Simulation of Electric Field Distribution and Depth of Electrodes Placed in Cancer Tissues

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***Abstract*— Cancer is the uncontrolled growth and spread of cells in any part of the human body and this growth often invades surrounding tissues, leading to fatalities. According to WHO, an estimated 14.1 million new cancer cases and 8.2 million cancer-related deaths occurred in 2012. Current standard of cure includes surgery, radiotherapy and chemotherapy. In surgery, since the total depth of tumor cannot be seen, often part of the tumor is left over, which could cause further issues. However, there are inoperable, chemo and radio-resistant tumors, which need alternative treatment and electrochemotheraphy (ECT) is an attractive alternative. In ECT, significant increase in the electrical conductivity and permeability of the cell plasma membrane is caused by an externally applied electrical field. For this purpose needle array electrodes are used in approximate depth on tumor tissues. The degree of permeability of cell membrane can be controlled by the intensity of the electric field, pulse duration and number of pulses. The purpose of this work is to study the effect of electric field on tumor tissues and to have some better approximations on the depth of needle electrodes in tumor tissues during the process of electroporation. Model of tumor tissues is created using finite element method and the electrical pulses are applied using needle electrodes. The internal electrical field distribution is captured using virtual electrodes placed on surface of the tumor structure for different depth of needle electrodes. The optimal position of depth of electrodes has to be analyzed using virtual electrode signals. Those virtual electrode signals are used as reference signals for different structures and sizes of tumors tissues, for creating an inverse problem so as to find the depth of needle electrodes for required electric field distribution over the cancer tissues. This study can be used to improve the efficiency of the electroporation technique.**