

Anton Thalmaier

Nationality: German

Family status: married, 1 child

Coordinates

Professional Address:

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Université du Luxembourg
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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, 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

H. Airault, Professeur à l'Université de Picardie;
M. Arnaudon, Professeur à l'Université de Poitiers;
R.O. Bauer, Professor at the University of Illinois at Urbana-Champaign;
A.-B. Cruzeiro, Professeur à l'Université de Lisboa;
B. Driver, Professor at the University of California at San Diego;
S. Fang, Professeur à l'Université de Bourgogne;
E.P. Hsu, Professor at Northwestern University;
X.-M. Li, Assistent Professor at the University of Warwick;
P. Malliavin, Membre de l'Académie des Sciences, Paris;
F.-Y. Wang, Professor at Beijing Normal University

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)

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, *Stochastic calculus on spaces of measures and groups of diffeomorphisms*, Université du Luxembourg (since 2006)

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)

Lecture courses and activities abroad

Course at the 28th *Finnish Summer School on Probability Theory* (Nagu Gammelgård, Finland, June 5–9, 2006)

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

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, 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

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. In: I. M. Davies, A. Truman and K. D. Elworthy (Eds.) *Stochastic Analysis and Applications*. Proc. of the Fifth Gregynog Symposium, Gregynog, 1995. Singapore: World Scientific Press, 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 and A. Thalmaier, Horizontal martingales in vector bundles. *Séminaire de Probabilités*, XXXVI, 419–456. Lecture Notes in Math. **1801**. Berlin: Springer, 2003.
- [14] 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.
- [15] H. Airault, P. Malliavin and A. Thalmaier, Support of Virasoro unitarizing measures. *C. R. Acad. Sci. Paris, Ser. I*, **335** (2002), 621–626.
- [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] 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.
- [30] M. Arnaudon, K. A. Coulibaly and A. Thalmaier, Horizontal diffusion in C^1 path space. *Séminaire de Probabilités, Lecture Notes in Math.* (2010).
- [31] S. Fang, D. Luo and A. Thalmaier, Stochastic differential equations with coefficients in Sobolev spaces. *J. Funct. Anal.* (2010).
- [32] M. Arnaudon and A. Thalmaier, Brownian motion and negative curvature. Proceedings to *Workshop on Boundaries* (Graz, 2009), Birkhäuser, 2010.
- [33] A. Thalmaier and F.-Y. Wang, A stochastic approach to a priori estimates and Liouville theorems for harmonic maps. Preprint, 2009.
- [34] M. Arnaudon and A. Thalmaier, The differentiation of hypoelliptic diffusion semigroups. Preprint, 2010.