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The modified Hodgkin-Huxley's model and correction of the vestibular function activity

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Statement of the Problem: There exist extreme situations of personal control of movement in which there is a need for supplementary information correction of the vestibular apparatus. For example: in a loss of a vertical stance of a person on the earth; or in cases of movement disease of the pilot in a cabin of the dynamic simulator; or the delay of the gaze stabilization of astronauts in orbit.

Aim: The purpose of this work is the development of correction algorithms and technical sensors such as micro accelerometers to provide additional information of the movement and correction signals.

Methods: The methodology to generate correction signals consists of three parts: Use of additional information from technical sensors for correction of inertial navigation systems; solution of the corresponding mathematical problem of the correction information; experiments with galvanic stimulation of the vestibular apparatus for realization of the algorithms generated in part two.

Findings & Theoretical Orientation: A new approach to the study of functional alterations of the vestibular system in extreme conditions using the mathematical model is proposed. We produced a modified and simplified Hodgkin-Huxley model of the primary afferent neuron activity of the vestibular end organs for which we used the data obtained from experiments in mammalian neurons. Applying this model, we have obtained the solution for output correction signals of the vestibular mechanoreceptors in extreme conditions. Our model can produce the corrective signal of the vestibular output. Algorithms for the correction using galvanic stimulation are presented.

Conclusion & Significance: Using the algorithms produced, we have been able to modulate the vestibular reflexes and the vestibule-sensory conflict in extreme situation. The results may contribute to the development of a vestibular prosthesis.

Biography

Vladimir V Alexandrov completed his PhD in Physics and Mathematics in 1969 and Doctor of Science in Physics and Mathematics in 1988 at Lomonosov Moscow State University. He is a member of International Academy of Technological Sciences and National Academy of Space Sciences, Russia. He works in the field of Biomechanics, and he is interested in "Information interaction between biological and mechatronic systems". Currently, he works with his colleagues at Autonomous University of Puebla (Mexico) in the area of Mathematical Modeling and Control of the Vestibular Function.

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