

## ANTICIPATION MECHANISM AND INFLUENCE OF FATIGUE IN MEDIOLATERAL STABILOGRAM

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### INTRODUCTION

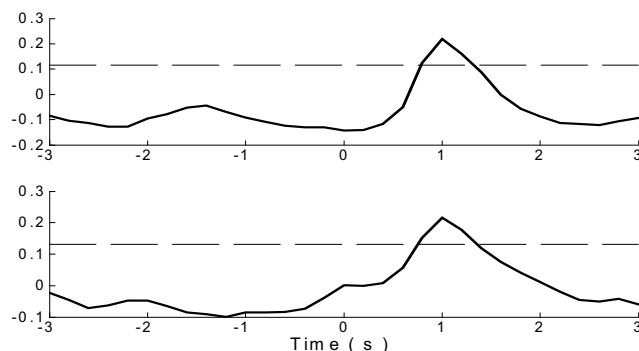
An important feature of the Central Nervous System (CNS) is its capability to foresee future movements of the body [1]. This control does not act by feedback and is named anticipation. Several investigators have focused anticipation by studying the synergism between anti-gravitational muscles and the ones responsible for limbs movements [2]. Others report that anticipation can be affected by fatigue [3]. This study aims to detect the anticipation mechanism and the latency between the gastrocnemius muscle myoelectric signal and the mediolateral (x) stabilogram during static posture and test the fatigue influence.

### METHODS

The instrumentation consisted of a vertical force platform and an electromyographic system, synchronized to register the stabilometric and myoelectric signals (EMG), with sampling frequencies of 50 and 1 kHz, respectively. Superficial silver/silver chloride electrodes (Ag/AgCl) were fixed on the lateral head of the gastrocnemius muscle. A group of 23 individuals (15 males and 8 females) were tested after free consent. The age was  $23.2 \pm 3.6$  years (mean  $\pm$  standard deviation), body mass  $70.6 \pm 10.9$  kg and height  $169.9 \pm 7.0$  cm. The individual stood on the force platform, with the feet together and the arms relaxed, for 120 s. Then he was asked to perform a maximum plantar flexion and maintain this position as much as he can support until muscle failure. During this time the right hand was gently placed on a stem on the platform side to avoid body unbalance. After muscle failure, the individual returned to the initial position for more 120 s data acquisition. The EMG RMS (RMS-EMG) values were calculated after mean removal at windows of 200 ms and stabilometric signals were subsampled to 5 Hz. The normalized cross correlation function (NCCF) was estimated for both pre- and post-fatigue data sets. The maximum correlation value and the corresponding lag were extracted from the NCCF of each individual. This lag was considered as estimation of the latency between signals. To test the presence of latencies as well as the differences between pre- and post-fatigue conditions, Students' t-test was applied ( $\alpha = 0.05$ ). Monte-Carlo simulation was applied to determine the critical value of the cross correlation function ( $\alpha = 0.01$ ).

### RESULTS AND DISCUSSION

The mean latency of the body displacement was significantly different from zero, either before ( $p < 0.001$ ) and after fatigue ( $p < 0.0015$ ). The fatigue caused a increase to the ensemble mean latency between RMS-EMG and mediolateral stabilogram, equal to  $0.82 \pm 0.91$  s before and  $0.90 \pm 1.17$  s after fatigue, however this increase was not significant



**Figure 1:** NCCF between RMS-EMG and x stabilogram (subject FA12), before (upper) and after (lower) fatigue (-- critical value by Monte Carlo simulation,  $\alpha = 0.01$ ).

( $p = 0.80$ ) (Figure 1). Only three individuals presented no significant correlation between RMS-EMG and the body sways. The mean maximum correlation decreased significantly later the fatigue of the  $0.39 \pm 0.23$  for  $0.28 \pm 0.16$  ( $p < 0.05$ ), decreasing ankle strategy for mediolateral control.

The cross correlation function permits the anticipation mechanism to become evident, in accordance to prior study [4]. These authors found a delay of the CP oscillations in relation to the rectified EMG signal, at magnitudes between 240 and 270 ms. This values differ from the ones in the present study, that are between 400 and 1.400 ms, agreeing with prior result for anterior-posterior stabilogram [3].

The results strengthen the hypothesis that an anticipatory control mechanism plays an important role on the body oscillation regulation. The plantar flexors fatigue decreases the ankle strategy control of the mediolateral sway and do not causes an increase to the time delay between the EMG signals of these muscles and the effective mediolateral sway of the center of pressure.

### REFERENCES

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