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COMPARISON OF DIFFERENT METHODS FOR POSITION RECONSTRUCTION FROM HIPPOCAMPAL PLACE CELL RECORDINGS. K. Chan,[1*] K. Zhang,[1] J.J. Knierim,[2] B.L. McNaughton[3] and T.J. Sejnowski[1]. [1]Salk Institute, Computational Neurobiology Lab, La Jolla, CA 92037; [2]Dept. of Neurobiology & Anatomy, University of Texas-Houston Medical School, Houston, TX 77225; [3]ARL Division of Neural Systems, Memory and Aging, University of Arizona, Tucson, AZ 85724.

The Bayes' conditional probability rule is the optimal method for decoding neuronal population activity within the probabilistic framework. Two efficient algorithms for reconstructing the position of a freely moving rat from hippocampal place cell spikes have been proposed previously assuming independent inhomogeneous Poisson firing statistics. One algorithm uses the timing of individual spikes and the assumptions of Gaussian place field shape and random walk behavior of the animal to obtain an analytical expression for position reconstruction (Brown et al., 1998). The second algorithm uses the number of spikes within a time window and the empirical firing maps to obtain a numerical solution (Zhang et al., 1998). For comparison, a multi-layer perceptron (MLP) was also implemented, with number of spikes from each cell in a time window as input and animal position as output. The three algorithms were applied to both real recordings from rats running in an open environment and a computer simulation of rat movements and neuronal firing. In general, the MLP method, while requiring no explicit assumption of cell firing statistics, yielded the least accurate reconstruction. The first Bayes' algorithm requires no manual parameter adjustment and provides clearer mathematical insight into population neural spikes decoding. The second Bayes' algorithm yielded better reconstruction accuracy because it was less susceptible to noise and the shape of the environment. Supported by the Howard Hughes Medical Institute, NS20331 and MH01565.