

ADAPTIVE AND ENERGY EFFICIENT SIGNAL PROCESSING BY NEURAL NETWORKS

Perquisites

- Random Signals (044202)
- Introduction to Biological Signals and Systems (046326)
- Matlab Programming

Introduction

The nervous system often provides highly effective estimates of important aspects of the state of the environment based on multiple noisy observations. Compared to artificial systems, the energy that is consumed by the brain for this task is surprisingly low. Encoding, processing and decoding of information usually take place in biological neuronal networks through point processes. Recent research has demonstrated that the encoding of external stimuli is adaptive allowing the system to significantly reduce its energy consumption. However, the specific means by which biological systems effectively trade-off between the estimation accuracy and the energy consumption is unknown. Naively it would seem that lowering the energy consumption would lead to degraded performance. However, the observed low energy consumption of biological systems suggests otherwise. It seems that neurons are able, through ill-understood processes, to extract relevant information at very low energetic costs.

Project Description

The aim of this project is to study the effect of adaptation on the quality of the state estimation in a biologically motivated context. The underlying theoretical framework is that of optimal point process filtering. Based on an existing theoretical framework, students are asked to characterize the effect of adaptation on the state estimation and energy consumption by means of computer simulations. The project is open to novel suggestions and testing of alternative, biologically plausible, estimation procedures.

Project Requirements

- Learning the mathematical formulation of the problem.
- Running simulations using the suggested model for adaptation and analyzing the results.
- Suggesting extensions of the basic model.

Project Duration

One Semester

Contact

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