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60 Three-dimenslonal simulation of cold and warm defence ln man

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Taking into account the spatial dependence of parameters and variables, an adequate simulation of the thermoregulatory system of man comprises a set of partial differential equations, the parameters of which have to be based on the realistic geometry and anatomy of the human body. Therefore we have constructed a three-dimensional digital atlas with a arid of 0.5cm for head and extremities and 1 cm for the trunk, and hive solved the syGem **01** equations by an implicit 'alternating direction' method on the vector-computer CYBER 205.

The simulation-system has delivered a realistic picture of the topography of temperatures under neutral conditions. Compatibility of reality and simulation was achieved solely on the basis of physical considerations and physiological data base. An adjustment of parameters of the passive system was not necessary. Therefore the simulation is suited to analyze functional controller equations by way of comparison of experimental and simulation results.

The physiological distribution of metabolic heat production and blood flow turned out to be an essential feature for a compatibility of the results. For cold defence a spatially distributed control of the skeletal muscles, with special regard to the proximal areas, must be required in order to get the decrease of temperature in the extremities, well known from experiments. A uniform control of all skeletal muscles turned out to be an inadequate controller structure. The small local differences of temperatures in warm stress make it, however, very difficult to analyze distributed controller structures for warm defence.

Global and local consequences of the inhomogeneity of the human body and its geometry can be demonstrated by the simulation. The transversal temperature profiles of the extremities and the uniform temperatures in the brain are examples for the global influence. the decrease of spinal cord temperature with respect to the adjacent tissue, due to high blood flow, is an example of local effects.
The simulation of dynamic effects is possible, but fails at present on account of the small working storage of the CYBER 205 version at the Ruhr-University. First tests demonstrate that the time courses of temperatures will be computed correctly.