Aim of the Study

The objective of this study is to verify the presence of rotational components in the CoP signal.

Introduction

Human upright stance is intrinsically unstable. A subject standing quietly in upright position perceives the resultant of balancing movements as continuous body oscillation around the perfect position. Static stabilometry is a quantitative technique aimed at characterizing the body sway during quiet standing [1]. By means of a force platform, the trajectories of the Centre of Pressure (CoP) on the platform surface are recorded.

Rotary Spectra Analysis

In order to extract rotational components in the CoP signal, we rely on the rotary spectra analysis, a well known technique developed in the meteorological and oceanographic fields by Gonella and Mooers [2], [3]. Rotary spectra analysis involves the decomposition of a motion in a plane into its clockwise (CW) and counter-clockwise (CCW) rotating components. In rotary representation $A_-$, $A_+$, and $\theta_-$, $\theta_+$ are amplitudes and phases of the CW and CCW rotating components, respectively. It is possible to obtain the spectral energy $S_+$ and $S_-$ for the two oppositely rotating components.

Experimental Protocol

The described analysis is applied to the posturographic data of healthy subjects recorded by means of a force platform.

Sample Population: 42 healthy volunteers.

Acquisition Protocol: Open eyes (OE) and closed eyes (CE) conditions.

Experimental Setup: Kistler 9286A (Kistler, Switzerland) force platform and acquisition system STEP32 (Demitalia, Italy).

Results

Applying rotary spectra analysis to CoP signals of the population of healthy subjects, we found rotational components in CCW and CW verses in all the examined sway paths (Fig. 5).

Figure 6 shows mean spectra for CCW and CW components estimated on the population, in open and closed-eye conditions. Most of the components are at frequency lower than 1.5 rps.

In order to study the sway path characteristics over the population of healthy subjects we defined four rotary spectral parameters. Fig. 7 shows boxplot representation of the four parameters calculated.

Conclusions

This study demonstrates that the CoP signal of healthy subjects contains rotational components. The hope is that this approach will help to better highlight the physiological mechanisms underlying postural control.

References