Numerical Analysis of Wireless Telemetry and Specific Absorption Rate for the Retinal Prosthesis Implant

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Future developments in biomedical applications, such as a retinal prosthesis implant, will require the transfer of larger quantities of power and information than earlier applications. The stability and reliability of the inductive link as well as the compliance with safety standards are of critical importance for these applications. Thus, in these biomedical telemetry applications, detailed numerical studies are necessary to assess the performance of the power coupling and information transfer between implanted and external coil, as well as power deposited in body tissues due to the operation of a wireless telemetry link.

In this paper, recent advances are presented in the numerical analysis of bioelectromagnetic problems such as the retinal prosthesis. Biomedical telemetry systems usually consist of an external primary coil and an implanted secondary coil, which are separated by a layer of skin and tissues. An analytical DC approximation, based on the Partial Inductance concept (A.E. Ruehli, *IBM J. of Res. and Develop.*, **16**, 470-481, 1972), is used to calculate the mutual and self-inductance of coupled coils. This method provides a very simple and efficient free-space analysis of inductively coupled wire traces. The effect that different implant coil geometries and locations have on coupling efficiency is studied. Furthermore, the effects of misalignment of the implant due to bodily motion are considered.

The effect of absorption and reflection due to the presence of body tissues surrounding the retinal prosthesis is also considered. The mutual coupling of implanted coils surrounded by power absorbing tissues is verified using finite-difference time-domain (FDTD) methods. The power deposition and specific absorption rate (SAR) resulting from a current in the external coil is computed while a secondary coil is present inside the head model.