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A study on thermal damage during hyperthermia treatment based on DPL model for multilayer tissues using finite element Legendre wavelet Galerkin approach

Dinesh Kumar*and K. N. Rai†

Abstract

Hyperthermia is a process that uses heat from the spatial heat source to kill cancerous cells without damaging the surrounding healthy tissues. Efficacy of hyperthermia technique is related to achieve temperature at the infected cells during the treatment process. A mathematical model on heat transfer in multilayer tissues in finite domain is proposed to predict the control temperature profile at hyperthermia position. The treatment technique uses dual-phase-lag model of heat transfer in multilayer tissues with modified Gaussian distribution heat source subjected to the most generalized boundary condition and interface at the adjacent layers. The complete dual-phase-lag model of bioheat transfer is solved using finite element Legendre wavelet Galerkin approach. The present solution has been verified with exact solution in a specific case and provides a good accuracy. The effect of the variability of different parameters such as lagging times, external heat source, metabolic heat source and the most generalized boundary condition on temperature profile in multilayer tissues is analyzed and also discussed the effective approach of hyperthermia treatment. Furthermore, we studied the modified thermal damage model with regeneration of healthy tissues as well. For viewpoint of thermal damage, the least thermal damage has been observed in boundary condition of second kind. The article concludes with a discussion of better opportunities for future clinical application of hyperthermia treatment.

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