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NUMERICAL INVESTIGATION OF THERMAL RESPONSE OF LASER-IRRADIATED TISSUE PHANTOM USING DUAL PHASE LAG MODEL IN CONJUNCTION WITH MODIFIED RADIATIVE TRANSFER EQUATION

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ABSTRACT. The objective of the present study is to numerically investigate the thermal response of laser-irradiated multi-layered tissue phantoms with spatially varying refractive index. This study is important in the context of photo-thermal therapy wherein accurate prediction of temperature distribution within the real biological sample is essential to destroy the cancerous cells with minimal damage to the surrounding healthy cells. Real biological samples consist of multiple layers which are generally characterized by different indices of refraction and/or optical properties. Under these conditions, because of the presence of various interfaces separating different layers of samples, the light rays undergo additional refraction and/or reflection events, thereby resulting into curved paths of the light beam through the medium. Moreover, the speed of light is also expected to be varying in a medium due to its dependence on the local values of refractive indices within the physical domain. In order to account for these factors, the conventional radiative transfer equation (RTE) has been modified. The modified RTE has been solved using the discrete ordinate method (DOM). The developed numerical model has been verified against the results available in the literature for the same operating conditions. Thereafter, the solution of the transient form of modified RTE has been coupled with Fourier as well as non-Fourier heat conduction models to determine the temperature distribution inside the multi-layered tissue phantoms. Results of the study revealed higher intensity levels in the regions characterized by higher values of refractive indices, and hence temperature is also higher in that region.