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Neural network realization of sensorimotor space organization using predictability and decorrelation

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Introduction

Different coding principles like stability have been successfully applied to passive sensory stimuli to capture sensory representation of neurons [1]. It has become obvious later that the agent's behavioral repertoire has a crucial impact on the formation of the sensory representation and thus highlights the importance of the sensorimotor space. A heuristic rule-based investigation [2] demonstrates that optimizing the predictability in sensorimotor space of foraging agent leads to the emergence of place fields. The present work implements this principle in a biologically plausible neural-network architecture.

Methods

We use a virtual robot exploring environments with different exploration parameters. Its behavior is captured in a transition matrix, quantifying the probability to receive certain sensory signals as a consequence of previous sensory signals and the chosen behavior. Next, we implemented predictability and decorrelation in a Hebbian framework. After learning, response properties of neurons are quantified and compared to alternative adaptation scheme [2].

Results

Figure 1 represents the initial assumed representation of a circular environment. This was taken from an intermediate stage of the heuristic rule based implementation [2]. Figure 2 obtained after learning on the neural network through 2000 timesteps (actions) by the robot in the envi-

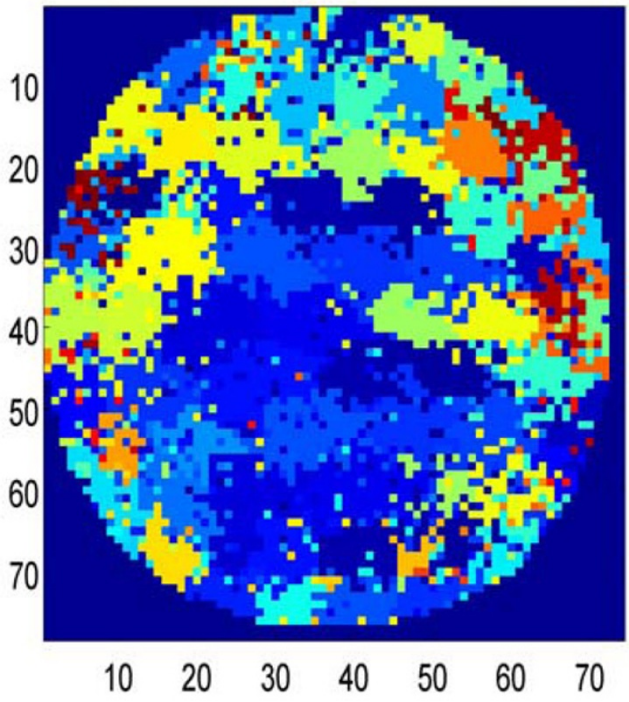

Figure 1
Initial assumed representation of a circular environment.

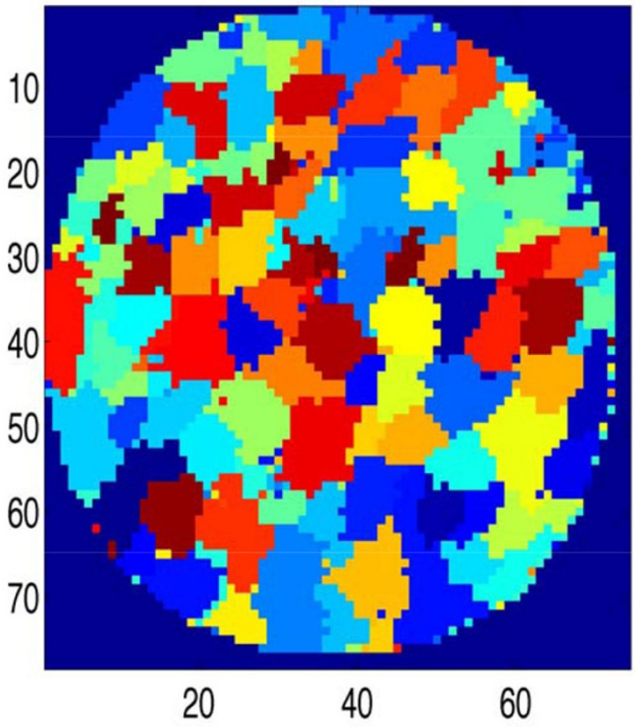

Figure 2
Sensorimotor representation after 2000 steps of learning.

ronment. The learning leads to compact states that are similar to place fields. The network learns quickly and converges to a stable state.

Discussion

Although predictability appears mathematically complex, it is possible to implement it in a biologically plausible neural network. The performance is as good as the heuristic rule based algorithm in terms of convergence. Therefore, predictability holds the promise to be a general principle in cortical processing.

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References

1. Wyss R, König P, Verschure PF: **A model of the ventral visual system based on temporal stability and local memory.** *PLoS Biology* 2006, **4:**e120.
2. Märtin R, Weiller D, Dähne S, Engel AK, König P: **Sensory space representations based on motor capabilities.** *Eighth Göttingen Meeting of the German Neuroscience Society* 2009.