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Presentation Abstract

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Title:	Online reconstruction of rat's position based on firing information from hippocampal place cells
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Authors:	***S. SCHAFFELHOFER**[1], C. GUGER[1], M. V. SANCHEZ-VIVES[2], T. GENER[2], J. BROTONS-MAS[2]; [1]G.Tec Med. Engin. GmbH, Schiedlberg, Austria; [2]Inst. d'Investigacions Biomédiques August Pi i Sunyer, Barcelona, Spain

Abstract:

Place cells (PC) are neurons that fire whenever the animal is at a specific place of its environment. These spatially modulated neurons have a background firing of about 0.1 Hz, but when the animal enters the neuron's responsible field, its firing rate goes up to about 5-20 Hz. Different neurons fire at different locations of their environment. This attribute was used to online reconstruct the trajectory of rats based on the firing of several simultaneously recorded PC.

Recordings were obtained from 6 different rats and two different brain regions (CA1, subiculum) while the rat was foraging in square open fields between 0.5 m x 0.5m - 1 m x 1 m. The reconstruction process was divided into two steps. In the first step, the algorithm training phase, the activity of all neurons was related to the position of the animal acquired with a tracking system. In this way, firing rate maps for every recorded neuron could be created. In the second step, the reconstruction phase, new recordings from the same neurons were obtained and assigned online to its neuron. The current firing rates within a constantly updated time window were compared with the firing rate maps of the training and reconstructed with a Bayesian 2-step algorithm. All necessary steps of the reconstruction phase were realized online. To distinguish electro-physiological signals from different neurons, a new template-matching algorithm for tetrode recordings was developed. Offline and online analysis have been realized with MATLAB.

The reconstructed position was highly correlated with the real position of the animal (Figure 1), with better results for larger neuronal populations , along with well distributed - not concentrated - firing fields. The median error was 13% (9.2 cm in 50 x 50 cm arena) relative to the arena diagonal in the best

case (CA1, 8 neurons) and 30 % in the worst case (subiculum, 4 neurons).

Figure 1: Position reconstruction results

The study with six different rats demonstrated that the position of rats in space can be reconstructed online by the use of PC recordings. This same methodology is currently being used in real-time.

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