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Modelling bioheat transfer in an aged body

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Ageing is a process due mainly to the accumulation of defective mithocondria, and it involves an intrinsic deterioration of the homoeostatic capabilities of an organism, with an increasing risk of death. At tissue level such irreversible cellular degradation leads to changes in organs functionalities, physical properties and volumes. Furthermore, ageing affects also the capacity of the body to react to changes of either internal or external conditions, such as physical workload, food digestion and thermal stress exposure. The energy balance of the body depends on different physiological and anatomical components such as cardiac output, tissue volumes and thermal properties, metabolic production, and may be extremely sensitive to any of these factors variation. Eldery people generally present significant alterations of such components with respect to the younger individuals, which may involve completely different thermal responses for the same external conditions. The difference of patterns becomes more evident whether the enviromental exposure is extreme, like in case of heat waves or hypothermic conditions. For such scenarios elderly people represent a cathegory at serious risk (even life-threatening), especially if adequate countermeasures are not taken. The prediction of the temperature distribution in an aged body under thermal stress may therefore provide insightful indications for preventing the onset of such phatogical conditions. To the best of the authors knowledge, a limited number of works were carried out on this topic. Some significant works are [1, 2] but they are cannot be considered comprehensive for all age-related changes occuring in the body. Aim of such work is to propose a comprehensive methodology for modelling ageing effects on arterial circulation and heat transfer occurring within the human body. This is carried out by introducing new features into a pre-existing bioheat transfer model recently proposed by the authors[**?**]. Blood variables are computed by employing a morphologically detailed arterial tree, including a realistic heart model. Age condition is simulated for the flow system by modifying respectively heart function, arterial stiffness and terminal resistance. Heat transfer in solid tissues is modelled by employing a multilayer conduction model coupled with the larger arterial network. Some of the tissue properties and volumes are assumed to be age-dependent and defined by using curves extrapolated from experimental data. Aortic and brachial pressure waveforms were computed for different ages and showed a good agreement with experimental data and other simulated results. The model was also used for evaluating the ageing effects on the body thermal balance when it is exposed to hot thermal stress.

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