

On informational content of a momentary spiking activity of hippocampal place cells

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Rat hippocampal principal cells called “place cells” have spatially localized firing which provides information about the animal’s current position in an environment. This information is commonly characterized by the method proposed by Skaggs et al. (1993). Their approach ignores potential differences in spatial information at different positions and at different times during a recording which may provide valuable clues to understanding the nature of place cell representation of space.

In general, to calculate the information about a stimulus that is contained in a response, one only requires the probability distributions of both the stimulus and the response. In our case, we have considered the stimulus to be the rat’s current position and the response the number of action potentials during a sufficiently long time interval (e.g. 100 ms). Our measure of positional information is then based on the distributions of the numbers of spikes at each position in the environment.

In this contribution we analyze the properties of this measure of the positional information in an arbitrarily distributed spike-at-position time series. It has two main advantages. First, it characterizes the positional information at each visited region and in this way it allows the construction of an information map. Second, the measure provides a way to estimate the current information of the discharge within a sufficiently sampled time-step. The measure was applied to simulated and experimental data from which the “overdispersion” of place cell discharge has been characterized (Olypher et al, 2001).

References

Olypher AV, Lánský P, Fenton AA (2001), "Properties of the extra-positional signal in hippocampal place cell discharge derived from the overdispersion in location-specific firing " (submitted to Neuroscience).

Skaggs WE, McNaughton BL, Gothard KM, and Markus EJ(1993), "An information-theoretic approach to deciphering the hippocampal code". In Hanson SJ, Cowan JD, and Giles CL, editors, *Advances in Neural Information Processing Systems*, volume 5, 1030-1037. Morgan Kaufmann.