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| **FACULTY:** | The Faculty of Mathematics and Natural Sciences |
| **DEPARTMENT:** | Department of Informatics |
| **AREA OF EXPERTISE:** | Computational neuroscience |
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**DISSERTATION TITLE:** *Uncertainty quantification in neuroscience*


The nervous system is an extremely complex system and computational tools and models help us understand how it functions. The computational models of these biological systems always contain uncertainties and in order to take the uncertainties into account, we have to perform an uncertainty analysis. The main focus of this thesis has been to develop a software toolbox for performing uncertainty analysis of computational models in neuroscience.

Computational models always contain parameters that describe the system we model, an example of which is the thickness of a cell membrane. These parameters are for various reasons often uncertain and do not have one specific value. This may either be because we are unable to accurately measure the parameter value, or because the parameter has a range of values that can occur in nature. The latter is especially common for biological systems. By performing an uncertainty analysis we quantify how the model depends on this naturally occurring parameter uncertainty and the uncertainty analysis allows our models to better reflect what we observe in nature.

The developed uncertainty analysis toolbox, named Uncertainpy, makes it easy for neuroscientists to perform uncertainty analysis on their own models. Uncertainpy is tailored towards models in neuroscience and allows an uncertainty analysis to be performed without having to make changes to the original model.

The work in this thesis also involves developing software tools to help improve other areas of neuroscience; namely Exdir for data storage and Neuronify for education. Exdir is a data format for organizing data in a hierarchy by using file-system directories. Neuronify is an educational app that enables students to easily create their own neural networks by dragging and dropping neurons onto the screen and then see how the networks behave.