

# Grid pattern formation

Simone Poetto

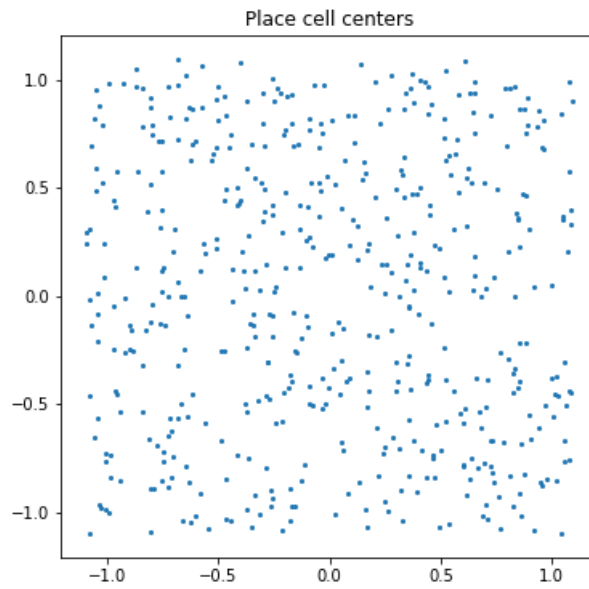
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## 1 Code Description

Description of the code from [2]

### 1.1 Place cells

Place cell centers are randomly and uniformly distributed throughout the environment (square box 2.2x2.2).

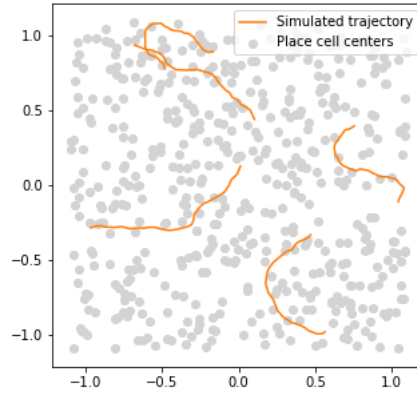


## 1.2 Trajectories

Trajectory are generated according to [1]

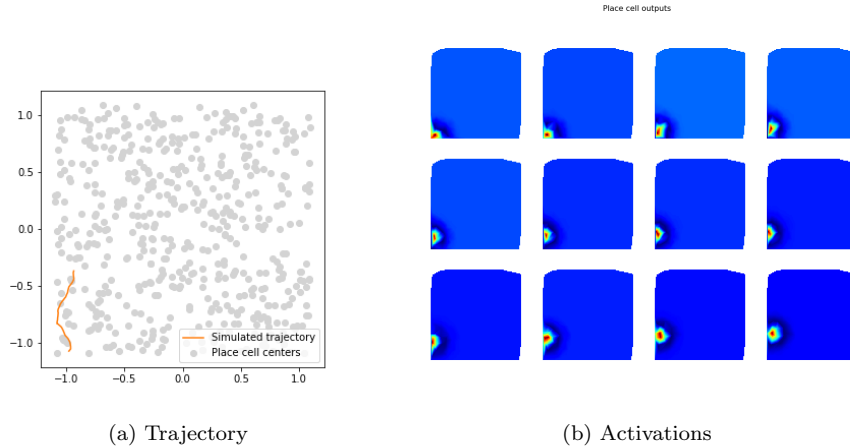
The rat uses first order motion dynamics, i.e. constant speed and no acceleration. It can detect and avoid obstacles by a limited line-of-sight mechanism.

Here are some sample trajectory generated inside the square arena:



## 1.3 Place cells activation

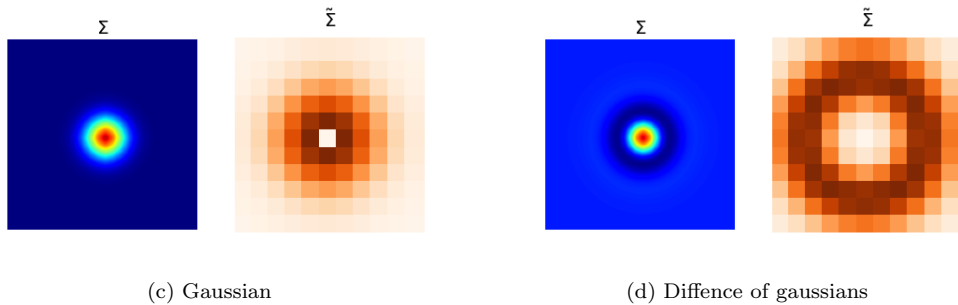
Here is an exemple of the place cells activations for a single trajectory at different time step.



The response of the  $i$ -th place cell is simulated either using a gaussian or a difference of gaussians.

## 1.4 Place cells covariance

Here is the place cells covariance for both cases: response modulated by a gaussian or by a difference of gaussians:



## References

- [1] Uur M. Erdem and Michael Hasselmo. A goal-directed spatial navigation model using forward trajectory planning based on grid cells. *European Journal of Neuroscience*, 35(6):916–931, 2012.
- [2] Ben Sorscher, Gabriel Mel, Surya Ganguli, and Samuel Ocko. A unified theory for the origin of grid cells through the lens of pattern formation. In H. Wallach, H. Larochelle, A. Beygelzimer, F. d'Alché-Buc, E. Fox, and R. Garnett, editors, *Advances in Neural Information Processing Systems 32*, pages 10003–10013. Curran Associates, Inc., 2019.