

Håkon Hoel

Curriculum Vitae

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Education

2012 PhD in Numerical Analysis at KTH Royal Institute of Technology
2006 MSc in Computational Science at University of Oslo (UiO)
2004 BSc in Computational Science at University of Oslo

Academic positions

Apr 2022 – Associate Professor at Department of Mathematics, UiO
Aug 2019 – Feb 2022 Junior Professor at Department of Mathematics, RWTH Aachen
Jul 2018 – Jul 2019 Visiting researcher at Division of Computer, Electrical and Mathematical Sciences and Engineering (CEMSE), KAUST university
Dec 2017 – Jun 2018 Guest teacher at Department of Mathematical Sciences University of Gothenburg (GU) and Chalmers University of Technology
Nov 2016 – Nov 2017 PostDoc at Mathematics Institute of Computational Science and Engineering, École Polytechnique Fédérale de Lausanne (EPFL)
Oct 2014 – Oct 2016 PostDoc at Department of Mathematics, UiO
Aug 2012 – Sep 2014 PostDoc at the CEMSE division, KAUST

Research interests

- Numerical methods for SDE and SPDE,
- Multilevel Monte Carlo methods,
- stochastic conservation laws,
- Bayesian statistics and nonlinear filtering methods,
- molecular dynamics and quantum mechanics.

Teaching activities

Winter 2021	Lecturer in Mathematics and numerics for data assimilation and state estimation (11.45000), RWTH
Summer 2021	Lecturer in Ordinary Differential Equations (11.53812), RWTH
Winter 2020	Lecturer in Mathematische Grundlagen III (11.00684), RWTH
Summer 2020	Lecturer in Mathematics and numerics for data assimilation and state estimation (11.45000), RWTH
Spring 2018	Lecturer in Linear Algebra (MVE520) and Linear Algebra and Numerical Analysis (TMA671), GU and Chalmers
Fall 2017	Teaching Assistant (TA) in Stochastic Simulations (MATH-414), EPFL
Spring 2017	TA in Advanced Analysis II (MATH-105), EPFL
Fall 2016	TA in Introduction to PDE (MATH-300), EPFL
Spring 2015	TA in Applications of Linear Algebra (MAT-INF2360), UiO
2007–2012	TA in Introductory Numerical Analysis, KTH
Fall 2011	TA in Numerical Methods for PDE, KTH
Spring 2010	TA in Numerical Methods for SDE, KTH
Spring 2007	TA in Partial Differential Equations (INF-MAT3360), UiO
Fall 2003	TA in Modeling and Computations (MAT-INF1100), UiO

Supervision of students

PhD

- ▶ Sankarasubramanian Rangunathan in Mathematics at RWTH, August 2021 – ongoing.

Master

- ▶ Sankarasubramanian Rangunathan in Mathematics at RWTH, summer semester 2021, on “Higher order integrators for multilevel Monte Carlo methods”.

Bachelor

- ▶ Anastasia Fedotova in mathematics at RWTH, summer semester 2021, on “Data assimilation for discrete-time stochastic processes”.
- ▶ Noah Oberweis in mathematics at RWTH, summer semester 2021, on “Modeling and numerical simulations of molecular dynamics”.
- ▶ Kai Schulz in mathematics at RWTH, summer semester 2021, on “Fundamentals of mathematical epidemiology - analysis and variations of the SIR-model”.
- ▶ Benedikt Wilkens in Mathematics at RWTH, winter semester 2021, on “Stochastic differential equations with applications in finance: an introduction to numerical modeling of SDEs”.
- ▶ Mathias Horres in Mathematics at RWTH, winter semester 2021, on “Hamiltonian Systems Solved by Symplectic Methods with an Extension to Stochastic Differential Equations”.

Co-supervision

- ▶ Nadhir Ben Rached for an MSc degree in Applied Mathematics and Computational Science in KAUST, 2013.
- ▶ Gaukhar Shaimerdenova for a PhD degree in Applied Mathematics and Computational Science in KAUST 2017-ongoing.

Peer reviews for scientific journals and proceedings

Afrika Statistica, AIMS Foundations of Data Science, BIT Numerical Mathematics, Calcolo, Electronic Journal of Qualitative Theory of Differential Equations, Elsevier Applied Mathematics and Computations, ESAIM: Mathematical Modelling and Numerical Analysis (M2AN), Journal of Computational Physics, JoFoCM Journal of Foundations of Computational Mathematics, MathSciNet

Mathematical Reviews, MCQMC 2014 conference proceedings, Quantitative Finance, SIAM/ASA Journal on Uncertainty Quantification, SIAM Journal on Numerical Analysis, SIAM Journal on Scientific Computing, Springer Journal of Scientific Computing, Springer Statistics and Computing, Springer Stochastic and Partial Differential Equations: Analysis and Computations.

Organizational work

Co-organized minisymposia:

- ▶ "Advanced methods for high dimensional Bayesian inference and nonlinear filtering" at SIAM UQ 2022, Atlanta, USA. Organized together with Sahani Patiraja, USNW, Australia.
- ▶ "Analysis and numerical methods for conservation laws with stochastic terms" at ENUMATH 2019, Egmond aan Zee, The Netherlands. Organized together with Nils Henrik Risebro and Kenneth Karlsen, UiO, Norway.
- ▶ "Advanced multilevel Monte Carlo methods" at SciCADE 2015, Potsdam, Germany. Organized together with Kody Law, University of Manchester, Uk.

Language skills

Norwegian (Native), English (fluent), Swedish (good), and German (beginner).

Programming skills (on a 1-5 scale)

Matlab (4), Julia (4), Java (3), Python(3), C and C++ (2).

Publications

Theses

1. Hoel, Håkon (2012). "Complexity and Error Analysis of Numerical Methods for Wireless Channels, SDE, Random Variables and Quantum Mechanics". PhD thesis. KTH, Royal Institute of Technology.
2. Hoel, Håkon (2006). "Constructible DP solutions". MSc thesis. Univeristy of Oslo.

Peer reviewed publications

1. Chernov, Alexey, Håkon Hoel, Kody JH Law, Fabio Nobile, and Raul Tempone (2021). Multilevel ensemble Kalman filtering for spatio-temporal processes. *Numerische Mathematik* **147**(1), 71–125.
2. Hoel, Håkon, Gaukhar Shaimerdenova, and Raúl Tempone (2020). Multilevel Ensemble Kalman Filtering based on a sample average of independent EnKF estimators. *Foundations of Data Science* **2**(4), 351.
3. Hoel, Håkon and Anders Szepessy (2020). Classical Langevin dynamics derived from quantum mechanics. *Discrete & Continuous Dynamical Systems-Series B* **25**(10).
4. Hoel, Håkon and Sebastian Krumscheid (2019). Central limit theorems for multilevel Monte Carlo methods. *J. Complexity* **54**, 101407, 16.
5. Hoel, Håkon, Kenneth H. Karlsen, Nils H. Risebro, and Erlend B. Storrøsten (2018). Path-dependent convex conservation laws. *Journal of Differential Equations* **265**(6), 2708–2744.
6. Hoel, Håkon, Kenneth Hvistendahl Karlsen, Nils Henrik Risebro, and Erlend Briseid Storrøsten (2018). Numerical methods for conservation laws with rough flux. *Stochastics and Partial Differential Equations: Analysis and Computations*, 1–76.
7. Hall, Eric Joseph, Håkon Hoel, Mattias Sandberg, Anders Szepessy, and Raúl Tempone (2016). Computable Error Estimates for Finite Element Approximations of Elliptic Partial Differential Equations with Rough Stochastic Data. *SIAM Journal on Scientific Computing* **38**(6), A3773–A3807.
8. Hoel, Håkon, Juho Häppölä, and Raúl Tempone (2016). "Construction of a Mean Square Error Adaptive Euler–Maruyama Method With Applications in Multilevel Monte Carlo". In: *Monte Carlo and Quasi-Monte Carlo Methods: MCQMC, Leuven, Belgium, April 2014*. Cham: Springer International Publishing, pp. 29–86.
9. Hoel, Håkon, Kody J. H. Law, and Raul Tempone (2016). Multilevel ensemble Kalman filtering. *SIAM J. Numer. Anal.* **54**(3), 1813–1839.

10. Bayer, Christian, Håkon Hoel, Ashraful Kadir, Petr Plecháč, Mattias Sandberg, and Anders Szepessy (2015). Computational error estimates for Born-Oppenheimer molecular dynamics with nearly crossing potential surfaces. *Appl. Math. Res. Express. AMRX* (2), 329–417.
11. Bayer, Christian, Håkon Hoel, Erik von Schwerin, and Raúl Tempone (2014). On nonasymptotic optimal stopping criteria in Monte Carlo simulations. *SIAM J. Sci. Comput.* **36**(2), A869–A885.
12. Hoel, Håkon and Henrik Nyberg (2014). An Extension of Clarke’s Model With Stochastic Amplitude Flip Processes. *IEEE Transactions on Communications* **62**(7), 2378–2389.
13. Hoel, Håkon, Erik von Schwerin, Anders Szepessy, and Raúl Tempone (2014). Implementation and analysis of an adaptive multilevel Monte Carlo algorithm. *Monte Carlo Methods Appl.* **20**(1), 1–41.
14. Hoel, Håkon, Erik von Schwerin, Anders Szepessy, and Raúl Tempone (2012). “Adaptive multilevel Monte Carlo simulation”. In: *Numerical analysis of multiscale computations*. Vol. 82. Lect. Notes Comput. Sci. Eng. Springer, Heidelberg, pp.217–234.
15. Hoel, Håkon A. (2007). A numerical scheme using multi-shockpeakons to compute solutions of the Degasperis-Procesi equation. *Electron. J. Differential Equations*, No. 100, 22 pp. (electronic).

Preprints

1. Chada, Neil K, Håkon Hoel, Ajay Jasra, and Georgios E Zouraris (2021). Improved efficiency of multilevel Monte Carlo for stochastic PDE through strong pairwise coupling. *arXiv preprint arXiv:2108.00794*.
2. Haji-Ali, Abdul-Lateef, Håkon Hoel, and Raúl Tempone (2021). A simple approach to proving the existence, uniqueness, and strong and weak convergence rates for a broad class of McKean–Vlasov equations. *arXiv preprint arXiv:2101.00886*.
3. Hoel, Håkon, Gaukhar Shaimerdenova, and Raúl Tempone (2021). Multi-index ensemble Kalman filtering. *arXiv preprint arXiv:2104.07263*.

Conference and workshop presentations

- SIAMUQ 22, hybrid zoom/in-person conference, Atlanta, USA, 2022. “Multilevel EnKF methods, convergence and some open questions”.
- **Invited speaker** at IRTG Modern Inverse Problems Annual Meeting, RWTH Aachen, 2021, “Hierarchical methods for nonlinear filtering”.
- GAMM 91st Annual meeting, Zoom online conference, 2021, “A simple approach to proving well-posedness and convergence rates for a broad class of McKean–Vlasov equations”.
- SIAM CSE21, Zoom online conference, 2021, “Multilevel ensemble Kalman filtering algorithms on high-dimensional state spaces”.
- 14th MCQMC, Oxford, UK, 2020 (online conference with talks available on Youtube). “Multilevel ensemble Kalman filtering algorithms”.
- ENUMATH, Egmond aan Zee, Netherland, 2019. “Numerical methods for stochastic conservation laws”.
- Annual meeting of the GAMM activity group on Modelling, Analysis and Simulation of Molecular Systems, Munich, 2019. “Langevin dynamics derived from heat bath dynamics”.
- Workshop on SDEs/SPDEs: Theory, Numerics and their interplay with Data Science, Heraklion, Crete 2019. “Multilevel ensemble Kalman filtering algorithms”.
- SIAM CSE19, Spokane, USA, 2019. “Multilevel ensemble Kalman filtering for spatio-temporal processes”.
- 13th MCQMC, Rennes, France, 2018. “Multilevel ensemble Kalman filtering for spatio-temporal processes”.
- Workshop on computational uncertainty quantification, Banff International Research Station, Canada, 2017. “Numerical methods for stochastic conservation laws”
- SciCADE17, Bath, England, 2017. “Multilevel ensemble Kalman filtering for spatio-temporal processes”.

- SIAM Annual Meeting, Pittsburgh, USA, 2017. “Multilevel ensemble Kalman filtering for spatially extended models”.
- NUMHYP17, Monte Verita, Switzerland, 2017. “Numerical methods for stochastic conservation laws”.
- **Invited speaker at** NASPDE16, Gothenburg, Sweden, 2016. “Numerical methods for stochastic conservation laws”.
- 11th International EnKF workshop, Ulvik, Norway, 2016. “Multilevel ensemble Kalman filtering”.
- KAUST UQ Annual Winter Workshop, Thuwal, Saudi Arabia, 2016. “Multilevel ensemble Kalman filtering”.
- SciCADE15, Potsdam, Germany, 2015. “Multilevel ensemble Kalman filtering”.
- EquaDiff, Lyon, France, 2015. “Multilevel ensemble Kalman filtering”.
- FoCM, Montevideo, Uruguay 2014. “Weak approximation of SDE by a mean square error adaptive multilevel Monte Carlo method”.
- 11th MCQMC, Leuven, Belgium, 2014. “Weak approximation of SDE by a strong error adaptive multilevel Monte Carlo method”.
- ENUMATH, Lausanne, Switzerland, 2014. “On non-asymptotic optimal stopping criteria in Monte Carlo simulations”.
- Workshop on Stochastic Numerical Methods, Montevideo, Uruguay, 2012. “Two applications of the central limit theorem in numerical analysis”.
- ICIAM, Vancouver, Canada, 2011. “How accurate is molecular dynamics?”
- Days on diffraction, St. Petersburg, Russia, 2011. “How accurate is molecular dynamics?”
- BIT, Lund, Sweden, 2010. “Gaussian coarse graining of a master equation generalization of Clarke’s model”.
- ENUMATH, Uppsala, Sweden, 2009. “Adaptive multilevel Monte Carlo simulation”.