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Research Article

Development of a Dynamic Virtual Reality Model of the Inner Ear Sensory System as a Learning and Demonstrating Tool

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Abstract

In order to keep track of the position and motion of our body in space, nature has given us a fascinating and very ingenious organ, the inner ear. Each inner ear includes five biological sensors—three angular and two linear accelerometers—which provide the body with the ability to sense angular and linear motion of the head with respect to inertial space. The aim of this paper is to present a dynamic virtual reality model of these sensors. This model, implemented in MATLAB/Simulink, simulates the rotary chair testing which is one of the tests carried out during a diagnosis of the vestibular system. High-quality 3D animations linked to the Simulink model are created using the export of CAD models into Virtual Reality Modeling Language (VRML) files. This virtual environment shows not only the test but also the state of each sensor (excited or inhibited) in real time. Virtual reality is used as a tool of integrated learning of the dynamic behavior of the inner ear using ergonomic paradigm of user interactivity (zoom, rotation, mouse interaction, etc.). It can be used as a learning and demonstrating tool either in the medicine field—to understand the behavior of the sensors during any kind of motion—or in the aeronautical field to relate the inner ear functioning to some sensory illusions.