# Zajednički seminar

### Znanstvenog centra izvrsnosti QuantiXLie i Hrvatskog biofizičkog društva

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### Sequential Bayesian estimation for

### gradient sensing with spatial comparison

Sensing by spatial comparison is an important mechanism that enables large and slow cells to efficiently navigate towards the maximum of the concentration field. Even the sensing by temporal comparison, like in navigation of sperm cells in open sea, can be mapped to the sensing by spatial comparison. It is known that molecular shot noise, as well as the motility noise, limit the accuracy of concentration and gradient sensing. The framework of sequential Bayesian estimation provides the efficient way to improve this accuracy. Here we study the minimal model of 2D agent that measures stationary gradient and concentration with the presence of sensing and motility noise and updates its likelihood function of the environment. We consider two modes of Bayesian estimation, depending on the environment model with and without rotational diffusion, which agent uses to predict the likelihood function. We show that model with rotational diffusion is superior, with the degree of improvement depending on the signal-to-noise ratio of the environment. We also show that the width and information present in the likelihood function of the environment depend solely on the signal-to-noise ratio. Our study reveals non-intuitive result for the width of likelihood function when motility noise is present. In conclusion, we propose the implementation of the sequential Bayesian estimation in single cells, as an iterative scheme that mimics the memory on the environmental state.



Znanstveni centar izvrsnosti za kvantne i kompleksne sustave te reprezentacije Liejevih algebri

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#### EUROPSKA UNIJA

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