669. A model of a thermal feedback in a biological object taking into account the processes of thermal self-regulation and their dynamics

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Abstract. The paper proposes a model for temperature distribution in an organism taking into account the internal heat sources and the processes of thermal self-regulation. The model describes temperature distribution and the processes of its self-regulation in hypothermal zones, where abnormal phenomena in a biological object are accompanied by a decrease of temperature. The presented model can be applied for diagnostics of inflammatory processes and tumors as well as for control of their dynamics by means of thermography.

Keywords: biological object, thermography, model of temperature distribution, processes of self-regulation and their dynamics.

Introduction

The obtained distribution of internal temperature provides an opportunity for the assessment of biomedical applications of the method while using thermographs [1, 2] as well as for a correct interpretation of the thermal image on examining abnormal thermal zones on surface of the skin integument of biological objects upon applying the method of infrared (IR) thermography. This is very important for the control of the functional status of the organism *in vivo* [3-5]. In the paper [6], the author proposed a model of the thermal field in a pathologic zone by applying the method of solving electrostatic problems based on an analogy between the electrostatic field and the thermal one. However, in the presented work, the processes of self-regulation of temperature in a living organism were not taken into account. Exothermal biochemical processes in cells and tissues of all internals of biological object result in generation of heat that is redistributed in the organism. The said continuous process takes place within the total period of vital activity of biological object upon essential interaction with the environment. The thermal disorders carry diagnostic information on the functional status of the organism and may be used for interpretation of thermographic images as indicators (markers) of various pathological conditions. Therefore for perception of the mechanism of the thermal disorders it is important to take into account the processes of self-regulation while analyzing the algorithm of formation of the surface temperature of biological object.

Theoretical background and temperature distribution in a living organism

As it is known, the processes of temperature redistribution are described by the thermal conductivity equation that is based on the condition of "continuity" of thermal energy flow [7]:

$$\frac{\partial q}{\partial t} + div\vec{j} = \dot{Q}, \quad (1)$$

where $q = c\rho(T - T_0)$ – density of thermal energy; c, ρ – thermal capacity and density of the substance, respectively; T – ambient temperature with respect to a certain fixed value T_0; $\vec{j}$ –