Tue J. **Boesen**

Machine learning Researcher

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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 code. Within machine learning, I have specialised in physics-informed and graph neural networks, but I have experience with most areas of deep learning.

Below I highlight a few different fields/problems I have used ML on and the ML methods used to solving the problem:

- Mechanical systems using symmetry/constraint obeying neural networks.
- Oil predictions using semi-supervised clustering.
- Generating geological maps from satellite data using GANS, transfer learning and reversible neural networks.
- Image classification using spectral clustering and active learning.
- Protein folding using NLP models.

Selected experiences

Neural Solutions *Denmark*

Owner *Dec 2021 - Nov 2022*

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

Proteic Bioscience Inc. *Vancouver, Canada*

Lead Machine Learning Specialist *Jan 2022 - June 2022*

- Lead developer of equivariant neural networks for biomolecules.
- Developed MLOps framework with MLflow and Optuna.

University of Bristish Columbia (UBC) *Vancouver, Canada*

Postdoctoral Research Fellow in Machine Learning *May 2019 - Aug 2021*

- Developed novel physics-informed neural network frameworks.
- 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.
- Deployed large scale training on Amazon Web Services.

Computational Geoscience Inc. *Vancouver, Canada*

AI Research Scientist *May 2019 - Aug 2020*

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

HydroGeophysics Group at Aarhus University *Aarhus, Denmark*

Research Assistant *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.

Danske Bank *Copenhagen, Denmark*

Analyst, Graduate position *Sep 2013 - Apr 2014*

- Worked in customer insight creating forecast models.

HydroGeophysics Group at Aarhus University *Aarhus, Denmark*

Software Developer *Mar 2013 - Sep 2013*

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

Education

Aarhus University *Denmark*

Ph.D. in Geophysics *2015 - 2018*

- Thesis: Numerical methods for electromagnetic geophysics beyond 1D

Aarhus University *Denmark*

M.S. in Theoretical Physics *2010 - 2011*

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

Aarhus University *Denmark*

B.S. in Physics *2006 - 2010*

- Thesis: Feynmans Pathintegral i 1 dimension med fokus på sinusbaner (Feynman's path integral in 1 dimension with focus on sinusoidal trajectories)

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 *Aarhus University, Denmark*

Instructor *2009-2017*

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

Supervision *UBC, Canada*

Co-Supervisor *2020*

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

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.

Publications

In Preparation

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

An efficient 2D inversion scheme for airborne frequency-domain data
Tue Boesen, Esben Auken, Anders Vest Christiansen, Gianluca Fiandaca, Casper Kirkegaard, Andreas Aspmo 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 Vest 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, G Michael Hoversten
ICLR AI for Earth Sciences workshop, 2020

Efficient 2D hybrid inversion of airborne frequency domain data
E Auken, T Boesen, AVC Christiansen, GF Fiandaca, AA Pfaffhuber, MV 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 Rønne Andersen, Andreas Aspmo Pfaffhuber, Anders Vest Christiansen
AGU Fall Meeting Abstracts, 2016

Rapid inversion of large airborne AEM data datasets utilizing massively parallel co-processors
C Kirkegaard, K Andersen, AV Christiansen, E Auken, T Boesen
First European Airborne Electromagnetics Conference, 2015

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

2.5D inversion of sea ice thickness from helicopter EM data
M Vöge, A Pfaffhuber, E Auken, C Kirkegaard, T Boesen, S Hendricks, P Hunkeler
First European Airborne Electromagnetics Conference, 2015