science Meeting, Ottawa, Canada, July 22-26, 2007*) using measured electrical properties of the human skin from the literature (*C. Gabriel, S. Gabriel, and E. Corthout, Phys. Med. Biol., 41, 2231-2249, 1996*). However, such measurements do not guarantee that the designed antenna will function properly when implanted in human since the antenna characteristics may be affected from the temperature and moisture changes in the tissue. In order to verify the proper functioning of the designed antennas *in vivo* they need to be tested on model animals. First logical step towards *in vivo* animal tests is to develop skin-mimicking gels for rat skin to perform *in vitro* studies.

In this study, we measured the dielectric properties of skin tissue samples taken from 3 rats of same ages (each 100 days old) between 500 MHz and 20 GHz. Based on these measurements, we designed a dual band antenna using particle swarm optimization algorithm in combination with an in house finite element boundary integral solver. In order to test the fabricated antenna, we prepared two skin-mimicking gels that approximate the relative permittivity and conductivity of the rat skin samples at 402 MHz and 2.4 GHz. Finally, *in vitro* measurements are performed using an E8362B PNA network analyzer and results are compared with the simulations.