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OPTIMIZATION OF TEMPERATURE DISTRIBUTION IN TISSUE BY MICROWAVE INDUCED HEATING POWER

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Abstract. *An analytical study of optimal control problem in distributed parameter system, described by one- dimensional single layered (homogeneous) bio-heat equation, is investigated so as to attain a beneficial therapeutic desired rise of temperature at a particular point of location of the tumour inside the tissue at the end of operation of the process by controlling optimally time dependent heating power induced by microwave and also by controlling surface cooling temperature. The heating power is constructed according to the well-known Beer's Law [Karaa, Zhang and Yang, 2005]. The analytical investigation is carried out using "Maximal principle" [Pontrayagin et al., 1962] with a suitably constructed 'Hamiltonian function' by finite difference method. A numerical calculation of temperature distribution along the length of the tissue on various values of total time of operation of the process is computed.*

Keywords: optimal control, heat source, surface cooling temperature, tumour, hyperthermia

Notations

C	=	specific heat of tissue, J/(kg ^{o}C)
H	=	heat transfer coefficient between the skin and the ambient air, W m^{-2}/°C
k	=	thermal conductivity of tissue, W m^{-1}/°C
L	=	length of the tissue, m
x_1	=	position of tumour, m
χ	=	temperature, °C
χ_a	=	arterial temperature, °C
χ_0	=	initial temperature, °C
χ^*	=	desired temperature to be attained, °C
T	=	total time of the process, s

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