Poster presentation

Spatial distribution of non-linear interdependency measures for focal hemisphere identification in epileptic patients from interictal intracranial EEG

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We study performance, stability and spatial distribution of three previously proposed [1,2] non-linear measures of interdependency between time series (named H, M and S) used to classify, from interictal recordings, the epileptogenic hemisphere in patients with drug-resistant mesial temporal lobe epilepsy (MTLE). Two electrodes penetrate the hippocampal region in the two hemispheres and include 10 recording contacts each. We consider only data recorded during interictal periods [3]. All measures are introduced through the reconstruction of a "state-space" for the recorded signals, using the widely adopted "embedding" approach, and quantify in different ways the average distance between neighbours in phase space for one signal and the distance between the corresponding equal-time partners in the other signal. One hemisphere is classified as *focal* if the average between-contacts interdependency value is significantly greater than the one for the other hemisphere. We investigate the dependence of the interdependency measures and associated performances on the inter-electrode distance, on the relevant parameters and non-stationarities across interictal periods. Two of the three measures (H and M) provide good and similar classification performances, as well as similar spatial distributions. For M, ten cases are correctly classified, one case is incorrectly classified and for four cases, M values are statistically indistinguishable for the two hemispheres. For the correctly classified cases, M shows long-range between-contacts interdependencies for the focal hemisphere (see Figure 1). We also show how interdependencies vary inside one interictal period and between different interictal periods. The role of the parameters entering the analysis is systematically studied to provide heuristic criteria for their choice. Two of the studied non-linear measures are found to be adequate for the classification of the focal hemisphere. The observed long-range interdependency for focal hemispheres is consistent with the expected propensity of pathological nervous tissue to be entrained in paroxysmal synchronous activity. We suggest that the observed non-stationarity of interdependencies across interictal periods could be used to improve the classification performance.

Acknowledgements

References

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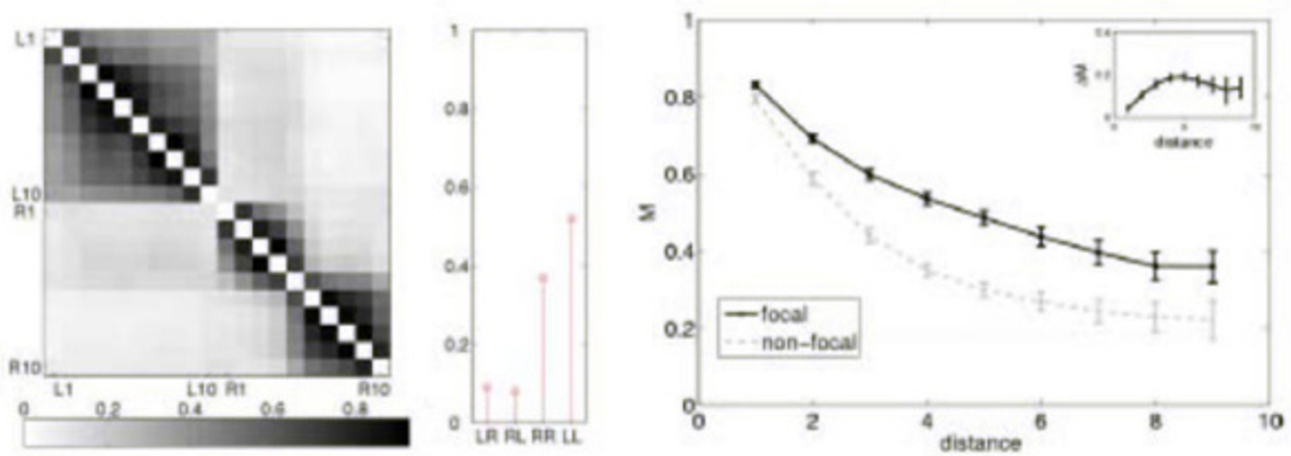
Figure 1
Left: Spatial distribution of the measure *M*, for a case of correct localization of the focal hemisphere. Stem-plots: Averages of the measure in the four quadrants LL, LR, RL and RR. Right: M vs inter-contact distance, averaged over all the contact pairs and over all the correct classification cases (10) at a given distance. Horizontal dashed line: average *M* values for cross-hemispheres interdependencies.