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Zero-lag long-range synchronization via hippocampal dynamical relaying

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Oscillations of cortical areas in gamma frequencies has been extensively studied, however, distant cortical areas are able to synchronize in other ranges besides the gamma band. Local field potentials recorded from the frontal (F) and visual (V) cortical areas of a rat performing exploratory motor behavior (active state) and motor quiescent (passive state) present distinct features concerning to the zero-lag synchronization of the two cortical regions.

In this work, we study the occurrence of zero-lag synchronization of distant cortical areas in the theta band mediated by the hippocampus (H). We propose to model the different behavioral states (passive and active) with the dynamical relaying mechanism [1-3]. The model shows good agreement with the experiment as displayed in Fig. 1, for the density of peaks obtained from the sliding window of the filtered average membrane potential cross-correlograms.

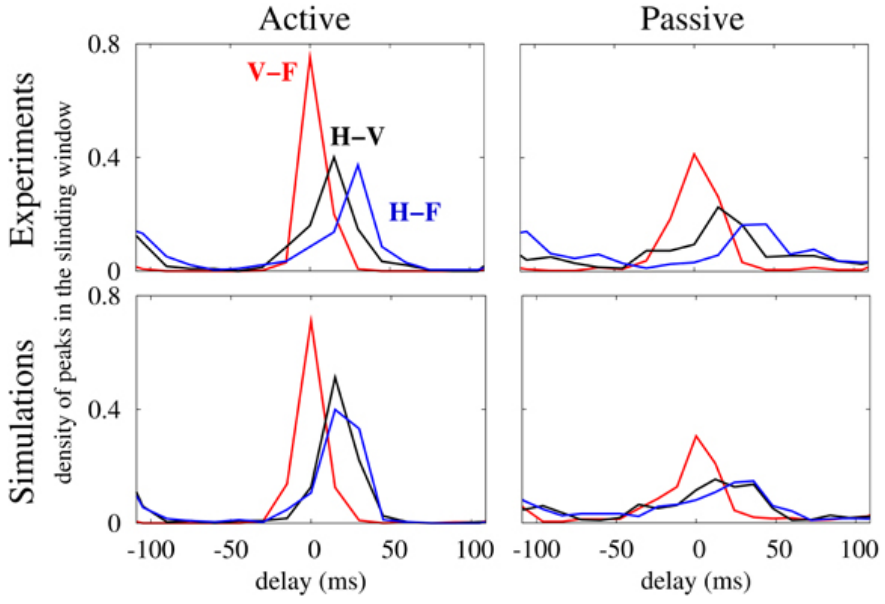

Figure 1 Comparison between numerical simulations and experimental data for both active and passive states. The curves represent the normalized histogram of the density of peaks in each of the cross-correlogram sliding window (from -300 to 300 ms) of 1 minute long of filtered time series.

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Conclusions

During the active state visual and frontal areas activate more coherently when compared to the passive state, as can be seen from a higher peak in the cross-correlogram shown in figure 1. The theta band synchronization of neuronal activity in the frontal and visual cortical regions can be explained by the dynamical relaying phenomenon in which the hippocampus is assumed to play the role of the mediating element.

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