INTERFACING ELECTRONIC FOR MEASUREMENT, SIGNAL PROCESSING AND WIRELESS COMMUNICATION

Edited by

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Chapter 3

WIRELESS TRANSFER OF POWER TO LOW-POWER IMPLANTED BIOMEDICAL DEVICES: 3-DIMENSIONAL COIL DESIGN CONSIDERATIONS

IMRAN M. KHAN, SHEROZ KHAN, OTHMAN O. KHALIFA

The most important parameter between two coils that needs to be optimized in terms of transmit and receive coils for power is the mutual inductance between them. The mutual inductance is a measure of the transmit coil's flux field that is incident on the receive coil. This measure can only be optimized if the flux field is calculated for a given geometry of transmit coil using some kind of model. However, many assumptions made in the modelling of inductive coils are quite limiting and do not provide an accurate picture of the flux – with many secondary effects causing inconsistencies. This chapter looks into some considerations for the 3D coil geometry of a transmit coil.

3.1. INTRODUCTION

Continuous patient monitoring is of paramount importance in the medical field. This is especially true for chronic illnesses such as heart disease, cerebrovascular disease, malignancies and several different types of infections. The seriousness of these disorders is compounded by the fact that they are amongst the top ten fatal diseases in the world (World Health Organization, 2010). Furthermore, the managerial care required in these types of diseases often requires lifestyle changes that need to be monitored for their impact on the human body as generally these diseases effect the quality of life of patients and become a major consideration in their everyday life. Research into possible cures for these diseases also requires monitoring of slight drug and dosage modifications. However, continuous patient monitoring would place a great strain on hospitals and clinics and is impractical in developing countries with limited medical resources. Furthermore, there is a recent trend in implanted devices to attempt building System-On-Chip (SoC) devices that provide all the functions of sensing and even responding in emergency situations that would otherwise need medical attention at a hospital. Heart-assist devices in particular employ this design vision by utilizing sensors that monitor the magnitude of the nerve action potential to determine whether it would trigger a natural cardiac cycle. If low threshold action potential is detected, the device tries to amplify the trigger by discharging a capacitor to assist the muscular contraction. Such devices would need on-demand power supply that must be reliable and efficient