# Electro Thermal Performance Prediction of Radio Frequency Ablation System for Efficient Cancer Treatment

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## Abstract

Cancer causes significant human deaths and is increasing due to increase in life expectancy and lifestyle. Radiofrequency ablation is an encouraging procedure for cancer treatment. The objective of this paper is to demonstrate the multiphysics simulation methodology and COMSOL Multiphysics capability for the radio frequency (RF) ablation procedure planning and simulation. This report briefly summarizes the problem description, governing equations, modeling methodology, assumptions, simulation results and discussion related to the thermal performance prediction of radio frequency ablation on a homogeneous tissue model. The electromagnetic interaction with biological tissue and thermal ablation coupling are highlighted. Effects of single electrode and two electrode energized simultaneously at various angles are investigated and reported. The main problem addressed in this paper is the prediction of temperature distribution of biological tissue due to Radio frequency energy of electrodes placed at various interval, angle, power and exposure time. This is critical to estimate and monitor the procedure to ablate only the defective tissues as identified by the physician. The simulation potential for the development safe procedure planning and protocol is highlighted. Radiofrequency ablation is an interventional technique, which is increasingly used for cancer treatment. The COMSOL Multiphysics simulation capability for the coupled electromagnetic and heat transfer capability is leveraged for efficient planning of the procedure for ablation. A typical single and twin electrode parallel configuration for cancer ablation and simulation and results are shown in the figure 1. An equivalent electrical potential as prescribed by the manufacturers is applied to the electrode. Coupled RF and thermal simulation is then performed with appropriate boundary, mesh conditions to predict the transient temperature built-up. The transient performance was predicted for the given exposure time. The contour plot of electrical potential and temperature distribution for the given probe configuration will be reported. Radiation frequency ablation system operates at a frequency range of around 500 kHz. The electrical properties of the tissue depend on the composition and structure and are dispersive. The electrical properties of the tissue for the given frequency determine the joule heating and temperature distribution. Accurate properties are critical for the prediction of temperature distribution. The simulation results are compared with previous published data. The simulation capability for virtual ablation and optimization will be highlighted for efficient treatment planning.
Keywords: Cancer treatment, cancer ablation, RF heating, Electromagnetic heating, bio heating, coupled heat transfer, liver tissue, ablation.

## Reference

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## Figures used in the abstract

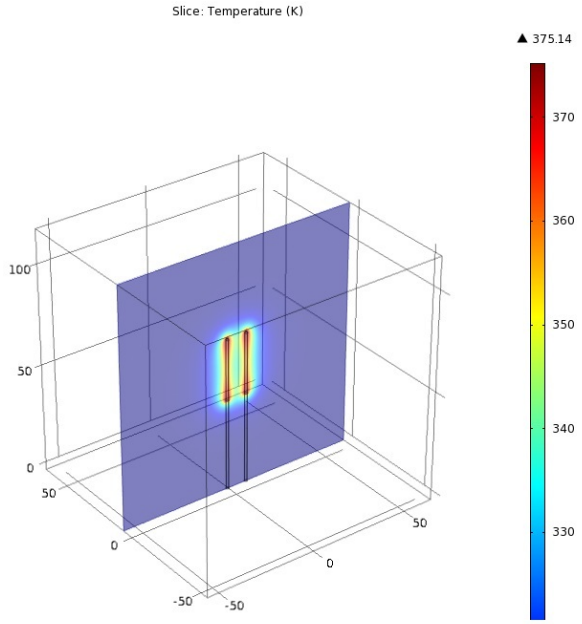


**Figure 1**: Typical simulation results for a typical twin electrode RF ablation setup.