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ACCEPTED MANUSCRIPT

Fast inverse prediction of the freezing front in cryosurgery

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Abstract

Cryosurgery has become a well-established technique for the ablation of undesirable tissues such as tumors and cancers. The motivation for this study is to improve the efficacy and safety of this technique. This study presents an inverse heat transfer method for monitoring the motion of the freezing front from a cryoprobe. With the help of a thermocouple inserted into the layer of diseased tissue, the inverse heat transfer method estimates simultaneously the blood perfusion rate and the thermal conductivities of both frozen and unfrozen tissues. This information is then fed to the *Pennes* bioheat equation that: (1) calculates the time-varying temperature distribution inside the layer of tissue and (2) predicts the motion of the freezing front. The effect of the most influential parameters on the inverse predictions is investigated. These parameters are (1) the initial guesses for the unknown Levenberg-Marquardt polynomial parameters of the thermo-physical properties; (2) the temperature of the

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