NORCE

Curriculum Vitae

Personal information	**LORENTZEN, Rolf Johan**
Telephone	+47 41 10 47 37
E-mail	rolo@norceresearch.no
Date of birth	03/09-1974
Nationality	Norwegian
Gender	Male
Occupational field	**Applied and Computational Mathematics**
	- Data assimilation
	- Mathematical optimization
	- Fluid dynamics
Work experience	
2007>	Principal Researcher, NORCE (IRIS until 2018)
2002-2007	Research Scientist, Rogaland Research / IRIS
Education and training	
2002	Ph. D., Applied Mathematics, University of Bergen
1998	Cand. Scient., Applied Mathematics, University of Bergen
1996	Cand. Mag., Applied Mathematics, University of Bergen
Language	
Mother tongue	Norwegian
Other language(s)	English (Verbally and Writing)
Awards	Winner of the Computers & Geosciences 2017 Best Paper Award: An auxiliary adaptive Gaussian mixture filter applied to flowrate allocation using real data from a multiphase producer, Rolf J. Lorentzen, Andreas S. Stordal, Neal Hewitt, Computers & Geosciences, Volume 102, May 2017, Pages 34-44.
Students supervised/co-supervised	PhD students; 3:
	- Statistics, University of Bergen, Norway
	- Energy Resources, University of Stavanger, Norway
	- Energy and Petroleum Engineering, University of Stavanger, Norway
Professional service	- In organization committee for the "SIAM Conference on Mathematical & Computational Issues in the Geosciences", Padua, Italy, June 17-20, 2013.
	- In organization committee of the "Workshop on ensemble Kalman filter for updating of reservoir simulation models", 2007. See http://www.iris.no/enkf
	- Served as a reviewer for journal papers in: SPE Journal, Journal of Petroleum Science and Engineering, Computational Geosciences, Geofluids and IEEE Transactions on Automatic Control.
Professional membership	Society for Industrial and Applied Mathematics (SIAM)

Project management	-	"Transient well flow modelling techniques for accurate production allocation". Project leader, total budget of 10.4 MNOK, partners: Gdf Suez E&P Norge AS, ConocoPhillips Skandinavia AS, Norwegian Research Council.
	-	"Advanced Transient Flowrate Allocation". Project leader, total budget of 6 MNOK, partners Gdf Suez E&P Norge AS.
	-	"LOOP Wind - Location Optimization for Offshore Platforms". Total budget of 1.85 MNOK, partners: WunderOcean, Lda., Agência Regional para o Desenvolvimento da Investigação Tecnologia e Inovação – ARDITI, Norwegian Research Council.
	-	"CSSR - Centre for Sustainable Subsurface Resources". Work package leader (WP3), total budget 166.164 MNOK, partners: Equinor Energy AS, Wintershall Dea Norge AS, University of Bergen, University of Stuttgart, TU Delft, Oregon State University, Imperial College of London, TNO, Sumitomo, SLB, GCE Ocean Technology, Earth Sc Analytics, Norwegian Research Council.

Journal papers

1. K. S. Eikrem, R. J. Lorentzen, R. Faria, A. S. Stordal and A. Godard, "Offshore wind farm layout optimization using ensemble methods", *Renewable Energy,* vol. 216, no. 119061, 2023.

2. R.J. Lorentzen, G. Nævdal, O. Sævareid, E. Hodneland, E. A. Hanson and A. Munthe-Kaas, "Perfusion estimation using synthetic MRI-based measurements and a porous media flow model", *PLOS Computational Biology,* vol. 19, no. 10, pp. e1011127, 2023.

3. A. S. Stordal, R. J. Lorentzen and K. Fossum, "Marginalized iterative ensemble smoothers for data assimilation", *Computational Geosciences*, 2023.

4. Y. Zhang, A. S. Stordal and R. J. Lorentzen, "A natural Hessian approximation for ensemble based optimization", *Computational Geosciences,* vol. 27, no. 2, pp. 355-364, 2023.

5. T. Keil, H. Kleikamp, R. J. Lorentzen, M. B. Oguntola and M. Ohlberger, "Adaptive machine learning-based surrogate modeling to accelerate PDE-constrained optimization in enhanced oil recovery", no. 73, 2022.

6. M. B. Oguntola and Rolf Lorentzen, "Robust value quantification of enhanced oil recovery methods using ensemble-based optimization", *SPE Reservoir Evaluation & Engineering*, vol. 25, 2022.

7. M. B. Oguntola and R. J. Lorentzen, "Ensemble-based constrained optimization using an exterior penalty method", *Journal of Petroleum Science and Engineering*, vol. 207, 2021.

8. D. S. Oliver, K. Fossum, T. Bhakta, I. Sandø, G. Nævdal and R. J. Lorentzen, "4D seismic history matching", *Journal of Petroleum Science and Engineering*, vol. 207, 2021.

9. X. Luo, R. J. Lorentzen and T. Bhakta, "Accounting for model errors of rock physics models in 4D seismic history matching problems: A perspective of machine learning", *Journal of Petroleum Science and Engineering*, vol. 196, no. 107961, 2021

10. Y. Chang, R. J. Lorentzen, G. Nævdal and T. Feng, "OLYMPUS Optimization Under Geological Uncertainty", *Computational Geosciences,* 2019.

11. R. Lorentzen, T. Bhakta, D. Grana, X. Luo, R. Valestrand and G. Nævdal, "Simultaneous assimilation of production and seismic data: application to the Norne field", *Computational Geosciences*, vol. 24, pp. 907-920, November 2019.

12. E. H. Hanson, E. Hodneland, R. J. Lorentzen, G. Nævdal, J. M. Nordbotten, O. Sævareid and A. Zanna, "Mathematics and Medicine: How mathematics, modelling and simulations can lead to better diagnosis and treatments", *Lecture Notes in Computational Science and Engineering*, vol. 126, pp. 66-82, 2019.

13. R. Lorentzen, X. Luo, T. Bhakta and R. Valestrand, "History Matching the Full Norne Field Model Using Seismic and Production Data", *SPE Journal,* vol. 24, no. 04, pp. 1452-1467, August 2019.

14. X. Luo, R. J. Lorentzen, R. Valestrand and G. Evensen, "Correlation-Based Adaptive Localization for Ensemble-Based History Matching: Applied To the Norne Field Case Study", *SPE Reservoir Evaluation & Engineering*, vol. 22, no. 03, pp. 1084-1109, 2019.

15. R. J. Lorentzen, A. S. Stordal and N. Hewitt, "An auxiliary adaptive Gaussian mixture filter applied to flowrate allocation using real data from a multiphase producer", *Computers & Geosciences*, vol. 102, pp. 34-44, 2017.

16. R. Lorentzen, S. Stordal, X. Luo and G. Nævdal, "Estimation of Production Rates Using Transient Well Flow Modeling and the Auxiliary Particle Filter - Full-Scale Applications," *SPE Production & Operations*, vol. 31, no. 02, pp 163-175, 2016.

17. X. Luo, A. S. Stordal, R. J. Lorentzen and G. Nævdal, "Iterative ensemble smoothing as an approximation solution to a regularized minimum-average-cost problem: theory and applications", *SPE Journal*, vol. 20, no. 05, pp. 962-982, 2015.

18. Y. Chen, R. J. Lorentzen and E. H. Vefring, "Optimization of well trajectory under uncertainty for proactive geosteering", *SPE Journal,* vol. 20, no. 02, pp 368-383, 2015.

19. X. Luo, R. J. Lorentzen, A. S. Stordal and G. Nævdal, "Toward an enhanced Bayesian estimation framework for multiphase flow soft-sensing", *Inverse Problems*, vol. 30, no. 114012, 2014.

20. A. S. Stordal and R. Lorentzen, "An Iterative Version of the Adaptive Gaussian Mixture Filter," *Computational Geosciences,* vol. 18, no. 3-4, pp. 579-595, 2014.

21. R. J. Lorentzen, G. Nævdal and A. Shafieirad, "Estimating facies fields using the ensemble Kalman filter and distance functions - applied to shallow-marine environments," *SPE Journal,* vol. 18, no. 1, pp. 146-158, 2013.

22. R. Lorentzen, A. S. Stordal, G. Nævdal, H. A. Karlsen and H. J. Skaug, "Estimation of Production Rates Using Transient Well Flow Modeling and the Auxiliary Particle Filter," *SPE Journal*, vol. 19, no 1, pp. 172-180, 2013.

23. R. J. Lorentzen, K. M. Flornes and G. Nævdal, "History Matching Channelized Reservoirs Using the Ensemble Kalman Filter," *SPE Journal,* pp. 137-151, March 2012.

24. R. J. Lorentzen and G. Nævdal, "An iterative ensemble Kalman filter," *IEEE Transactions on Automatic Control,* vol. 56, no. 8, pp. 1990-1995, August 2011.

25. E. Peters, R. J. Arts, G. K. Brouwer, C. R. Geel, R. J. Lorentzen, Y. Chen, F. Vossepoel, R. Xu, P. Sarma, A. H. Alhutali and A. Reynolds, "Results Of The Brugge Benchmark Study For Flooding Optimization And History Matching," *SPE Reservoir Evaluation & Engineering,* vol. 13, no. 3, pp. 391-405, 2010.

26. J. E. Gravdal, R. J. Lorentzen, K. K. Fjelde and E. H. Vefring, "Tuning of Computer Model Parameters in Managed Pressure Drilling Applications using an Unscented Kalman Filter Technique," *SPE Journal,* vol. 15, no. 3, pp. 856-866, 2010.

27. G. Nygaard, E. H. Vefring, K. K. Fjelde, G. Nævdal, R. J. Lorentzen and S. Mylvaganam, "Bottomhole Pressure Control During Drilling Operations in Gas-Dominant Wells," *SPE Journal,* vol. 12, no. 1, pp. 49-61, 2007.

28. E. H. Vefring, G. Nygaard, R. J. Lorentzen, G. Nævdal and K. K. Fjelde, "Reservoir Characterization during UBD: Methodology and Active Tests," *SPE Journal,* vol. 11, no. 2, pp. 181-192, June 2006.

29. R. J. Lorentzen and K. K. Fjelde, "Use of slopelimiter techniques in traditional numerical methods for multi-phase flow in pipeline and wells," *International Journal for Numerical Methods in Fluids,* vol. 48, pp. 723-745, 2005.

30. R. J. Lorentzen, G. Nævdal and A. C. V. M. Lage, "Tuning of parameters in a two-phase flow model using ensemble Kalman filter," *Int. J. Multiphase Flow,* vol. 29, no. 8, pp. 1283-1309, 2003.

Conference papers

1. T. H. Sandve, O. Sævareid, F. Lomeland and R. J. Lorentzen, "History Matching Field Scale Model Using LET Based Relative Permeability", in *European Conference on the Mathematics of Oil Recovery - ECMOR 2022,* p. 1 – 9.

2. M. Oguntola and R. Lorentzen, "On the Robust Value Quantification of Polymer EOR Injection Strategies for Better Decision Making", in *ECMOR XVII 2012 – 17th European Conference on the Mathematics of Oil Recovery*, September, 2020.

3. Y. Chang, G. Nævdal and R. J. Lorentzen, "Optimizing Well Economic Limits Using Ensemble-Based Optimization on Olympus Field", in *SPE One Day Seminar*, Bergen, Norway, November, 2020.

4. K. Fossum and R. J. Lorentzen, "Assisted History Matching of 4Dseismic Data - A Comparative Study", in *Petroleum Geostatistics,* 2019.

5. X. Luo, R. Lorentzen and T. Bhakta, "Ensemble-based Kernel Learning to Handle Rock-physics-model Imperfection in Seismic History Matching: A Real Field Case Study", in *Petroleum Geostatistics,* 2019

6. R. Lorentzen, T. Bhakta, D. Grana, X. Luo, R. Valestrand and G. Nævdal, "History Matching Of Real Production and Seismic Data In The Norne Field", in *ECMOR XVI 2018 – 16th European Conference on the Mathematics of Oil Recovery*, 3-6 September, Barcelona, Spain.

7. X. Luo, R. J. Lorentzen, R. Valestrand and G. Evensen, "History Matching Using an Iterative Ensemble Smoother with Correlation-Based Adaptive Localization-A Real Field Case Study", in *80th EAGE Conference and Exhibition*, Copenhagen, Denmark, 11-14 June, 2018.

8. Y. Zhang, A. S. Stordal and R. J. Lorentzen, "Practical Use of the Ensemble-Based Conjugate Gradient Method for Production Optimization in the Brugge Benchmark Study", in *SPE One Day Seminar*, Bergen, Norway, 18 April, 2018.

9. Y. Zhang, A. S. Stordal, R. J. Lorentzen and Y. Chang, "A Novel Ensemble-Based Conjugate Gradient Method for Reservoir Management", in *SPE One Day Seminar*, Bergen, Norway, 18 April, 2018.

10. T. Bhakta, X. Luo, R. J. Lorentzen and G. Nævdal, "Estimation of pressure-saturation and porosity fields from seismic acoustic impedance data using an ensemble based method", in *SEG International Exposition and 87th Annual Meeting*, pp. 3107-3112.

11. R. J. Lorentzen, A. S. Stordal and N. Hewitt, "An Auxiliary Adaptive Gaussian Mixture Filter Applied to Flowrate Allocation Using Real Data from a Multiphase Producer", in *ECMOR XV – 14th European Conference on Mathematics of Oil Recovery,* 29 August – 1 September, 2016, Amsterdam, Netherlands.

12. G. Nævdal, O. Sævareid and R. J. Lorentzen, "Data assimilation using MRI data", in *ECCOMAS Congress 2016 – European Congress on Computational Methods in Applied Sciences and Engineering*, June 5-10, 2016, Crete Island, Greece.

13. X. Luo, Y. Chen, R. Valestrand, A. S. Stordal, R. J. Lorentzen and G. Nævdal, "On an Alternative Implementation of the Iterative Ensemble Smoother and its Application to Reservoir Facies Estimation", in *ECMOR XIV – 14th European Conference on Mathematics of Oil Recovery*, Catalania, Italy, 8-11 September, 2014.

14. Y. Chen, R. J. Lorentzen and E. H. Vefring, "Optimization of Well Trajectory under Uncertainty for Proactive Geosteering," in *ECMOR XIII – 13th European Conference on the Matematics of Oil Recovery*, Biarritz, France, 10-13 September, 2012.

15. R. Lorentzen, A. S. Stordal, G. Nævdal, H. A. Karlsen and H. J. Skaug, "Estimation of Production Rates Using Transient Well Flow Modeling and the Auxiliary Particle Filter," in *ECMOR XIII – 13th European Conference on the Matematics of Oil Recovery*, Biarritz, France, 10-13 September, 2012.

16. A. S. Stordal and R. Lorentzen, "An Iterative Version of the Adaptive Gaussian Mixture Filter," in *ECMOR XIII – 13th European Conference on the Matematics of Oil Recovery*, Biarritz, France, 10-13 September, 2012.

17. R. J. Lorentzen, G. Nævdal and A. Shafieirad, "Estimating facies fields using the ensemble Kalman filter and distance functions– applied to shallow-marine environments," in *SPE EUROPEC/EAGE Annual Conference and Exhibition*, Vienna, Austria, 2011.

18. R. J. Lorentzen, O. Sævareid and G. Nævdal, "Soft Multiphase Flow Metering for Accurate Production Allocation," in *SPE Russian Oil & Gas Conference*, Moscow, Russia, 26-28 October, 2010.

19. R. J. Lorentzen, O. Sævareid and G. Nævdal, "Rate Allocation: Combining Transient Well Flow Modeling and Data Assimilation," in *SPE Annual Technical Conference and Exhibition*, Florence, Italy, 19-22 September 2010.

20. R. J. Lorentzen, K. M. Flornes and G. Nævdal, "History Matching Channelized Reservoirs Using the Ensemble Kalman Filter," in *the International Petroleum Technology Conference*, Doha, Qatar, 7-9 December, 2009.

21. R. J. Lorentzen, A. Shafieirad and G. Nævdal, "Closed Loop Reservoir Management Using the Ensemble Kalman Filter and Sequential Quadratic Programming," in *the 2009 SPE Reservoir Simulation Symposium*, The Woodlands, Texas, USA, 2-4 February, 2009.

22. R. J. Lorentzen and G. Nævdal, "Data Assimilation of Large-Scale Models Within the Petroleum Industry," in *Nordic Matlab User Conference*, Stockholm, Sweden, 20-21 November, 2008.

23. G. Nævdal, A. Bianco, A. Cominelli, L. Dovera, R. J. Lorentzen and B. Vallès, "State Estimation of a Large-Scale System in the Petroleum Industry," in *8th International Symposium on Dynamics and Control of Process Systems*, Cancun, Mexico, 6-8 June, 2007.

24. R. J. Lorentzen, A. M. Berg, G. Nævdal and E. H. Vefring, "A new approach for dynamic optimization of water flooding problems," in *SPE Intelligent Energy Conference and Exhibition*, Amsterdam, The Netherlands, 11-13 April 2006.

25. J. E. Gravdal, R. J. Lorentzen, K. K. Fjelde and E. H. Vefring, "Tuning of Computer Model Parameters in Managed Pressure Drilling Applications using an Unscented Kalman Filter Technique," in *SPE Annual Technical Conference and Exhibition*, Dallas, Texas, USA, 9 – 12 October, 2005.

26. R. J. Lorentzen, G. Nævdal, B. Vallès, A. M. Berg and A.-A. Grimstad, "Analysis of the ensemble Kalman filter for estimation of permeability and porosity in reservoir models," in *SPE Annual Technical Conference and Exhibition*, Dallas, Texas, USA, 9 – 12 October, 2005.

27. G. H. Nygaard, K. K. Fjelde, G. Nævdal, R. J. Lorentzen and E. H. Vefring, "Evaluation of drillstring and casing instrumentation needed for reservoir characterization during drilling operations," in *SPE/IADC Middle East Drilling Technology Conference & Exhibition*, Dubai, U.A.E., 12-14 September 2005.

28. G. Nygaard, E. H. Vefring, K. K. Fjelde, G. Nævdal, R. J. Lorentzen and S. Mylvaganam, "Bottomhole Pressure Control During Pipe Connection in Gas-Dominant Wells," in *SPE/IADC Underbalanced Technology Conference*, Houston, Texas, USA, 11 – 12 October 2004.

29. G. H. Nygaard, E. H. Vefring, S. Mylvaganam, R. J. Lorentzen, G. Nævdal and K. K. Fjelde, "Underbalanced Drilling: Improving Pipe Connection Procedures Using Automatic Control," in *SPE Annual Technical Conference and Exhibition*, Houston, Texas, USA, 26 –29 September 2004.

30. E. H. Vefring, G. Nygaard, R. J. Lorentzen, K. K. Fjelde and G. Nævdal, "Reservoir Characterization during UBD: Methodology and Active Tests," in *IADC/SPE Underbalanced Technology Conference and Exhibition*, Houston, Texas, USA, 25 – 26 March 2003.

31. E. H. Vefring, G. Nygaard, K. K. Fjelde, R. J. Lorentzen, G. Nævdal and A. Merlo, "Reservoir characterization during underbalanced drilling: Methodology, accuracy, and necessary data," in *SPE Annual Technical Conference and Exhibition*, San Antonio, Texas, USA, 29 September – 2 October 2002.

32. R. J. Lorentzen, K. K. Fjelde, J. Froeyen, A. Lage, G. Naevdal and E. Vefring, "Underbalanced and Low-head Drilling Operations: Real Time Interpretation of Measured Data and Operational Support," in *SPE Annual Technical Conference and Exhibition*, New Orleans, Lousianna, USA, 30 Sep. – 3 Oct.2001.

33. R. J. Lorentzen, K. K. Fjelde, J. Froeyen, A. Lage, G. Naevdal and E. Vefring, "Underbalanced Drilling: Real Time Data Interpretation and Decision Support," in *SPE/IADC conference*, Amsterdam, The Netherlands, 27 Feb. – 1 Mar. 2001.

Other Publications

1. Co-author of the open-source software Python-Ensemble-Toolbox (PET), published at GitHub.

2. R. J. Lorentzen, Higher order numerical methods and use of estimation techniques to improve modelling of two-phase flow in pipelines and wells, Bergen, Norway: Dr. Sc. thesis in applied mathematics, Department of Mathematics, University of Bergen, 2002.

3. R. J. Lorentzen, Tofasestrømning I grenbrønner, Bergen, Norway: M. Sc. thesis in applied mathematics, Department of Mathematics, University of Bergen, 1998.