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An exact analytical solution for thermal response in biological tissues under therapeutic treatments incorporating an actual initial condition

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The genesis of the present research paper is to develop a revised exact analytical solution of thermal profile of 1-D Pennes' bioheat equation (PBHE) for living tissues influenced in thermal therapeutic treatments. In order to illustrate the temperature distribution in living tissue both Fourier and non-Fourier model of 1-D PBHE has been solved by 'Separation of variables' technique. Till date, most of the research works have been carried out with the constant initial steady temperature of tissue which is not at all relevant for the biological body due to its living cells. There should be a temperature variation in the body before the therapeutic treatment. Therefore, a coupled heat transfer in skin surface before therapeutic heating must be taken account for establishment of exact temperature propagation. This approach has not yet been considered in any research work. In this work, an initial condition for solving governing differential equation of heat conduction in biological tissues has been represented as a function of spatial coordinate. In a few research work, initial temperature distribution with PBHE has been coupled in such a way that it eliminates metabolic heat generation. The study has been devoted to establish the comparison of thermal profile between present approach and published theoretical approach for particular initial and boundary conditions inflicted in this investigation. It has been studied that maximum temperature difference of existing approach for Fourier temperature distribution is 19.6% while in case of non-Fourier, it is 52.8%. We have validated our present analysis with experimental results and it has been observed that the temperature response based on the spatial dependent variable initial condition matches more accurately than other approaches.

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