

Analysis of the Centre of Pressure Movements of Standing Subjects

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Measurement of the human body centre of pressure (COP) movement with a force platform (stabilometry) is a standard procedure for the assessment of postural stability. Here a subject stands still on a special platform that is mounted on pressure sensors transmitting data via analogue to digital converter to a computer where the time dependence of the COP trajectory (postural sway) is recorded. Anyhow, it is still an open question how to extract physiological relevant information from the experimental data. Recently we proposed a method where the outline of the sway region is expressed in terms of Fourier coefficients [1] that are determined by asymmetric fitting considering minimal outline bending energy [2,3].

In this study it is shown that the postural sway data can be reproduced by considering random movement of the COP within a central ellipsoidal region whereas outside it the positions are accepted only with the probability $\exp(-E/T)$. E represents the energy and is proportional to the square of the distance from the central ellipsoidal region whereas T plays the role of temperature.

Simulated data were compared to the measurements of 41 elderly (60 to 80 years) and 20 young (20 to 25 years) subjects where the influence of different sensory inputs was studied by performing the experiments with the subjects standing on a hard and compliant surface with their eyes open and closed. From the COP trajectories the outlines and areas were calculated and compared to the sway areas as calculated by the principal component analysis [4]. For all the experimental conditions this area ratio, which is related to the shape of the sway area, was for 60 s measurements typically close to 2 for young subjects and about twice as large, with much larger standard deviation, for elderly subjects. The exact value of this ratio was used to determine the temperature parameter (T) from the simulated data.

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References

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