Curriculum Vitae for Mats K. Brun

Personal information

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Born:	19.04.1988	Nationality:	Norwegian

Summary

I hold a Ph.D. in applied and computational mathematics, and have several years of experience with mathematical modeling and numerical programming. Through my work as a researcher both at the University of Bergen and the University of Oslo, I have gained a good understanding of mathematical modeling of diverse real-world systems, ranging from geothermal energy storage to evolutionary biology. A common factor has been the identification and classification of conservational principles in the relevant system, which then allows for the formulation of a mathematical model, typically using partial differential equations (PDE's). I have come to view PDE's both as a modeling tool, and as a source of theoretical insights which may translate into a deeper understanding of the real-world system, or, aid in the development of numerical algorithms for the particular problem at hand.

Technical skills

Numerical methods	(Mixed) finite element method, finite volume method.
Frameworks	NumPy, SciPy, FEniCS, Pandas, Matplotlib, Keras.
Languages	Python, Matlab, Java.
Tools	Git, LaTeX, Microsoft Office.

Education

2016 - 2019	Ph.D. in Applied and Computational Mathematics, Department of Mathematics, University of Bergen. Thesis title: 'Upscaling, analysis, and iterative numerical solution schemes for thermo-poroelasticity'. Main supervisor: Florin Radu. Co-supervisors: Inga Berre and Jan M. Nordbotten.
2013 - 2015	MSc. in Applied and Computational Mathematics, Department of Mathematics, University of Bergen. Thesis title: 'Wave breaking in long wave models and undular bores'.

2009 - 2012	BSc. in Physics, Department of Physics and Technology, University of Bergen.

Professional experience

2021 –	Consultant at Expert Analytics.
2021	20% position as substitute teacher in mathematics (S2) at Sonans, Oslo.
2020 – 2021	Postdoctoral Fellow at CEES - Centre for Ecological and Evolutionary Synthesis, Department of Biosciences, University of Oslo.
2019	Analyst at Frende Insurance, Bergen.
2016 – 2019	Ph.D. Research Fellow, Department of Mathematics, University of Bergen. - 2019: Co-supervisor for a MSc. student in the Porous Media Research Group. - 2018: Visiting researcher, Institute of Applied Mathematics, Leibniz Universität Hannover, Germany.
2016	Substitute teacher (with varying hours) in mathematics and physics (VG1 and VG2) at Bergen Katedralskole, Bergen.
2011 – 2016	Part-time Team-leader at ADAM 2326.
2014	Teaching assistant in Calculus II (MAT112) at the University of Bergen.
2008 – 2011	Part-time employee at Dolly Dimple's Torgallmenningen, Bergen.

Languages

Norwegian	Native language.
English	Fluent, written and spoken.

Personal skills

Analytical	Through many years of technical education I have gained a good ability to think logically and analytically, and am not afraid to confront challenging problems.
Modeling and numerical programming	Good experience in mathematical modeling of real-world systems, and implementation into numerical computer code.
Creative	Good experience in creative thinking, both in terms of creative solutions to academic and technical problems, and musical performance and expression.
Communication and teaching	Several teaching experiences at both the high-school and university levels has augmented my ability to internalize and communicate difficult concepts.
Problem solving	Always up for a new challenge, and always eager to explore new skills and new technology.

Some interests and hobbies

Music	Hobby musician (guitar and piano), primarily jazz and blues and related styles.
Sports	Weightlifting, running, hiking, skiing.
Personal	Personal development, traveling, live music, reading.

Extended descriptions of selected projects

Activity	Drivers of evolutionary change: Understanding stasis and non-stasis through integration of micro- and macroevolution.
Period	2020 – 2021
Role	Researcher
Staffing	Team of 4
Volume	100%
Description	As a postdoctoral researcher in biomathematics, I was part of a research project led by Prof. Nils Chr. Stenseth and Prof. Jan M. Nordbotten, devoted to developing a mathematical framework for eco-evolutionary modeling. In particular, to connect evolutionary models at different scales in a unified mathematical framework. E.g., one may consider a population as a system of interacting species where species evolve together as separate species, or, one may consider the population as distinct individuals without imposing the category of species upon them. A multi-scale description of an eco-evolutionary system can therefore give new insight into phenomena such as *speciation*. My role in this project was two-fold: To extend the existing mathematical framework in a more mathematically rigorous direction, and to apply this framework to a real-world eco-evolutionary system using biological data.
Tools	Mathematical modeling and analysis, mathematical biology, finite volume method, Matlab, Latex.

Activity	An iterative staggered scheme for phase field brittle fracture propagation with stabilizing parameters.
Period	2018
Role	Researcher
Staffing	Team of 5
Volume	100%

Description	During my doctoral work I spent some time at the Leibniz Universität Hannover, Germany, as a visiting researcher, where I collaborated with Prof. Thomas Wick. The purpose of this collaboration was to work on numerical solution algorithms for fracture propagation in brittle materials, where the fracture surface is represented by a phase-field variable. Our strategy was to decouple the mechanics from the phase-field and solve each linearized sub-problem separately, while iteratively updating coupling terms. Analysis of the proposed algorithm revealed bounds on the elastic strain and the thickness of the phase-field surface for which convergence is guaranteed. Moreover, stabilizing parameters were introduced and tailored specifically to each subproblem. The resulting algorithm is a stable and efficient solution procedure for the notoriously difficult phase-field brittle fracture propagation problems, including conditions for guaranteed convergence.
Tools	Mechanics, finite element method, Latex, Deal II.

Activity	Upscaling, analysis, and iterative numerical solution schemes for thermo-poroelasticity.
Period	2016 – 2019
Role	Researcher
Staffing	Team of 5
Volume	100%
Description	The main objectives of my doctoral research was to provide part of the mathematical models and simulation technology required to assess large-scale deployment of thermo-mechanical subsurface energy storage in the context of intermittent renewable energy. The relevant physical processes for this application is the coupling of geomechanics, flow, and heat transfer within a porous material, i.e., *thermo-poroelasticity*. Thus, together with my supervisors, Prof. Florin A. Radu, Prof. Inga Berre, and Prof. Jan M. Nordbotten, we focused on different aspects of thermo-poroelasticity, relevant for the previously mentioned application, and under the technical umbrella of mathematical modeling and analysis. In particular, the research was separated into three parts; (1) modeling, (2) analysis and (3) numerical implementation.
Tools	Mathematical modeling and analysis, finite flement method, Python, NumPy, SciPy, Latex.