DEFORMING THE HIPPOCAMPAL MAP

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Abstract

To investigate conjoint stimulus control over place cells, Fenton et al. (2000a) recorded while rats foraged in a cylinder with 45° white and black cue cards on the wall. Card centers were 135° apart. In probe trials the cards were rotated together or apart by 25°. Firing field centers shifted during these trials, stretching and shrinking the cognitive map. Fenton et al. (2000b) described this deformation with an *ad hoc* vector field equation.

We consider what sorts of neural network mechanisms might be capable of accounting for their observations. In an abstract, maximum likelihood formulation, the rat's location is estimated by a conjoint probability density function of landmark positions. In an attractor neural network model, recurrent connections produce a bump of activity over a 2D array of cells; the bump's position is influenced by landmark features such as distances or bearings. If features are chosen with appropriate care, the attractor network and maximum likelihood models yield similar results, in accord with previous demonstrations that recurrent neural networks can efficiently implement maximum likelihood computations (Pouget et al., 1998; Deneve et al., 2001).

Keywords: **place cell, attractor network, maximum likelihood, map deformation, rodent hippocampus**