Curriculum vitae with 10-year track record

Personal information

First name, Surname:	Espen Robstad Jakobsen		
Date of birth:	11.04.1972	Sex:	Male
Nationality:	Norwegian		
Researcher unique identifier(s) (ORCID, ResearcherID, etc.):	https://orcid.org/0000-0003-4432-1589		
URL for personal website:	folk.ntnu.no/erj		

Education

2001	Ph.D., Department of Mathematical Sciences, NTNU, Norway
1996	Master, Department of Mathematical Sciences, NTNU, Norway

Positions

2008-	**Professor/NTNU/Norway**
2005-2008	Associate Professor/NTNU/Norway
2002-2005	National NFR PostDoc / NTNU + University of Oslo + University of Tours / Norway + France Associate Professor (temporary) / NTNU + University of Bergen / Norway
1998-2001	PhD fellow/NTNU/Norway
2009, 2015	Sabbaticals: University of Tours (2009-2010), Ecole Normale Superieur, Paris (2015-2016)

Project management experience

Year	Project owner - Project - Role - Funder
2016-2021	IE/NTNU - Toppforsk project (research excellence): *Waves and Nonlinear Phenomena.* 25 million NOK - PI (Main PI H. Holden) - Research Council of Norway (FriPro)
2012-2016	IME/NTNU - Researcher Project: *Discrete Models in Mathematical Analysis.* 8.3 million NOK - PI (Main PI Y. Ljubarski) - Research Council of Norway (FriPro)
2006-2010	IME/NTNU - Researcher Project: *Integro-PDEs: Numerical methods, Analysis, and Applications to Finance.* 3.5 million NOK - Main PI - Research Council of Norway (eVITA)
2003-2005	IME/NTNU - PostDoc Project: *Viscosity methods, Hamilton-Jacobi-Bellman equations, and applications to finance* - Main PI - Research Council of Norway (FriPro)

Supervision of students

Master students	24	NTNU (21), University of Bergen (2), Ecole Normale Superieur Paris (1)
Ph.D. students	3 (+4)	Department of Mathematical Sciences / NTNU / Norway (co-advisor of 4) (Including S. Cifani, J. Endal, O. Ersland, L. Chen, O. Mæhlen)
PostDocs	6	Department of Mathematical Sciences / NTNU / Norway (H. Sande, F. del Teso, J. Endal, I. Chowdhury, M. Krupski, S. Mazid)

Other relevant professional experiences

2011-2020	**Head** of Differential Equations and Numerical Analysis group, NTNU (50+ scientific staff) **Member of Math-Department board** (utvidet ledergruppe), NTNU
2005-	**Math-Department NTNU (partial):** deputy head of research group, administrator of several Professor and PhD committees; PhD hiring and pedagogical committees; organiser of research group seminars. **IME/IE Faculty NTNU (partial):** Department representative in the Research committee. **External (partial):** Member of 4 PhD committees (Paris, Oslo, Madrid, Paris), referee for Professor positions (India, Australia), Professor evaluation committee (University of Stavanger), funding proposal evaluator (Canada).
2019-	**Associate editor**, IMA journal of Numerical Analysis / UK (a top journal in its field)
2019	**Head of committee** for the first Norwegian Meeting on PDEs
2018-	**Elected member** of the Royal Norwegian Society of Sciences and Letters (DNKVS)
2017-2021	Host for 4 incoming **ERCIM Alain Benssousan** postdoc fellowships.
2003-	**Referee** of 60+ papers for 30+ international research journals, including top journals like Acta Math, SINUM, SICON, SIMA, JDE, CPDE, JMPA, MCOMP, JLMS, AIHP.
1999-	**Major collaboration:** *N. Alibaud* (Univ. Borgogne/Franche-Comte, France) convection-diffusion/nonlocal equations; *E. Chasseigne* and *G. Barles* (Univ. Tours, France) fully nonlinear/nonlocal equations; *K. H. Karlsen* (Univ. Oslo, Norway) fully nonlinear /convection-diffusion/nonlocal equation; *F. del Teso* (Univ. Complutense Madrid) porous medium equations. Collaboration on include analysis, PDEs, numerics, and stochastics.
2001-	**Awards and prizes:** National PhD fellowship 2001 (Research Council of Norway), Esso Prize 2002 for NTNU PhD thesis, Carl Erik Fröberg Prize 2006, BIT J. Numerical Math./Sweden

Publication statistics

47 publications during the career: 40 in journals (70% in level 2 journals, i.e. top 20 % in Norwegian ranking system), 5 in conference proceedings, 2 book chapters. Co-authored with 19 researchers in 8 countries.

Citations/h-index: Google scholar 1585/21, MathSciNet 765/NA, Web of Science 802/16.

10-year track record

27 publications in 2010-2020, 22 journal, 3 conference proceedings, 2 book chapters. **82% of journal publications in level 2 journals** (top level in Norwegian ranking system). In all publications I have contributed fully in the planning, the proofs of the theorems, as well as in the writing.

Summary of research: Partial differential equations and related fields like stochastic processes, stochastic control/games, and numerical analysis. Both local and nonlocal problems have been studied using a variety of tools from functional, stochastic, and numerical analysis along with probability and control theory:

I. *Nonlocal operators:* Through a new analysis of the Liouville theorem we have improved a famous classical theory that has been continuously developed since the 19th century. Published in a top journal:

1. N. Alibaud, F. del Teso, J. Endal, and E. R. Jakobsen. *The Liouville theorem and linear operators satisfying the maximum principle.* J. Math. Pures Appl., 142: 229-242, 2020.

Variable coefficient nonlocal problems are very challenging mathematically but needed in practice. Combining stochastic, probabilistic, and analytic tools, we study Fokker-Planck operators in the paper below.

2. L. Chen and E. R. Jakobsen. *L1 semigroup generation for Fokker-Planck operators associated with general Levy driven SDEs.* Discrete Contin. Dyn. Syst. 38(11): 5735-5763, 2018.

II. *Porous medium equations:* We develop a new and unified mathematical theory that encompasses a much larger class of equations than previously considered: both local, general nonlocal, and surprisingly to the experts, numerical discretisations. The paper below represents the first theoretical development. The framework has later been used to propose and analyse numerical schemes in a very general setting.

3. F. del Teso, J. Endal, and E. R. Jakobsen. *Uniqueness and properties of distributional solutions of nonlocal equations of porous medium type.* Advances in Mathematics 305: 78-143, 2017.

III. *Nonlocal convection-diffusion:* Seminal (according to referee) analytical results explaining how to handle degenerate nonlocal conservation laws. Opened up a new class of equations for mathematical study.

4. S. Cifani and E. R. Jakobsen. *Entropy solution theory for fractional degenerate convection-diffusion equations.* Ann. Inst. H. Poincare Anal. Non Lineaire 28(3): 413-441, 2011.

Development and analysis of different numerical schemes for such equations, here represented by a paper where we propose and analyse a high order scheme that converges even for discontinuous shock-solutions.

5. S. Cifani and E. R. Jakobsen. *On the spectral vanishing viscosity method for periodic fractional conservation laws.* Math. Comp. 82: 1489-1514, 2013.

An example of further development is the optimal quantitative stability results published in a top journal:

6. N. Alibaud, S. Cifani, and E. R. Jakobsen. *Optimal continuous dependence estimates for fractional degenerate parabolic equations.* Arch. Ration. Mech. Anal. 213(3): 705-762, 2014.

IV. *Fully nonlinear equations and stochastic control:* Building on our earlier breakthrough results for nonlocal equations, the first study of nonlocal Neumann boundary value problems for viscosity solutions.

7. G. Barles, E. Chasseigne, C. Georgelin, and E. R. Jakobsen. *On Neumann type problems for non-local equations set in a half space.* Trans. Amer. Math. Soc. 366(9): 4873-4917, 2014.

Development and analysis of different numerical schemes for equations in stochastic control theory, here represented by a paper on local equations that has become a standard reference in the field.

8. K. Debrabant and E. R. Jakobsen. *Semi-Lagrangian schemes for linear and fully non-linear diffusion equations.* Math. Comp. 82: 1433-1462, 2013.

The first results for switching control of stochastic jump processes, connecting the control problem and the equation (PDE) via dynamic programming. Combination of stochastic analysis and differential equations.

9. I. H. Biswas, E. R. Jakobsen, and K. H. Karlsen. *Viscosity solutions for a system of integro-PDEs and connections to optimal switching and control of jump-diffusion processes.* Appl. Math. Optim. 62(1): 47-80, 2010.

V. *New duality* between degenerate nonlinear divergence form equations and degenerate fully nonlinear non-divergence form equations. New and surprising connections between seemingly unrelated problems.

10. N. Alibaud, J. Endal, and E. R. Jakobsen. *Optimal and dual stability results for L1 viscosity and L-infinity entropy solutions.* Preprint: https://arxiv.org/abs/1812.02058.

VI. *Other research topics:* *Mean field game theory* (papers [P5, I2, I3] on homepage), numerical solution of *Fokker-Planck equations* (paper [34] on homepage), approximate *stochastic control* (paper [38]), *deep neural net based Monte Carlo* approximation of PDEs (paper [I1]), and *mathematical biology* (paper [I4]).

Presentations: 20 talks at international conferences, 12 talks at international and national seminars. Selected presentations:

2020 NMAC20 Online Conference on Nonlocal Problems, China. Invited speaker.

2019 Analysis of nonlocal and nonsmooth models, Bielefeld, Germany. Invited speaker.

2018 Joint meeting of the Italian Mathematical Union, the Italian Society for Industrial and Applied Mathematics, and the Polish Mathematical Society. Wroclaw. Invited speaker.

2017 The 27th edition of the Biennial Numerical Analysis Conference, Glasgow, UK. Invited speaker.

2016 The 3rd Conference on Nonlocal operators and PDEs, Banach center, Poland. Invited speaker. HJ2016: Hamilton-Jacobi equations: New trends and applications, Rennes, France. Invited speaker.

2015 The 5th Spring School on Nonlinear PDEs, Essaouira, Morocco. Invited lecturer.

Organised meetings:

2020 *Cancelled due to covid-19:* **The Abel Symposium 2020.** Partial Differential Equations. Waves, Nonlinearities and Nonlocalities, Røros, Norway. Member of committee.

2019 **Norwegian meeting on PDEs**, Trondheim, Norway. First national meeting on partial differential equations in Norway. Head of committee.

2016 **Non-linear PDEs, mathematical physics, and stochastic analysis**. A conference in honour of Helge Holden. Trondheim. International conference with refereed proceeding. 60+ participants. Member of committee.

2017 **Stability for evolution problems**, Gaeta, Italy. Mini-symphosium in the International Conference on Elliptic and Parabolic Problems. Member of committee.

2013 **Symposium on Nonlinear PDEs,** Trondheim. International conference, 40+ participants. Member of committee.

Selected early career contributions:

Jørgen Endal – former PhD and postdoc, winner of The Chorafas Foundation Award, now Marie Skłodowska-Curie individual Fellow at Autonoma University, Madrid, Spain (https://verso.mat.uam.es/~jorgen.endal/).

Felix del Teso – former predoc and postdoc, winner of UAM extraordinary Ph.D. Thesis Prize 2016, Vicent Caselles Prize 2017, ERCIM Alain Benssousan and Juan de la Cierva Postdoctoral Fellows, now permanent position at Complutense University, Madrid, Spain (https://sites.google.com/view/felixdelteso/home).

List of publications

In refereed journals:

[1] N. Alibaud, F. del Teso, J. Endal, and E. R. Jakobsen. *The Liouville theorem and linear operators satisfying the maximum principle.* J. Math. Pures Appl., 142: 229-242, 2020.

[2] F. del Teso, J. Endal, and E. R. Jakobsen. *Robust numerical methods for local and nonlocal equations of porous medium type. Part I: Theory*. SIAM J. Numer. Anal. 57(5): 2266-2299, 2019.

[3] E. R. Jakobsen, A. Picarelli, C. Reisinger. *Improved order 1/4 convergence for piecewise constant policy approximation of stochastic control problems.* Electon. Commun. Probab. 24(59):1-10, 2019.

[4] I. H. Biswas, I. Chowdhury, and E. R. Jakobsen. *On the rate of convergence for monotone numerical schemes for nonlocal Isaacs equations*. SIAM J. Numer. Anal. 57(2): 799-827, 2019.

[5] F. del Teso, J. Endal, and E. R. Jakobsen. *Robust numerical methods for nonlocal (and local) equations of porous medium type. Part II: Schemes and experiments*. SIAM J. Numer. Anal. 56(6): 3611-3647, 2018.

[6] L. Chen and E. R. Jakobsen. *L1 semigroup generation for Fokker-Planck operators associated with general Levy driven SDEs.* Discrete Contin. Dyn. Syst. 38(11): 5735-5763, 2018.

[7] L. Chen, E. R. Jakobsen, and A. Naess. *On numerical density approximations of solutions of SDEs with unbounded coefficients*. Adv. Comput. Math., 44(3): 693-721, 2018

[8] F. del Teso, J. Endal, and E. R. Jakobsen. *On distributional solutions of local and nonlocal problems of porous medium type*. C. R. Math. Acad. Sci. Paris 355(11): 1154-1160, 2017.

[9] E. Chasseigne and E. R. Jakobsen. *On nonlocal quasilinear equations and their local limits*. J. Differential Equations 262(6): 3759-3804, 2017.

[10] F. del Teso, J. Endal, and E. R. Jakobsen. *Uniqueness and properties of distributional solutions of nonlocal equations of porous medium type.* Advances in Mathematics 305: 78-143, 2017.

[11] J. Endal and E. R. Jakobsen. *L1 contraction for bounded (non-integrable) solutions of degenerate parabolic equations*. SIAM J. Math. Anal. 46(6): 3957-3982, 2014.

[12] N. Alibaud, S. Cifani, and E. R. Jakobsen. *Optimal continuous dependence estimates for fractional degenerate parabolic equations.* Arch. Ration. Mech. Anal. 213(3): 705-762, 2014.

[13] G. Barles, E. Chasseigne, C. Georgelin, and E. R. Jakobsen. *On Neumann type problems for non-local equations set in a half space.* Trans. Amer. Math. Soc. 366(9): 4873-4917, 2014.

[14] S. Cifani and E. R. Jakobsen. *On numerical methods and error estimates for degenerate fractional convection-diffusion equations.* Numer. Math. 127(3): 447-483, 2014.

[15] G. Barles, C. Georgelin, and E. R. Jakobsen. *On Neumann and oblique derivatives boundary conditions for nonlocal elliptic equations.* J. Differential Equations. 256(4): 1368-1394, 2014.

[16] S. Cifani and E. R. Jakobsen. *On the spectral vanishing viscosity method for periodic fractional conservation laws.* Math. Comp. 82: 1489-1514, 2013.

[17] K. Debrabant and E. R. Jakobsen. *Semi-Lagrangian schemes for linear and fully non-linear diffusion equations.* Math. Comp. 82: 1433-1462, 2013.

[18] N. Alibaud, S. Cifani, and E. R. Jakobsen. *Continuous dependence estimates for nonlinear fractional convection-diffusion equations.* SIAM J. Math. Anal. 44(2): 603-632, 2012.

[19] S. Cifani, E. R. Jakobsen, and K. H. Karlsen. *The discontinuous Galerkin method for fractional degenerate convection-diffusion equations.* BIT 51(4): 809-844, 2011.

[20] S. Cifani, E. R. Jakobsen, and K. H. Karlsen. *The discontinuous Galerkin method for fractal conservation laws.* IMA J. Numer. Anal. 31(3): 1090-1122, 2011.

[21] S. Cifani and E. R. Jakobsen. *Entropy solution theory for fractional degenerate convection-diffusion equations.* Ann. Inst. H. Poincare Anal. Non Lineaire 28(3): 413-441, 2011.

[22] I. H. Biswas, E. R. Jakobsen, and K. H. Karlsen. *Difference-quadrature schemes for nonlinear degenerate parabolic integro-PDE.* SIAM J. Numer. Anal. 48(3): 1110-1135, 2010.

[23] I. H. Biswas, E. R. Jakobsen, and K. H. Karlsen. *Viscosity solutions for a system of integro-PDEs and connections to optimal switching and control of jump-diffusion processes.* Appl. Math. Optim. 62(1): 47-80, 2010.

[24] F. Camilli and E. R. Jakobsen. *A Finite Element like Scheme for Integro-Partial Differential Hamilton-Jacobi-Bellman Equations.* SIAM J. Numer. Anal. 47(4): 2407-2431, 2009.

[25] E. R. Jakobsen, K. H. Karlsen, and C. La Chioma. *Error estimates for approximate solutions to Bellman equations associated with controlled jump-diffusions.* Numer. Math. 110(2): 221-255, 2008.

[26] E. R. Jakobsen and C. A. Georgelin. *Continuous dependence results for non-linear Neumann type boundary value problems.* J. Differential Equations 245(9): 2355-2704, 2008.

[27] I. H. Biswas, E. R. Jakobsen, and K. H. Karlsen. *Error estimates for a class of finite difference-quadrature schemes for fully nonlinear degenerate parabolic integro-PDEs.* J. Hyperbolic Differ. Equ. 5(1): 187-219, 2008.

[28] G. Barles and E. R. Jakobsen. *Error bounds for monotone approximation schemes for parabolic Hamilton-Jacobi-Bellman equations.* Math. Comp. 76(240): 1861-1893, 2007.

[29] E. R. Jakobsen. *On error bounds for monotone approximation schemes for multi-dimensional Isaacs equations.* Asymptotic Analysis 49(3,4): 249-273, 2006.

[30] E. R. Jakobsen and K. H. Karlsen. *A "maximum principle for semicontinuous functions" applicable to integro-partial differential equations.* NoDEA Nonlinear Differential Equations Appl. 13:137-165, 2006.

[31] G. Barles and E. R. Jakobsen. *Error bounds for monotone approximation schemes for Hamilton-Jacobi-Bellman equations.* SIAM J. Numer. Anal. 43(2):540-558, 2005.

[32] E. R. Jakobsen and K. H. Karlsen. *Convergence rates for semi-discrete splitting approximations for degenerate parabolic equations with source terms.* BIT 45(1): 37-67, 2005.

[33] E. R. Jakobsen and K. H. Karlsen. *Continuous dependence estimates for viscosity solutions of integro-PDEs.* J. Differential Equations 212(2): 278-318, 2005.

[34] E. R. Jakobsen. *On error bounds for approximation schemes for non-convex degenerate elliptic equations.* BIT 44(2): 269-285, 2004.

[35] E. R. Jakobsen. *W^{2,\infty} regularizing effect in a nonlinear, degenerate parabolic equation in one space dimension.* Proc. Amer. Math. Soc. 132(11): 3203-3213, 2004.

[36] E. R. Jakobsen. *On the rate of convergence of approximation schemes for Bellman equations associated with optimal stopping time problems.* Math. Models Methods Appl. Sci. (M3AS) 13(5): 613-644, 2003.

[37] G. Barles and E. R. Jakobsen. *On the convergence rate of approximation schemes for Hamilton-Jacobi-Bellman equations.* M2AN Math. Model. Numer. Anal. 36(1): 33-54, 2002.

[38] E. R. Jakobsen and K. H. Karlsen. *Continuous dependence estimates for viscosity solutions of fully nonlinear degenerate elliptic equations.* Electron. J. Diff. Eqns. 2002(39): 1-10, 2002.

[39] E. R. Jakobsen and K. H. Karlsen. *Continuous dependence estimates for viscosity solutions of fully nonlinear degenerate parabolic equations.* J. Differential Equations 183: 497-525, 2002.

[40] E. R. Jakobsen, K. H. Karlsen, and N. H. Risebro. *On the convergence rate of operator splitting for Hamilton-Jacobi equations with source terms.* Siam J. Numer. Anal. 39(2): 499-518, 2001.

In refereed conference proceedings:

[41] F. del Teso, J. Endal, and E. R. Jakobsen. *On the well-posedness of solutions with finite energy for nonlocal equations of porous medium type*. In Non-Linear Partial Differential Equations, Mathematical Physics, and Stochastic Analysis, pp. 129-168, EMS Series of Congress Reports, 2018.

[42] J. Droniou and E. R. Jakobsen. *A uniformly converging scheme for fractal conservation laws*. In *Proceedings of FVAC7 -- The International Symposium of Finite Volumes for Complex Applications VII held in Berlin, Germany, 2014*, pp. 237-245, Springer Proceedings in Mathematics, 2014.

[43] K. Debrabant and E. R. Jakobsen. *Semi-Lagrangian schemes for linear and fully non-linear Hamilton-Jacobi-Bellman equations*. In *Hyperbolic Problems: Theory, Numerics, Applications*, Proceedings of HYP2012 -- The 14th International Conference on Hyperbolic Problems held in Padova, Italy, 2012. AIMS conference proceedings, 2014.

[44] I. H. Biswas, E. R. Jakobsen, and K. H. Karlsen. *Error estimates for finite difference-quadrature schemes for a class of nonlocal Bellman equations with variable diffusion.* In *Stochastic Analysis and Partial Differential Equations,* Contemp. Math. 429, pp. 19--31, Amer. Math. Soc., 2007.

[45] E. R. Jakobsen, K. H. Karlsen, and N. H. Risebro. *On the convergence rate of operator splitting for weakly coupled systems of Hamilton-Jacobi equations.* In *Hyperbolic problems: theory, numerics, applications*, Proceedings of HYP2000 The 8th International Conference on Hyperbolic Problems held in Magdeburg, Germany, 2000. Internat. Ser. Numer. Math. 141, pp. 553-562, Birkhauser, 2001.

Refereed chapters in books:

[46] K. Debrabant and E. R. Jakobsen. *Semi-Lagrangian schemes for parabolic equations*. In Recent Developments in Computational Finance, pp. 279--298, World Scientific/Imperial College Press, 2013.

[47] E. R. Jakobsen. *Monotone schemes*. In Encyclopedia of Quantitative Finance, pp. 1253-1263, John Wiley & Sons Ltd., 2010.

Theses:

[48] E. R. Jakobsen. *On the Theory and Numerical Analysis of Viscosity Solutions.* Doktor Ingeniør Thesis 2001:95, Norwegian University of Science and Technology, 2001.

[49] E. R. Jakobsen. *The Stochastic Wave Equation. D*iploma Thesis, Norwegian University of Science and Technology, 1996.