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Analiza numeryczna sztucznej hipertermii z wykorzystaniem różnych modeli przepływu biociepła

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Numerical analysis of artificial hyperthermia using different models of bioheat transfer

Summary

In this thesis the different mathematical models are used to determining the temperature distribution of the heated tissue. The Pennes model, the Cattaneo-Vernotte equation and the dual phase lag equation (DPL) were considered. In addition to those, attention has been given to the models based on the theory of porous medium. Among these models, the generalized dual phase lag model (GDPL) was particulary considered. GDPL was supplemented by an ordinary differential equation for the blood temperature distribution or by two ordinary differential equations: one for the arterial blood and second for venous blood. The problem was solved by the explicit scheme of the finite difference method. The two dimensional (axisymmetric) and three dimensional models were examined. In order to solve the presented problems, the algorithms and computer programs were prepared. The Microsoft Visual Studio (integrated development environment) and the C++ language were used to writing the programs. Parallelization of calculations on graphic cards were applied to increase computing performance. The degree of tissue destruction was determined by one of the following parameters: thermal dose or Arrhenius model. In this thesis the different variants of heating of the considered regions were applied. In order to partial verify the results of the numerical calculations, the experiment was performed.