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Edited by

A.K.M. Mohiuddin

Asif Hoda

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Chapter 30

Thermal analysis of a micro device used for detection of colorectal cancer

Mirghani I. Ahmed, Meftah Hrairi

Department of Mechanical Engineering, International Islamic university Malaysia

Abstract

Finite element modelling is widely used in technological applications. The benefits of using simulation are clear: reduced time and cost when introducing new products to market, better knowledge of part dynamic and static properties, and the opportunity to replace life cycle device tests, among others. Finite element analysis (FEA) is extensively used in medical devices development cycle especially during the preliminary analysis of re-design and optimization and when passing the final design analysis and reliability evaluation. Typical analysis of implantable medical devices is challenging due to the highly nonlinear nature of the physical problem due to large geometric changes, contact and material behaviour. The current paper will investigate the design of a micro device intended for detection of colorectal cancer through a thermal analysis process and optimum sizing of air slits and side cuts between the different thermal zones of the device. By comparing the results of the numerous carried out simulations, an optimum design was found.

Keywords: Biomedical, finite element analysis, simulation, medical device, cancer

INTRODUCTION

Design analysis involving the modelling of components using finite element methods enables design concepts to be evaluated and design optimisation to be achieved prior to prototype manufacture, thus saving time and cost and minimising risk. For these reasons, the power and versatility of engineering simulation has been used in developing innovative life-saving and life-enhancing biomedical products that touch the lives of millions of people around the world every day. By performing analysis up front in development, engineers have the time and resources to improve concepts, evaluate alternatives, run 'what-if' scenarios and come up with innovative designs. Biomedical simulations are many and varied, and cover all simulation disciplines, from the traditional structural analysis to fluid flow, multi-body dynamics and electromagnetics. Some researchers used ANSYS® Structural™ software in studies to determine to what extent an artificial spinal disc helps restore motion and how performance is affected by placement relative to the centreline of the spine nucleus [1]. Others showed that FEA simulation helps design highly sensitive protein ion sources used in detecting