ACCURACY OF HIPPOCAMPAL PLACE FIELDS IN PREDICTING LOCATION IS ENHANCED IN THE PRESENCE OF THETA RHYTHM.

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Theta rhythm recorded from the hippocampus is observed mainly when a rat is running or exploring its environment. It has been observed that the place-specific activity of single hippocampal pyramidal cells is more robust in the presence of theta rhythm in the EEG (Kubie et. al., Soc. Neurosci. Abst., 1984), but no quantitative analysis has been performed on how this change affects the accuracy of a population of place cells in predicting the rat's location in space. We have estimated the effectiveness of the hippocampal place cells in coding for the location of the rat in space in two conditions: (1) the place fields are defined using only spikes that appear when theta rhythm is present in the EEG, and (2) the place fields are defined using all the spikes that occurred when the rat is running on the maze. We analyzed data from a large ensemble of simultaneously recorded hippocampal cells and reconstructed the path made by the rat when running in the maze, using the population activity vector, as described by Wilson and McNaughton, 1993. The reconstruction error is reduced by 40% when using only the spikes that appear when theta rhythm is present in the EEG, in comparison to the case when all spikes are taken into account. Clearly, the presence of theta rhythm is well correlated with relatively high accuracy of the place fields in predicting location. Supported by MH46823, AG12609 and MH01227.