Stationarity during REM sleep in Old Adults

(Nombres y grados académicos)

Logo UAEH

Introduction

REM sleep is characterized as it exhibits low voltage mixed frequency EEG activity, muscular atonia and rapd eye movement.
Weak stationarity is found to be statistically less present on EEG records during REM sleep, compared to the rest of night sleep. This result suggest weak stationarity as to help in automatic detection of REM sleep by quantitive means.

Methods (I)

Subjects

Nine Old Adults [3 m, 6 w; age=67.3+5.5] were volunteer to register one night polysomnography (PSG): EEG from the 19 scalp loci of the 10-20 system, plus 2 electrooculogram (EOG) and 1 bipolar EMG at submentionan muscle. MEDICID 5 equipment (Neuronic mexicana) was used.
Data was organized as 30 s epochs, then REM sleep was visually classified according to AASM manual[].
Data was filtered to remove trends and periodic components, by using STL algorith[], then PSR test was performed over every epoch aviable [approx. 1 hour per subject]. Epochs which failed to be nonstationary ($a<0.05$) are called Possibly Stationary (PS).

> REM
> nonREM

> Detrendig filter
> PSR test
> Classification as PS

% PS epochs whole sleep VS % PS epochs at REM

Results

The PSR classification effectively showed different proportions of stationarity according to the classification of stages in each subject. In Figure 1, in one OA, PS epochs are shown in black while REM sleep is shown green. Clearly, a lower proportion of PS epochs was found in REM sleep compared to other stages. These differences reached significance in C3, C4, CZ, F7, Fp1, Fp2, O2, P4, LOG and ROG ($p<0.05$, Figure 2)
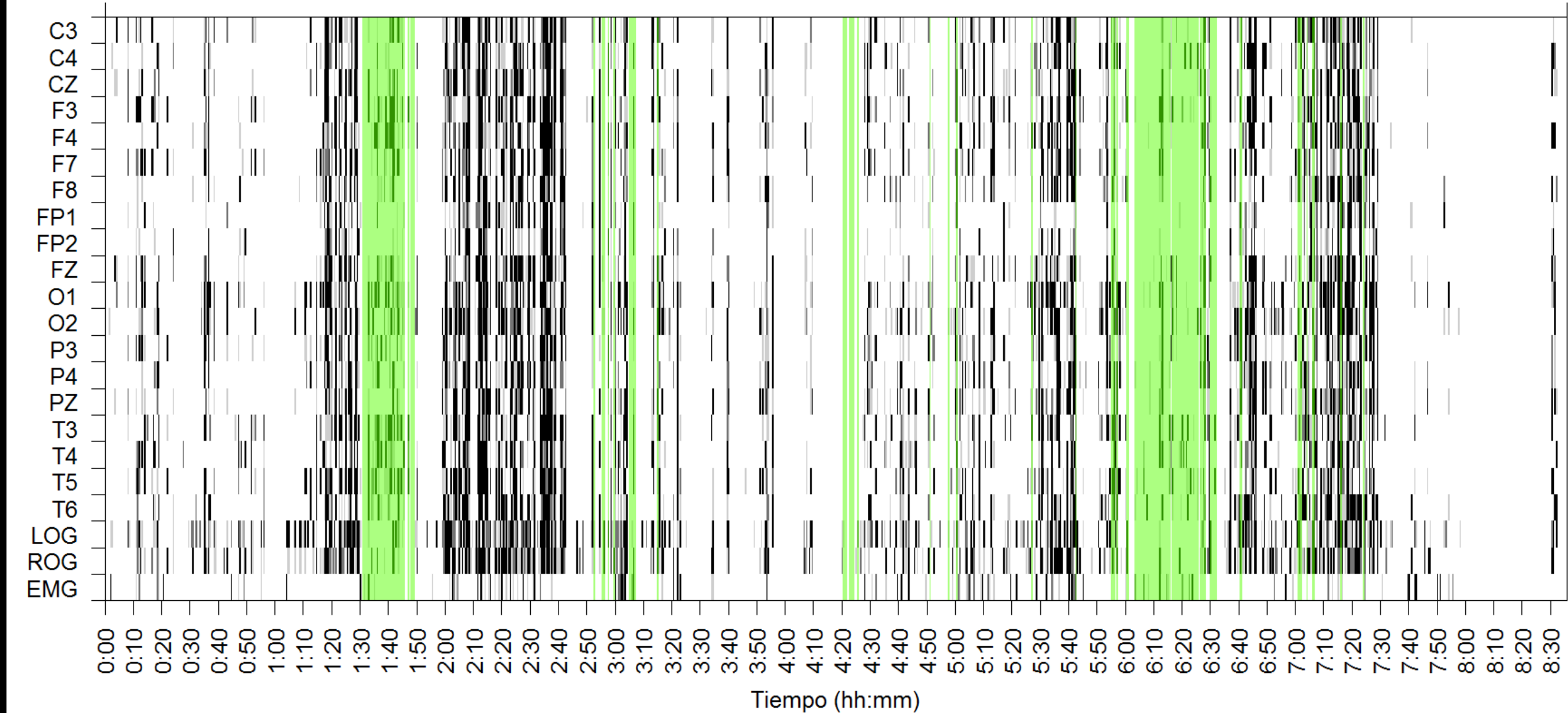

Figure 1: Distribution of the PS epochs (black) for one single subject. REM sleep is shown in green.
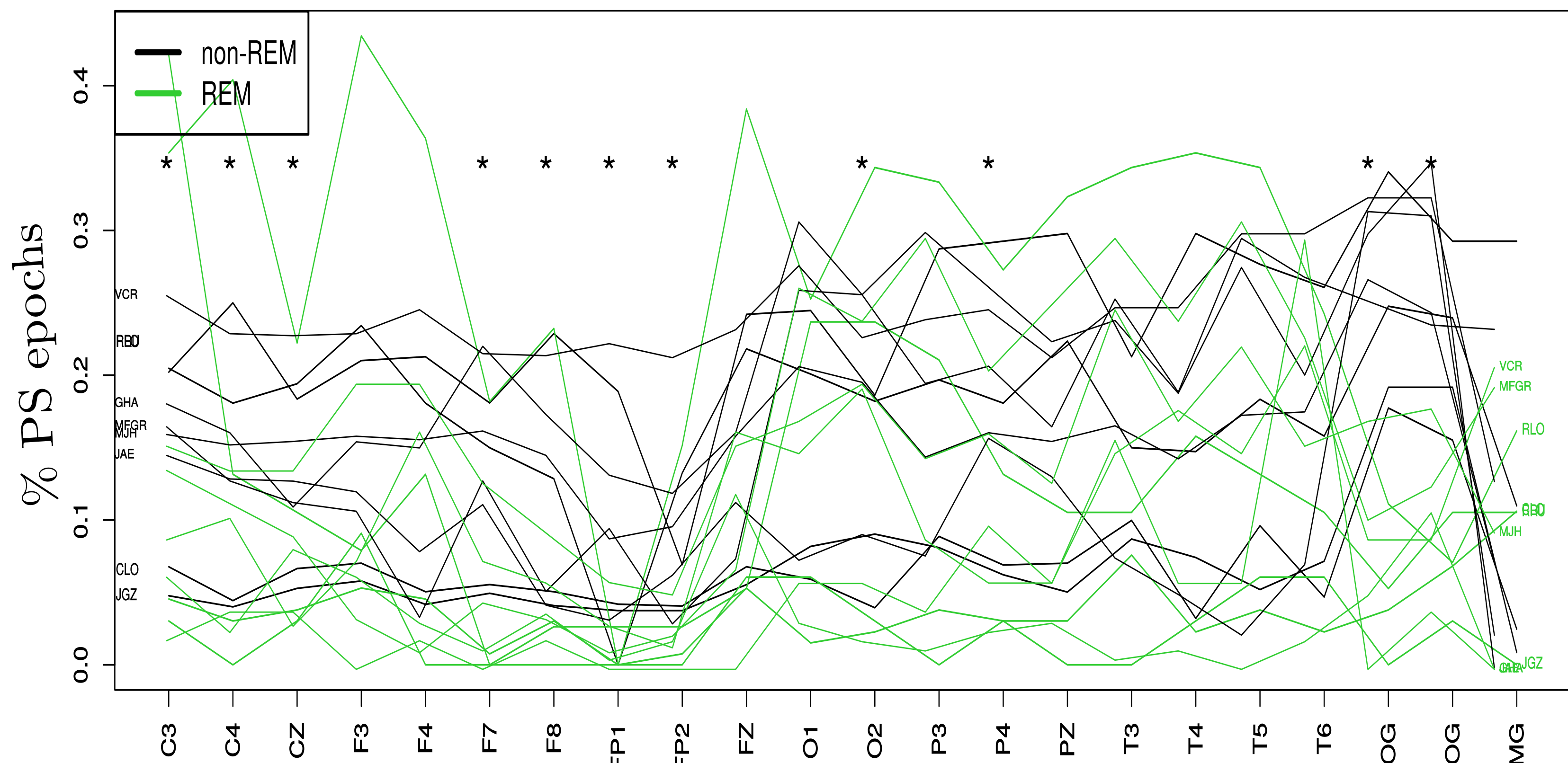

Figure 2: % of PS epochs calculated for all 9 subjects, both over REM (R phase) and non-REM (W and N). Plots were overlapped to emphasize where the differences were found via Wilcoxon test; "group" means where calculated for both stages, and plotted

Conclusions

In Old Adults, REM sleep showed lower proportions of epochs with weak stationarity compared to W and NREM sleep at anterior areas, a result that could be explained by the tonic and phasic REM sleep.

Methods (II)

Priestley-Subba Rao test for weak stationarity

A stochastic process [set of random variables over time] is said to be weakly stationary if its mean, variance and autocorrelation function doesn't depend on time.
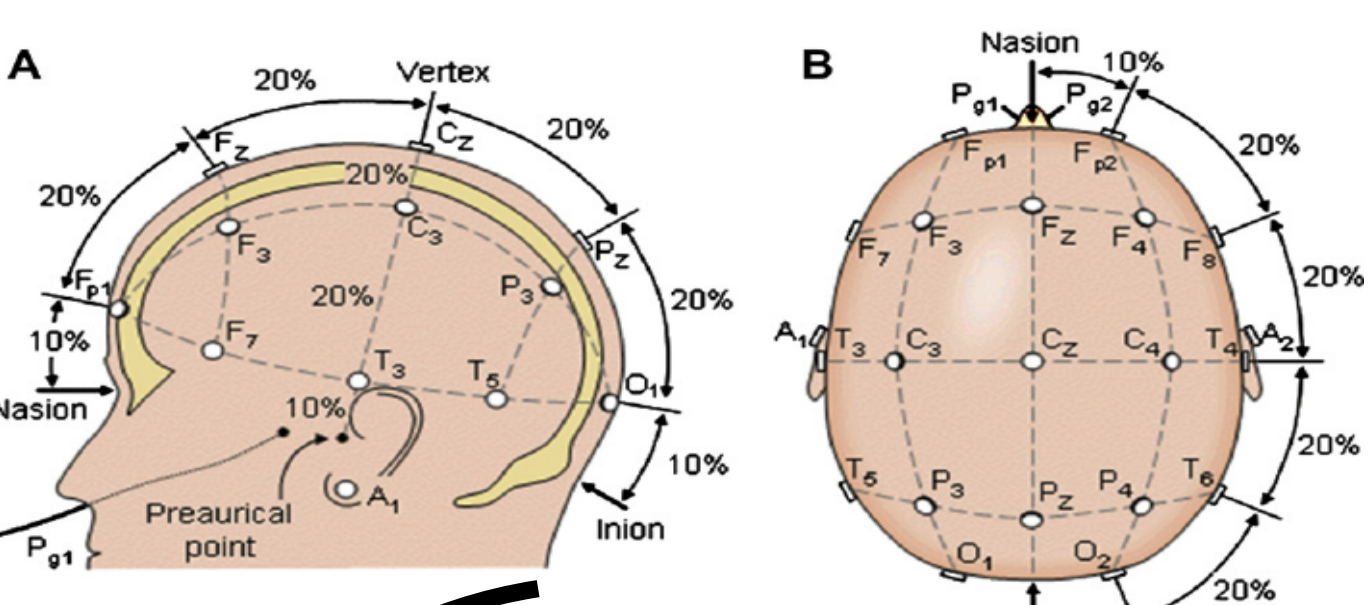The method introduced by Priestley and Subba Rao to detect it[] estimates locally the spectral density function (SDF) and then test the hypothesis "SDF doesn't vary over time" -if it does, the process would be weakly nonstationary.
The whole procedure is implemented in statistical software R, which is free and open source.

Aknowledgements

References

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