Design of Radio-Frequency Ablation Catheter

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Abstract

Radiofrequency (RF) ablation is a treatment modality that kills unwanted tissue by heat. RF ablation is now the treatment of choice for certain types of cardiac arrhythmia. During RF ablation, an electrode is inserted into, or steered intravascularly to the target tissue region under medical imaging guidance. Then, a tissue volume surrounding the electrode is destroyed by heating via RF electric current. The electrode is destroyed by heating via RF electric current. The control system of the heart is the heart's conduction system which takes care that the pumping action occurs regularly and effectively.
The model approximates the body tissue with a rectangular box and assumes that its boundary temperature remains at 37 °C during the entire procedure. The tumor is located near the center of the rectangular box and has the same thermal properties as the surrounding tissue. The model locates the probe along the center line such that its electrodes span the region where the tumor is located. The boundary conditions at the outer boundaries is ground (0 V potential). At the electrode boundaries the potential equals 20 V.
One method for removing cancerous tumors from healthy tissue is to heat the malignant tissue to a critical temperature that kills the cancer cells. This example accomplishes the localized heating by inserting an electric probe through which an electric current runs. The electric field is converted into temperature field in the tissue. The heat source resulting from the electric field is known as resistive heating or Joule heating.
It is important to visualize the region where unwanted cells die, where the temperature has reached at least 50 °C. In order to visualize this area, an isotherm for 50 °C temperature is plotted.
RF ablation allows localized tissue destruction by heating. Image guidance for RF ablation procedures is in general of great importance as it allows identification and visualization of the target region, and guidance of the procedure. Improvement of imaging modalities in the near future will allow for improved accuracy of RF ablation and thermal therapies in general. COMSOL Multiphysics® tool plays a major role during the design and development of an RF ablation catheter.