

# Master Thesis

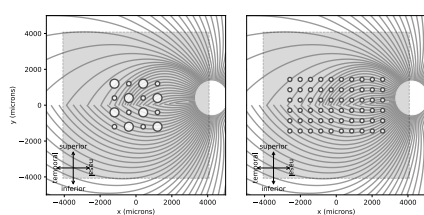
## Bayesian Optimization-based Electrode Layout Design for Retinal Implants

**Prof. Dr.-Ing. Johannes Stegmaier**  
 Lehrstuhlinhaber

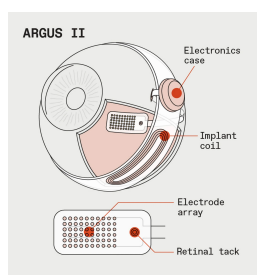
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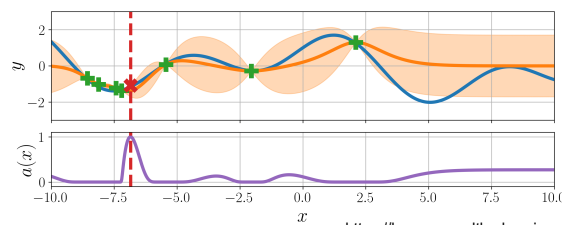
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Electrode layout of retinal implants: Argus I & Argus II.



<https://spectrum.ieee.org/bionic-eye-obsolete>



<https://bayeso.readthedocs.io>

## Background

Designing the layout of the electrode array for the retinal implant is a challenging task, as many factors have to be taken into consideration, e.g., the anatomical structure of the retina, the trade-off between the resolution and the crosstalk effect of the electrodes, and the patient-specifically elicited phosphenes. Bruce & Beyeler [1] propose to design the electrode arrangement automatically with a greedy algorithm and a simulation model [2]. In this thesis, we would like to use Bayesian Optimization [3] instead, where the acquisition function can be defined based on the classification results following our previous work [4].

- [1] A Bruce and M Beyeler. "Greedy optimization of electrode arrangement for epiretinal prostheses." *MICCAI 2022*
- [2] M Beyeler et al. "pulse2percept: A Python-based simulation framework for bionic vision." *SciPy 2017*
- [3] J Močkus. "On Bayesian methods for seeking the extremum." *IFIP Technical Conference on Optimization Techniques 1975*
- [4] Y Wu et al. "A deep learning-based in silico framework for optimization on retinal prosthetic stimulation." *IEEE EMBC 2023*

## Tasks

- Literature review on Bayesian Optimization algorithm
- Develop and refine the acquisition functions and sampling strategies
- Implement and evaluate with `pulse2percept` simulation package
- Propose new electrode layout designs suggested by Bayesian Optimization

## Your Profile

- Programming experience with Python
- Knowledge in probability theory and optimization
- Knowledge in computer vision and deep learning
- High motivation and good time management

## Our Offer

Our institute features a cluster with over 2000 CPU cores and 100 GPUs. We have more than 16TB of RAM and 1TB of VRAM available for computationally demanding tasks. Throughout the thesis period, you will be actively supported via your fixed meetings. If you are interested, a short email to [yuli.wu@lfb.rwth-aachen.de](mailto:yuli.wu@lfb.rwth-aachen.de) with the latest résumé and the transcript of grades (Notenspiegel) would be expected.