

Anton Thalmaier

Nationality: German

Family status: married, 1 child

Coordinates

Professional Address:

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Degrees

Ph.D. in Mathematics, University of Regensburg, 1989

Habilitation and “Venia legendi” in Mathematics, University of Bonn, 1999

Qualification aux fonctions de professeur d’Université (section 25 mathématiques, section 26 mathématiques appliquées et applications des mathématiques, janvier 2001, Conseil National des Universités, Ministère de l’Education Nationale et de la Recherche, France)

Work Experience

1989 – 1993	Instructor, R.H. Bing Fellow, University of Texas at Austin, USA
1993 – 1996	Wissenschaftlicher Assistent, University of Regensburg
1997	Wissenschaftlicher Angestellter, University of Erlangen-Nürnberg
1997 – 2000	Wissenschaftlicher Mitarbeiter (DFG), University of Bonn
2000 – 2001	Lehrstuhlvertretung (C4), University of Regensburg
2001 – 2002	Wissenschaftlicher Angestellter (SFB), University of Bonn
2002 – 2003	Enseignant Associé, Université d’Evry
2003 – 2006	Maître de Conférence, Université de Poitiers
since 2006	Full professor, Université du Luxembourg

Research Profile

Stochastic Analysis on manifolds, Stochastic Differential Geometry, Geometry of Stochastic Differential Equations, Stochastic Riemannian Geometry (also in infinite dimensions), Mathematical Finance

An essential part of my research is related to the fact that Brownian motion and martingales on manifolds or vector bundles connect local and global geometry in an intrinsic way, and that many questions related to the geometry of Laplace operators have a direct probabilistic counterpart. Probabilistic methods often extend naturally to areas, like singular spaces or infinite dimensional spaces, where standard tools of differential analysis or PDE methods fall short.

Selected key words Gradient estimates for harmonic maps; a priori estimates for non-linear evolution equations; Yang-Mills fields and random holonomy; Brownian motion on Jordan curves and univalent functions; unitarizing measures for representations of the Virasoro algebra; stochastic calculus of variations and the computation of price sensitivities in Mathematical Finance.

International collaborations

Hélène Airault, Professeur à l'Université de Picardie, France;
Marc Arnaudon, Professeur à l'Université de Bordeaux, France;
Fabrice Baudoin, Professor at the University of Connecticut, USA;
Ana Bela Cruzeiro, Professeur à l'Université de Lisboa, Portugal;
Bruce Driver, Professor at the University of California at San Diego, USA;
Shizan Fang, Professeur à l'Université de Bourgogne, France;
Erlend Grong, Associate Professor at the University of Bergen, Norway;
Hongxin Guo, Professor at Wenzhou University, Zhejiang, China;
Elton P. Hsu, Professor at Northwestern University, USA;
Kazumasa Kuwada, Professor at Tohoku University, Japan;
Kazuhiro Kuwae, Professor at Fukuoka University, Japan;
Xue-Mei Li, Professor at Imperial College London, UK;
Robert Neel, Associate Professor at Lehigh University, USA;
Feng-Yu Wang, Professor at Tianjin University, China;
Qi S. Zhang, Professor at University of California Riverside, USA

Research Stays (since 2001)

Sept 2001	Mathematics Department, Beijing Normal University (1 month)
March 2002	Université de Poitiers, Professeur invité (1 month)
May 2002	University of California at San Diego (2 weeks)
June 2002	Université de Picardie, Professeur invité (1 month)
May 2005	Beijing Normal University (3 weeks)
June 2006	Nagu/Nauvo and University of Jyväskylä (2 weeks)
March 2007	Beijing Normal University (2 weeks)

May/June 09 Bangalore, India (3 weeks)
 June 2010 Université de Bourgogne, Professeur invité (1 month)
 June/Sept 2018 South Central University, Wuhan, China (1 month)

Funding

GEOM-SDE – Geometry of Stochastic Differential Equations (PUL, 2008-2011), 328.238 €

GEOM-SDE12 – Geometry of Stochastic Differential Equations (PUL, 2012-2015), 368.538 €

AGSDE – Analysis and Geometry of Stochastic Differential Equations (PUL, 2015-2018), 269.500 €

GEOMREV – Geometry of random evolutions (Open FNR, 2015-2018), 500.000 €

PhD students

Holger Plank *Stochastic Representation of the Gradient and Hessian of Diffusion Semigroups on Riemannian Manifolds*, University of Regensburg (Dec 2002)

Stephanie Ulsamer, *Non-trivial Bounded Harmonic Functions on Cartan-Hadamard Manifolds of Unbounded Curvature*, University of Regensburg (Dec 2003)

Abdoulaye Coulibaly, *Etude d'équations d'évolution non linéaires en géométrie globale avec des méthodes de calcul stochastique*, Université de Poitiers (June 2009)

Christian Selinger, *Geometry and Stochastic Calculus on Wasserstein spaces*, Université du Luxembourg (Nov 2010)

Sami El Rahouli, *Financial modeling with Volterra Lévy processes and application to option pricing, interest rates and credit risk modeling*, Université du Luxembourg (Febr 2014)

Antoine Ledent, *Kusuoka-Stroock type bounds for densities of solutions to SDE projected on a low dimensional space*, Université du Luxembourg (Sept 2017)

Christian Krein, *Contributions to the statistics of random processes using Malliavin Calculus*, joint supervision with G. Peccati, Université du Luxembourg (Nov 2017)

Bob Pepin, *Time averages of diffusion processes and applications to two-timescale problems*, Université du Luxembourg (April 2018)

Robert Baumgarth, *Stochastic Analysis of heat semigroups on static and evolving manifolds*, Université du Luxembourg (since 2016)

Administrative activities

Membre de la Commission de Spécialistes 25/26ème sections de l'Université de Poitiers (2004-06) ; Membre extérieur de la Commission de Spécialistes 25/26ème sections de l'Université d'Angers (2005-06)

Member of the Faculty Council (FSTC), University of Luxembourg

Directeur-Adjoint des Études du “Master en Mathématiques (académique)”,
filière “Mathématiques financières”, Université du Luxembourg

Organisation of Conferences

Organisation of a Mini-Symposium (with Shizan Fang and A. Grigor'yan):
Geometry and Probability (DMV-Jahrestagung Bonn, Sept 17–23, 2006)

Organisation of a Special Session on “Stochastic Analysis” at the 1st Joint
Conference of the Belgian, Royal Spanish and Luxembourg Mathe-
matical Societies (June 6-8, 2012), Liège, Belgium

Organisation of a Conference on the Occasion of Martin Schlichenmaier's
60th Birthday (December 10–12, 2012), University of Luxembourg.

Organisation of the International Conference “ANR ProbaGeo 2013” in
Luxembourg (Oct 28–31, 2013), University of Luxembourg

Organisation of a Thematic Session on *Stochastic Calculus in Mathemati-
cal Finance* at the XIII Latin American Congress of Probability and
Mathematical Statistics (Cartagena, Colombia 2014)

Organisation of the International Conference “GeoProb 2017” in Luxem-
bourg (July 10–14, 2017), University of Luxembourg

Organisation of a Mini-Workshop (with Batu Güneysu, Matthias Keller and
Kazumasa Kuwada): *Recent Progress in Path Integration on Graphs
and Manifolds* (Mathematisches Forschungsinstitut Oberwolfach, April
7–13, 2019)

Selected invited Lectures (since 2001)

- 2001 Stochastic Analysis: Geometric Aspects and Applications (8–11 Jan 2001), EURANDOM, Eindhoven, The Netherlands
- 2001 Mathematisches Kolloquium (2 Febr 2001), Mathematische Fakultät at, Universität Regensburg, Germany
- 2001 Laboratoire de Probabilités et Modèles Aléatoires (5 April 2001), Université Paris 6, Pierre et Marie Curie, France
- 2001 International Conference “Probability and Geometry” (10–15 Sept 2001), Université de Bourgogne, Dijon, France
- 2001 Colloquium (26 Sept 2001), Department of Mathematics, Beijing Normal University, Beijing, China
- 2001 Colloquium (27 Sept 2001), Institute of Mathematics, Chinese Academy of Sciences, Beijing, China
- 2001 International Conference “Analyse en dimension infinie” (8–12 Oct 2001), C.I.R.M. Luminy, France
- 2002 Séminaire tournant “Martingales et leurs applications récentes” (11 March 2002), Université d’Angers, France
- 2002 Colloquium (14 March 2002), Laboratoire de Mathématiques, Université de Poitiers, France
- 2002 Séminaire (14 May 2002), Trimester programme: *Noyaux de la chaleur, marches aléatoires, analyse sur les variétés et les graphes*, Institut Henry Poincaré, Paris, France
- 2002 Colloquium (23 May 2002), Department of Mathematics, University of California at San Diego, USA
- 2002 Berliner Kolloquium Wahrscheinlichkeitstheorie (3 July 2002) Humboldt University, Berlin, Germany
- 2002 International Conference on Stochastic Analysis – Satellite Conference of ICM 2002 (Aug 29 – Sept 3, 2002), Beijing, China
- 2002 Colloque (14 Nov 2002), Département de Mathématiques, Université d’Evry, France
- 2002 Rencontres Evry-Nancy-Strasbourg de Probabilités, (12–13 Dec 2002), Institut Elie Cartan — Université Henri Poincaré, Nancy, France
- 2003 Session de Printemps du G.D.R “Inégalités géométriques: Approches stochastiques et géométriques” (13–15 Mars 2003), Université de Blaise Pascal, Clermont-Ferrand, France

- 2003 Colloque tournant des Probabilités (17 Nov 2003), Université d’Angers, France
- 2004 Séminaire “Equations aux Dérivées Partielles” (25 Nov 2004), Séminaire “Analyse, Géométrie et Algèbre” (26 Nov 2004), Laboratoire de Mathématiques, Université de Metz, France
- 2005 International Conference “Flots aléatoires” (18–22 Apr 2005), C.I.R.M. Luminy, France
- 2005 Colloquium (27 May 2005), Department of Mathematics, Beijing Normal University, Beijing, China
- 2005 Colloquium (1 June 2005), Institute of Mathematics, Chinese Academy of Sciences, Beijing, China
- 2005 2nd Joint Meeting of AMS, DMV and ÖMG 2005 Session “Stochastic Analysis on Metric Spaces” (16–19 June 2005) Mainz, Germany
- 2005 Journées de Probabilités (4–9 Sept 2005) Institut Elie Cartan — Université Henri Poincaré, Nancy, France
- 2005 Workshop on Stochastic Analysis and Computational Finance (10–12 Nov 2005), Imperial College London, U.K.
- 2005 Oberwolfach-Tagung “Heat Kernels, Stochastic Processes and Functional Inequalities” (27 Nov–3 Dec 2005), Germany
- 2006 Berliner Kolloquium Wahrscheinlichkeitstheorie (1 Febr 2006), Technische Universität Berlin, Germany
- 2006 Colloquium (6 March 2006), Institut Camille Jordan, Université Claude Bernard Lyon 1, France
- 2006 The 28th Finnish Summer School on Probability Theory (6 lectures) (June 5–June 9, 2006), Nagu/Nauvo, Finland
- 2006 Colloquium (13 June 2006), Department of Mathematics and Statistics, University of Jyväskylä, Finland
- 2006 Colloquium (22 June 2006), Statistical Laboratory, Centre for Mathematical Sciences, University of Cambridge, UK
- 2006 31st Conference on Stochastic Processes and their Applications (July 17–21, 2006), University Paris 5, France
- 2006 8th Colloque interregional de mathématiques (Oct 12–13, 2006) Universität Trier, Germany
- 2007 Séminaire de Probabilités (Febr 1, 2007), Laboratoire de Mathématiques, Université de Poitiers, France

- 2007 Séminaire Calcul stochastique (Febr 5, 2007), Institut de Recherche Mathématique Avancée, Université Louis Pasteur, Strasbourg, France
- 2007 Colloquium (17 April 2007), Department of Mathematics, Beijing Normal University, Beijing, China
- 2007 Kolloquium (22 Juni 2007), Mathematische Fakultät der Universität Saarbrücken, Germany
- 2007 Conference on “Innovations in Mathematical Finance” (25 June–1 July) Loen, Norway
- 2007 East Midlands Stochastic Analysis Seminars (31 Aug 2007), Warwick Mathematics Institute, University of Warwick, Great Britain
- 2007 International Workshop “Stochastic calculus on manifolds, graphs, and random structures” (Oct 8–12, 2007), Hausdorff Research Institute for Mathematics, University of Bonn, Germany
- 2007 International Conference on Stochastic Analysis and Applications (Nov 5-10, 2007), Hammamet, Tunisia
- 2007 Séminaire de Probabilités (Nov 15, 2007) Institut Élie Cartan Nancy, Université Henri Poincaré Nancy, France
- 2007 Infinite Dimensional Analysis and Representation Theory (Dec 10–14, 2007) Fakultät für Mathematik, Universität Bielefeld, Germany
- 2008 Colloquium (7 March 2008), Warwick Mathematics Institute, University of Warwick, UK
- 2008 60th British Mathematical Colloquium (March 25–28, 2008), University of York, UK
- 2008 International conference “Glimpses of Geometry” (May 15–17, 2008) ENS Lyon, France
- 2008 First MSJ-SI (Mathematical Society of Japan, Seasonal Institute) “Probabilistic Approach to Geometry” (July 28–Aug 8, 2008) Kyoto University, Kyoto, Japan
- 2008 International Conference on Complex Analysis and Related Topics “The 11th Romanian–Finnish Seminar” (Aug 14–19, 2008) Alba Iulia, Romania
- 2008 Rencontres Franco-Chinoises en probabilités et analyse (Sept 8–12, 2008) C.I.R.M. Luminy, France
- 2009 Probability Colloquium (Apr 24, 2009), Department of Mathematics, University of Swansea, UK
- 2009 Conference in Analysis and its Applications, IISc Bangalore (May 25–27, 2009), India

- 2009 Lecture Course, Indian Institute of Science (May 23–June 13, 2009), Bangalore, India
- 2009 Workshop on “Boundaries” (June 28–July 3, 2009), Graz University of Technology, Austria
- 2009 Interregional Colloquium in Mathematics (Oct 23–24, 2009), Universität des Saarlands, Saarbrücken, Germany
- 2010 Oberseminar Stochastik (March 4, 2010), Institute of Applied Mathematics, University of Bonn, Germany
- 2010 Chinese-German Meeting on Stochastic Analysis and Related Fields (May 3–7, 2010), Academy of Mathematics and Systems Science, Beijing, China
- 2010 Stochastic Partial Differential Equations (31 May–4 June, 2010). Isaac Newton Institute for Mathematical Sciences, Satellite Meeting at the University of York, UK
- 2010 Journées de Probabilités 2010 (21–25 juin, 2010), Institut de Mathématiques, Université de Bourgogne, Dijon, France
- 2010 Workshop on Advanced Mathematical Methods for Finance (Sept 27–30, 2010), Berlin, Germany
- 2010 Conference in Memory of Paul Malliavin (Oct 4–6, 2010), Institut de Mathématiques, Université de Bourgogne, Dijon, France
- 2010 International Conference on Applied Mathematics and Informatics (Nov 28–Dec 3, 2010), San Andres Island, Colombia
- 2011 Mathematical Seminar (April 29, 2011), Beijing Normal University, China
- 2011 Geometric Stochastic Partial Differential Equations (May 5-7, 2011), School of Mathematics and Statistics, University of New South Wales, Sydney, Australia
- 2011 Malliavin Calculus and Computational Finance (26-28 July, 2011), Lecture Course of 6 hours, Universidad de los Andes, Bogotá, Colombia
- 2011 Conference “Taller de Matemáticas Financieras y Finanzas Computacionales” (July 26–28, 2011), Universidad de los Andes, Bogotá, Colombia
- 2011 Mathematical Seminar (Aug 3, 2011), Facultad de Ciencias, Universidad Nacional de Colombia, Bogotá, Colombia
- 2011 Mathematical Colloquium (Aug 4, 2011), Universidad de los Andes, Bogotá, Colombia

- 2011 5th International Conference on Stochastic Analysis and its Applications (Sept 5–9, 2011), Hausdorff Center of Mathematics, University of Bonn, Germany
- 2011 Mathematical Seminar (Nov 7, 2011), Department of Mathematics and Oxford-Man Institute, University of Oxford, UK
- 2012 Harmonic and Complex Analysis and its Applications HCAA 2012 (March 5–9, 2012), Puerto de la Cruz, Tenerife, Canary Islands.
- 2012 Mathematical Analysis Seminar (April 3, 2012), University of Bergen, Norway.
- 2012 EPSRC Symposium Workshop – Stochastic Analysis and Stochastic PDEs (April 16–20, 2012) Mathematics Institute, University of Warwick, UK.
- 2012 Mathematics Seminar (June 15, 2012), Université Paris-Sud/Orsay, France
- 2012 Conférence en l'honneur d'Yves Le Jan (Sept 6–7, 2012), ENS de Paris, France
- 2013 Workshop: Heat Kernels, Stochastic Processes and Functional Inequalities (5–11 May, 2013), Mathematisches Forschungsinstitut Oberwolfach, Germany
- 2013 Workshop: Stochastic Differential Geometry (29–31 May 2013), Lebesgue Center of Mathematics, Rennes, France
- 2013 Dirichlet Forms and Applications – German-Japanese Meeting on Stochastic Analysis (9–13 Sept 2013), Mathematisches Institut der Universität Leipzig, Germany
- 2013 Workshop on Geometric aspects in probability and analysis (Sept 14, 2013), Mathematisches Institut, Friedrich-Schiller-Universität Jena, Germany
- 2014 AMSI/AustMS Conference on Geometric Analysis and Stochastic Methods in Geometry (July 21–25, 2014), The University of Queensland, Brisbane, QLD, Australia
- 2014 Maths Colloquium (July 28, 2014), The University of Queensland, Brisbane, QLD, Australia
- 2015 New Trends in Optimal Transport (March 2–6, 2015), Hausdorff Center for Mathematics, University of Bonn, Germany
- 2015 Mathematics Seminar (April 21, 2015), Beijing Normal University, China

- 2015 Probability Seminar (April 23, 2015), Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, China
- 2015 IMS-China International Conference on Statistics and Probability (July 1-4, 2015), Kunming, China
- 2015 Colloque Franco-Roumain en Théorie des Probabilités, Institut de Mathématiques “*Simion Stoilow*” de l’Académie Roumaine (Oct 30 – Nov 1, 2015) Bucarest, Roumanie
- 2015 Workshop on Stochastic Analysis and Related Topics (Nov 30 – Dec 2, 2015) Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing, China
- 2016 BeNeLux Mathematical Congress 2016 (22–23 March 2016), Amsterdam, Netherlands
- 2016 Séminaire de Probabilités, Laboratoire de Probabilités et Modèles Aléatoires des Universités Pierre et Marie Curie et Denis Diderot (March 29, 2016), Paris, France
- 2016 Second joint Conference of the Belgian, Royal Spanish and Luxembourg Mathematical Societies (June 6–8, 2016), Logroño (La Rioja), Spain
- 2016 School on Algebraic, Geometric and Probabilistic Aspects of Dynamical Systems and Control Theory (July, 4–15, 2016), 4 plenary lectures, ICTP, Trieste, Italy
- 2017 Probability Seminar (May 5, 2017), Tianjin University, China
- 2017 Max-Planck Institute for Mathematics (Sept 11-15, 2017), Activity: “Metric Measure Spaces and Ricci Curvature”, Lecture course, Bonn, Germany
- 2017 International Conference on Applied Mathematics and Informatics, ICAMI (Nov 26 – Dec 1, 2017), San Andres Island, Colombia
- 2018 “Geometry and Probability” (Jan 13 – 16, 2018), Tohoku University, Sendai, Japan
- 2018 “Mark Kac Seminar” (March 2, May 4, June 8, 2018), 6 lectures, University of Utrecht, The Netherlands
- 2018 “Conférence de Lancement” (June 18 – 20, 2018), Laboratoire de Probabilités, Statistique et Modélisation (LPSM), Sorbonne Université, Paris, France
- 2018 “Workshop on Stochastic Systems: their Analysis, Geometry and Perturbation” (July 10 – 14, 2018), Chinese Academy of Sciences, Beijing, China

- 2018 “Atelier de travail en stochastique et EDP” (Sept 14–15, 2018),
Simion Stoilow Institute of Mathematics of the Romanian Academy,
Bucharest, Romania
- 2018 “Analysis of Differential Operators on Manifolds” (Sept 24–26, 2018),
Universität Freiburg, Germany
- 2018 “Journées Analyse et Physique Mathématique” (Oct 4–5, 2018), Uni-
versité de Lorraine, Metz, France
- 2018 “Stability Phenomena in Geometry and Mathematical Physics” (Oct
9–12, 2018), Humboldt University, Berlin, Germany
- 2018 “Workshop on Stochastic Differential Equations and Applications”
(Nov 2–4, 2018), SCUN Wuhan, China
- 2018 “Probability seminar” (Nov 7, 2018), Wuhan University, China
- 2018 “Séminaire Calcul stochastique” (Dec 6, 2018), IRMA, Strasbourg,
France
- 2019 “Analyse stochastique et thèmes connexes” (May 6–9, 2019), Faculty
of Mathematics and Informatics, University of Bucharest, Romania
- 2019 “Oberseminar Global Analysis and Operator Algebras” (June 11th,
2019), University of Bonn, Germany
- 2019 “Eleventh School on Analysis and Geometry in Metric Spaces” (June
24–28, 2019), 6 hours lecture course, Levico Terme (Trento), Italy
- 2019 “Japanese-German Open Conference on Stochastic Analysis 2019” (Sept
02–06, 2019), Fukuoka University, Japan
- 2019 “Self-adjoint Extensions in New Settings” (Oct 6–12, 2019), Oberwol-
fach Research Institute for Mathematics (MFO), Germany
- 2019 “Heat Kernels, Stochastic Processes and Functional Inequalities” (Nov
17–23, 2019), Oberwolfach Research Institute for Mathematics (MFO),
Germany
- 2019 “Journée Analyse et Probabilité” (Nov 28, 2019), Institut de Mathé-
matiques, Université de Bordeaux, France
- 2019 “Problems of roughness, geometry and random fluctuations” (Dec 09–
12, 2019), Hausdorff Research Institute for Mathematics (HIM), Bonn,
Germany
- 2020 “Workshop on Manifold and Shape Stochastics” (Febr. 23-27, 2020),
Sandbjerg Estate, Denmark

Publications

- [1] A. Thalmaier, Asymptotik Brownscher Bewegungen. *Regensburger Mathematische Schriften* **22** (1989).
- [2] W. Hackenbroch and A. Thalmaier, *Stochastische Analysis. Eine Einführung in die Theorie der stetigen Semimartingale*. (560 pages). Stuttgart: Teubner, 1994.
- [3] A. Thalmaier, Brownian motion and the formation of singularities in the heat flow for harmonic maps. *Probab. Theory Relat. Fields* **105** (1996) 335–367.
- [4] A. Thalmaier, Martingales on Riemannian manifolds and the nonlinear heat equation. *Stochastic analysis and applications* (Powys, 1995), World Sci. Publ., River Edge, NJ, 1996, 429–440.
- [5] A. Thalmaier, On the differentiation of heat semigroups and Poisson integrals. *Stochastics and Stochastics Reports* **61** (1997) 297–321.
- [6] A. Thalmaier and F.-Y. Wang, Gradient estimates for harmonic functions on regular domains in Riemannian manifolds. *J. Funct. Anal.* **155** (1998) 109–124.
- [7] M. Arnaudon and A. Thalmaier, Stability of stochastic differential equations in manifolds. *Séminaire de Probabilités, XXXII*, 188–214. Lecture Notes in Math. **1686**. Berlin: Springer, 1998.
- [8] M. Arnaudon and A. Thalmaier, Complete lifts of connections and stochastic Jacobi fields. *J. Math. Pures Appl.* **77** (1998) 283–315.
- [9] A. Thalmaier, Some remarks on the heat flow for functions and forms. *Electron. Comm. Probab.* **3** (1998) 43–49.
- [10] M. Arnaudon, X.-M. Li and A. Thalmaier, Manifold-valued martingales, changes of probabilities, and smoothness of finely harmonic maps. *Ann. Inst. H. Poincaré Probab. Statist.* **35** (1999) 765–792.
- [11] M. Arnaudon and A. Thalmaier, Bismut type differentiation of semigroups. *Prob. Theory and Math. Stat. (Vilnius, 1998)*, 23–32, VSP/TEV, Utrecht and Vilnius, 1999.
- [12] B. K. Driver and A. Thalmaier, Heat equation derivative formulas for vector bundles. *J. Funct. Anal.* **183** (2001) 42–108.
- [13] M. Arnaudon, R. O. Bauer and A. Thalmaier, A probabilistic approach to the Yang-Mills heat equation. *J. Math. Pures Appl.* **81** (2002) 143–166.
- [14] H. Airault, P. Malliavin and A. Thalmaier, Support of Virasoro unitarizing measures. *C. R. Acad. Sci. Paris, Ser. I*, **335** (2002) 621–626.

- [15] M. Arnaudon and A. Thalmaier, Horizontal martingales in vector bundles. *Séminaire de Probabilités, XXXVI*, 419–456. Lecture Notes in Math. **1801**. Berlin: Springer, 2003.
- [16] M. Arnaudon and A. Thalmaier, Yang-Mills fields and random holonomy along Brownian bridges. *Ann. Probab.* **31** (2003) 769–790.
- [17] E. Barrucci, P. Malliavin, M. E. Mancino, R. Renò and A. Thalmaier, The price-volatility feedback rate: an implementable mathematical indicator of market stability. *Mathematical Finance* **13** (2003) 17–35.
- [18] M. Arnaudon, H. Plank and A. Thalmaier, A Bismut type formula for the Hessian of a heat semigroup. *C. R. Acad. Sci. Paris, Ser. I*, **336** (2003) 661–666.
- [19] P. Malliavin and A. Thalmaier, Numerical error for SDE: Asymptotic expansion and hyperdistributions. *C. R. Acad. Sci. Paris, Ser. I*, **336** (2003) 851–856.
- [20] A. Thalmaier and F.-Y. Wang, Derivative estimates of semigroups and Riesz transforms on vector bundles. *Potential Anal.* **20** (2004) 105–123.
- [21] A. B. Cruzeiro, P. Malliavin and A. Thalmaier, Geometrization of Monte-Carlo numerical analysis of an elliptic operator: strong approximation. *C. R. Acad. Sci. Paris, Ser. I*, **338** (2004) 481–486.
- [22] H. Airault, P. Malliavin and A. Thalmaier, Canonical Brownian motion on the space of Jordan curves and resolution of Beltrami equations by a continuity method along stochastic flows. *J. Math. Pures Appl.* **83** (2004) 955–1018.
- [23] P. Malliavin and A. Thalmaier, *Stochastic Calculus of Variations in Financial Mathematics*. Springer Finance. Springer-Verlag, Berlin, 2005.
- [24] M. Arnaudon, A. Thalmaier and Feng-Yu Wang, Harnack inequality and heat kernel estimates on manifolds with curvature unbounded below. *Bull. Sci. Math.* **130** (2006) 223–233.
- [25] M. Arnaudon, B. K. Driver and A. Thalmaier, Gradient estimates for positive harmonic functions by Stochastic Analysis. *Stochastic Processes Appl.* **117** (2007) 202–220.
- [26] M. Arnaudon, K. A. Coulibaly and A. Thalmaier, Brownian motion with respect to a metric depending on time; definition, existence and applications to Ricci flow. *C. R. Acad. Sci. Paris, Ser. I*, **346** (2008) 773–778.
- [27] M. Arnaudon, A. Thalmaier and S. Ulsamer, Existence of non-trivial harmonic functions on Cartan-Hadamard manifolds of unbounded curvature. *Math. Zeitschrift* **263** (2009) 369–409.

- [28] M. Arnaudon, A. Thalmaier and Feng-Yu Wang, Gradient estimate and Harnack inequality on non-compact Riemannian manifolds. *Stochastic Processes Appl.* **119** (2009) 3653–3670.
- [29] S. Fang, D. Luo and A. Thalmaier, Stochastic differential equations with coefficients in Sobolev spaces. *J. Funct. Anal.* **259** (2010) 1129–1168.
- [30] M. Arnaudon and A. Thalmaier, Li-Yau type gradient estimates and Harnack inequalities by Stochastic Analysis. *Advanced Studies in Pure Mathematics* **57** (2010) 29–48.
- [31] H. Airault, P. Malliavin and A. Thalmaier, Brownian measures on Jordan-Virasoro curves associated to the Weil-Petersson metric. *J. Funct. Anal.* **259** (2010) 3037–3079.
- [32] M. Arnaudon and A. Thalmaier, The differentiation of hypoelliptic diffusion semigroups. *Illinois J. Math.* **54** (2010) 1285–1311.
- [33] M. Arnaudon, K. A. Coulibaly and A. Thalmaier, Horizontal diffusion in C^1 path space. *Séminaire de Probabilités, XLIII*, 73–94, Lecture Notes in Math. **2006**. Berlin: Springer, 2011.
- [34] A. Thalmaier, Paul Malliavin (10 September 1925 – 3 June 2010). *Eur. Math. Soc. Newsl.* **81** (2011) 17–20.
- [35] A. Thalmaier and F.-Y. Wang, A stochastic approach to a priori estimates and Liouville theorems for harmonic maps. *Bull. Sci. Math.* **135** (2011) 816–843.
- [36] M. Arnaudon and A. Thalmaier, Brownian motion and negative curvature. *Random Walks, Boundaries and Spectra*, Progress in Probability, Vol. 64, 145–163. Springer Basel, 2011.
- [37] H. Guo, R. Philipowski and A. Thalmaier, Entropy and lowest eigenvalue on evolving manifolds. *Pacific J. Math.* **264** (2013) 61–82.
- [38] H. Guo, R. Philipowski and A. Thalmaier, A note on Chow’s entropy functional for the Gauss curvature flow. *C. R. Math. Acad. Sci. Paris* **351** (2013) 833–835.
- [39] M. Arnaudon, A. Thalmaier and F.-Y. Wang, Equivalent Harnack and gradient inequalities for pointwise curvature lower bound. *Bull. Sci. Math.* **138** (2014) 643–655.
- [40] H. Guo, R. Philipowski and A. Thalmaier, A stochastic approach to the harmonic map heat flow on manifolds with time-dependent Riemannian metric. *Stochastic Processes Appl.* **124** (2014) 3535–3552.
- [41] H. Guo, R. Philipowski and A. Thalmaier, An entropy formula for the heat equation on manifolds with time-dependent metric, application to ancient solutions. *Potential Analysis* **42** (2015) 483–497.

- [42] H. Guo, R. Philipowski and A. Thalmaier, Martingales on manifolds with time-dependent connection. *J. Theoret. Probab.* **28** (2015) 1038–1062.
- [43] R. Philipowski and A. Thalmaier, Heat equation in vector bundles with time-dependent metric. *J. Math. Soc. Japan* **67** (2015) 1759–1769.
- [44] H. Guo, R. Philipowski and A. Thalmaier, On gradient solitons of the Ricci-Harmonic flow. *Acta Math. Sinica, English Series* **31** (2015) 1798–1804.
- [45] Erlend Grong and Anton Thalmaier, Curvature-dimension inequalities on sub-Riemannian manifolds obtained from Riemannian foliations: Part I. *Math. Zeitschrift* **282** (2016) 99–130.
- [46] Erlend Grong and Anton Thalmaier, Curvature-dimension inequalities on sub-Riemannian manifolds obtained from Riemannian foliations: Part II. *Math. Zeitschrift* **282** (2016) 131–164.
- [47] Anton Thalmaier, Geometry of subelliptic diffusions. In: *Dynamics, geometry and analysis on sub-Riemannian manifolds*, Vol. II. (D. Barilari, U. Boscain, M. Sigalotti, eds.) EMS Series of Lectures in Mathematics (ELM), Zürich: European Mathematical Society, 2016, pp. 85–169.
- [48] Li-Juan Cheng and Anton Thalmaier, Characterization of pinched Ricci curvature by functional inequalities. *J. Geom. Anal.* **28** (2018) no. 3, 2312–2345.
- [49] Li-Juan Cheng and Anton Thalmaier, Spectral gap on Riemannian path space over static and evolving manifolds. *J. Funct. Anal.* **274** (2018) 659–684.
- [50] Li-Juan Cheng and Anton Thalmaier, Evolution systems of measures and semigroups properties on evolving manifolds. *Electron. J. Probab.* **23** (2018), paper no. 20, 27 pp.
- [51] Li-Juan Cheng, Anton Thalmaier and James Thompson, Quantitative C^1 -estimates by Bismut formulae. *J. Math. Anal. Appl.* **465** (2018) no. 2, 803–813.
- [52] Li-Juan Cheng, Anton Thalmaier and James Thompson, Uniform gradient estimates on manifolds with a boundary and applications. *Analysis and Mathematical Physics* **8** (2018), no. 4, 571–588.
- [53] Li-Juan Cheng, Anton Thalmaier and James Thompson, Functional inequalities on manifolds with non-convex boundary. *Sci. China Math.* **61** (2018), no. 8, 1421–1436.

- [54] Marc Arnaudon, Anton Thalmaier and Feng-Yu Wang, Gradient estimates on Dirichlet and Neumann eigenfunctions. *Int. Math. Res. Not. IMRN* (2018), <https://doi.org/10.1093/imrn/rny208>
- [55] Erlend Grong and Anton Thalmaier, Stochastic completeness and gradient representations for sub-Riemannian manifolds. *Potential Analysis* **51** (2019), no. 2, 219–254.
- [56] Anton Thalmaier and James Thompson, Derivative and divergence formulae for diffusion semigroups. *Ann. Probab.* **47** (2019), no. 2, 743–773.
- [57] Fabrice Baudoin, Erlend Grong, Kazumasa Kuwada and Anton Thalmaier, Sub-Laplacian comparison theorems on totally geodesic Riemannian foliations. *Calc. Var. Partial Differential Equations* **58** (2019), no. 4, Art. 130, 38 pp.
- [58] Anton Thalmaier and James Thompson, Exponential integrability and exit times of diffusions on sub-Riemannian and metric measure spaces. *Bernoulli* **26** (2020), no. 3, 2202–2225.
- [59] Batu Güneysu and Anton Thalmaier, Scattering theory without injectivity radius assumptions, and spectral stability for the Ricci flow. *Ann. Inst. Fourier (Grenoble)* **70** (2020), no. 1, 437–456.
- [60] Li-Juan Cheng, Erlend Grong and Anton Thalmaier, Functional inequalities on path space of sub-Riemannian manifolds and applications. arXiv:1912.03575 (2020) 30 pp.
- [61] Li-Juan Cheng and Anton Thalmaier, Exponential contraction in Wasserstein distance on static and evolving manifolds. arXiv:2001.06187 (2020) 18 pp.
- [62] Fabrice Baudoin, Erlend Grong, Kazumasa Kuwada, Robert Neel and Anton Thalmaier, Radial processes for sub-Riemannian Brownian motions and applications. arXiv:2002.02556 (2020) 21 pp.