Measuring and Modeling Changes of Direction Detection Thresholds for Different Acceleration Profiles

In the absence of vision, the perceived direction of translational self motion is largely governed by signals originating from the otoliths. Although it has been shown that direction detection thresholds depend on the frequency of the motion stimulus, the influence of the actual time course of the motion has not been thoroughly investigated. The goal of our study was to measure, model and predict vestibular direction detection thresholds for different motion profiles in the horizontal plane.
Three types of acceleration profiles (sinusoidal, trapezoidal and triangular) were tested for three different durations (1.5s, 2.36s and 5.86s). The lowest thresholds were found for trapezoidal profiles and the highest for triangular profiles. The measurements are further explained by a model based on a transfer function which is able to predict direction detection thresholds for all types of acceleration profiles. Since previous models were only able to describe thresholds for sinusoidal profiles, our modeling approach represents an important advancement.