

Tue J. Boesen

MACHINE LEARNING SPECIALIST

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Summary

I am a machine learning scientist and have previously worked as: software developer, researcher, project lead, and technical advisor/consultant on various projects. I have a solid foundation in: physics, mathematics, data science, and high-performance-computing. I am familiar with programming best practices and generating production-ready code. Within machine learning, I have specialized in physics-informed and graph neural networks, but I have experience with most areas of deep learning, and I have applied machine learning in many different fields.

Selected experiences

MACHINE LEARNING HIGHLIGHTS

- Developed novel **physics-informed graph neural networks** that allow the consideration of constraints and symmetries, and used them on mechanical and molecular systems to lower constraint violations by several orders of magnitudes, while increasing prediction accuracy.
- Developed novel **active learning** techniques for image classification and used them to significantly lower the amount of training images required for high accuracy.
- Developed novel **clustering** techniques to more accurately predict oil and mineral concentrations in the ground.
- Built **natural language processing** and **convolutional** models and used self-training to teach them how amino acids bind together and how proteins fold.
- Used **transfer learning** and reversible networks to create geological maps from satellite data.
- Used **reinforcement learning** and Monte Carlo graph search techniques to create AIs that can play boardgames.

Owner – Consultant

[Aarhus, Denmark](#)

NEURAL SOLUTIONS

Dec 2021 - Nov 2022

- Scoping of business problems solvable by machine learning.
- Designed tailored neural network architectures.

Lead Machine Learning Specialist

[Vancouver, Canada](#)

PROTEIC BIOSCIENCE INC.

Jan 2022 - June 2022

- Lead developer of equivariant twice-differentiable neural networks for biomolecules.
- Developed MLOps framework with MLflow and Optuna for automatic data ingestion, processing and feature transforms, hyperparameter tuning and model tracking.

Postdoctoral Research Fellow in Machine Learning

[Vancouver, Canada](#)

UNIVERSITY OF BRITISH COLUMBIA (UBC)

May 2019 - Aug 2021

- Developed novel physics-informed neural networks inspired by differential algebraic systems of equations capable of honoring constraints and symmetries.
- Published reversible mimetic graph neural networks.
- Developed self-supervised conditional probability neural networks inspired by natural language processing models.
- Published a semi-supervised active learning algorithm utilizing pseudo-labeling which offers theoretical guarantees to be optimal.
- Deployed large-scale training on Amazon Web Services.

AI Research Scientist

[Vancouver, Canada](#)

COMPUTATIONAL GEOSCIENCE INC.

May 2019 - Aug 2020

- Developed clustering techniques for oil exploration.
- Published novel graph-based semi-supervised learning methods applied to seismic data.

Research Assistant

[Aarhus, Denmark](#)

HYDROGEOPHYSICS GROUP AT AARHUS UNIVERSITY

Aug 2017 - Nov 2017

- Open-sourced a sparse iterative parallel linear solver based on my research during my Ph.D.
- Open-sourced an OpenMP parallelization framework developed during my Ph.D.

Analyst, Graduate Position

[Copenhagen, Denmark](#)

DANSKE BANK

Sep 2013 - Apr 2014

- Worked in customer insight creating forecast models.

Software Developer

[Aarhus, Denmark](#)

HYDROGEOPHYSICS GROUP AT AARHUS UNIVERSITY

Mar 2013 - Sep 2013

- Created SPIA, an application for ground-based electromagnetic measurements.

Education

Ph.D. in Geophysics

AARHUS UNIVERSITY

- Thesis: Numerical methods for electromagnetic geophysics beyond 1D

Denmark

2015 - 2018

M.S. in Theoretical Physics

AARHUS UNIVERSITY

- Thesis: Foundation for a parallel time-dependent density functional theory simulator in a spherical harmonic basis using the exact exchange energy functional

Denmark

2010 - 2011

B.S. in Physics

AARHUS UNIVERSITY

- Thesis: Feynman's path integral in one dimension with focus on sinusoidal trajectories

Denmark

2006 - 2010

Skills

Platforms Windows, Linux Ubuntu, AWS

Programming Python, Pytorch, LaTeX, Git, Matlab, Fortran, Julia, Delphi/Pascal, OpenMp, MPI

Languages Danish, English

Teaching and supervision

Teaching

INSTRUCTOR

- Calculus.
- Electric and Electromagnetic methods.
- Data processing and interpretation for groundwater mapping.
- Geophysical methods.
- Hydrogeophysical field course (twice).

Aarhus University, Denmark

2009-2017

Supervision

CO-SUPERVISOR

- Jingrong Lin – Ph.D. student in geophysics and machine learning.

UBC, Canada

2020

Publications

Submitted

Neural DAEs: Constrained neural networks

Tue Boesen, Eldad Haber, Uri M Ascher

arXiv preprint arXiv:2211.14302 (2022). 2022

Journal Articles

A-optimal active learning

Tue Boesen, Eldad Haber

Physica Scripta 98.4 (Mar. 2023) p. 045014. IOP Publishing, 2023

Mimetic neural networks: a unified framework for protein design and folding

Moshe Eliasof, Tue Boesen, Eldad Haber, Chen Keasar, Eran Treister

Frontiers in Bioinformatics 2 (2022). 2022

Data-driven semi-supervised clustering for oil prediction

Tue Boesen, Eldad Haber, Michael G Hoversten

Computers & Geosciences 148 (2021) p. 104684. Pergamon, 2021

An efficient 2D inversion scheme for airborne frequency-domain data

Tue Boesen, Esben Auken, Anders V Christiansen, Gianluca Fiandaca, Casper Kirkegaard, Andreas A Pfaffhuber, Malte Vöge

Geophysics 83.4 (2018) E189–E201. Society of Exploration Geophysicists and American Association of Petroleum ..., 2018

A parallel computing thin-sheet inversion algorithm for airborne time-domain data utilising a variable overburden

Tue Boesen, Esben Auken, Anders V Christiansen, Gianluca Fiandaca, Cyril Schamper

Geophysical Prospecting 66.7 (2018) pp. 1402–1414. European Association of Geoscientists & Engineers, 2018

A review of airborne electromagnetic methods with focus on geotechnical and hydrological applications from 2007 to 2017

Esben Auken, Tue Boesen, Anders V Christiansen

Advances in geophysics 58 (2017) pp. 47–93. Elsevier, 2017

Conference Proceedings

Semi-supervised clustering for oil prospectivity

Tue Boesen, Eldad Haber, Michael G Hoversten

ICLR AI for Earth Sciences workshop, 2020

Efficient 2D hybrid inversion of airborne frequency domain data

Esben Auken, Tue Boesen, Anders V Christiansen, Gianluca Fiandaca, Andreas A Pfaffhuber, Malte Vöge

Second European Airborne Electromagnetics Conference, 2017

2D FEM inversion with a moving footprint and a hybrid 1D and 2D forward and derivative implementation

Tue Boesen, Esben Auken, Malte Vöge, Casper Kirkegaard, Kristoffer Andersen, Andreas A Pfaffhuber, Anders V Christiansen

AGU Fall Meeting Abstracts, 2016

Utilizing massively parallel co-processors in the AarhusInv 1D forward and inverse AEM modelling code

Casper Kirkegaard, Kristoffer Andersen, Tue Boesen, Anders V Christiansen, Esben Auken, Gianluca Fiandaca

ASEG Extended Abstracts, 2015

Rapid inversion of large airborne AEM data datasets utilizing massively parallel co-processors

Casper Kirkegaard, Kristoffer Andersen, Anders V Christiansen, Esben Auken, Tue Boesen

First European Airborne Electromagnetics Conference, 2015

2.5D inversion of sea ice thickness from helicopter EM data

Malte Vöge, Andreas A Pfaffhuber, E Auken, Casper Kirkegaard, Tue Boesen, Stefan Hendricks, Priska Hunkeler

First European Airborne Electromagnetics Conference, 2015

About me

My main hobbies outside work are boardgames, rock climbing and beach volley. Apart from those I like to tinker with various projects, my current project is to **develop a framework** that can play various boardgames, while previous ones include: building a quadcopter, and designing and building a hangboard with a CNC machine and laser cutter.