

Curriculum Vitae

Romain Tessera

Personal information

- Professional address: ENS de Lyon; 46, allée d'Italie 69364, Lyon Cedex 07 (France).
- Email address: romtessera@gmail.com

Professional experience

- Permanent pure research position in CNRS (chargé de recherche). École Normale Supérieure de Lyon.
- Between 2006 and 2009: Postdoc in Vanderbilt's University.
- Between 2003 and 2006: PhD thesis in Université de Cergy Pontoise, adviser: Thierry Coulhon, and University of Neuchatel, adviser: Alain Valette.

Grants and awards

- ANR: Allocation Nationale de Recherche, collective grant (french equivalent of NSF):
 - 2006-2008: (Coordinator: Yann Ollivier),
 - 2009–2011: AGORA "Actions, Groupes, et Algèbres d'Opérateurs" (Damien Gaboriau).
 - 2010–2012: GGAA : "Aspects géométriques, analytiques et algorithmiques des groupes" (Cornelia Drutu Badea).
- 2007–2009: NSF-grant Award ID 0706486.
- Samir Aldroubi and Amira Azhari prize (Prize for Excellence in Postdoctoral Research, awarded by the Mathematics Department of Vanderbilt University).

Research interests

Most of my work is devoted to the study of the large scale geometry of different kinds of objects, among which: discrete groups, Lie groups, Riemannian manifolds, graphs, and more general metric measure spaces. More specifically, here is a list of subjects I have been working on.

- Early in my PhD, I have been working on the connections between isoperimetric inequalities, Sobolev inequalities and probability of return of random walks on general metric measure spaces, in particular on locally compact groups. For instance, I proved that a symmetric non-degenerate random walk on a locally compact group has a “spectral gap” if and only if it is non-amenable or non-unimodular.
- I also studied the relations between isoperimetry and volume growth in metric measure spaces. I gave for instance a very short proof of the fact (new in that generality) that the sequence of powers of a generating compact set in a locally compact group with polynomial growth is a Følner sequence. This result has applications in ergodic theory.
- I have been interested in L^p -cohomology of homogeneous Riemannian manifolds. My main result, combined with former results by Pierre Pansu, allowed me to obtain an algebraic characterization of those homogeneous manifolds which are Gromov-hyperbolic.
- A fair amount of my research has been devoted to the problem of quantifying, or characterizing how well metric spaces can be coarsely embedded into various classes of Banach spaces, most interestingly Hilbert spaces. For instance I gave a precise answer for free groups, and for Lie groups and their lattices. More recently, I have characterized those metric spaces which cannot be coarsely embedded in terms of containing a sequence of expanders (in some weak sense).
- During my PhD, I started a collaboration with Yves Cornuier, and Alain Valette which have led to a list of papers on harmonic analysis of groups. To summarize briefly, we have been investigating “how well” a group can act by affine isometries on a Hilbert space. This work is motivated by the antagonist properties of Kazhdan and of Haagerup. With Yves Cornuier, we have been able recently to characterize relative Kazhdan’s property T for a semi-direct product with an abelian group.

- During my postdoc, I started a collaboration with Erik Guentner and Guoliang Yu on topological rigidity of manifolds. We developed new tools (involving some large-scale geometry), in order to prove the Stable Borel conjecture for a wide class of closed manifolds.
- Also during my postdoc, I worked with Guoliang Yu and others on the coarse Baum-Connes assembly map for sequences of expanders. Again introducing new geometric tools, we managed to prove the coarse Novikov conjecture for a large class of expanders families.
- In a work still in progress, in collaboration with Yves Cornuier, we have been studying the 2-dimensional isoperimetric function on Lie groups. Our ambition is to characterize algebraically those Lie groups for which this function grows exponentially.
- I recently worked with Akram Aldroubi on the problem of approximating a finite set in a Hilbert space by a family of linear subspaces. Reformulating this problem in terms of projectors and states, we managed to give a geometric characterization of the so-called Subspace Minimal Approximation Property.
- Finally, inspired by discussions with Akram Aldroubi, I got interested in the problem of finding a left-inverse in ℓ^p for an operator with some “decay” far from the diagonal. Using some large-scale geometry ideas, I obtained a general and optimal result concerning operators lying in certain “weighted Schur algebras”.

List of (pre-)publications

The list of my (pre-)publications is available on my webpage: <http://www.normalesup.org/tessera/>

- **Geometry and analysis on groups and metric measure spaces**
 - (2007) Large-scale isoperimetry on locally compact groups and applications. Actes du Séminaire de Théorie Spectrale et Géométrie. Vol. 25. Année 2006–2007, 179–188, Sémin. Théor. Spectr. Géom., 25, Univ. Grenoble I, Saint-Martin-d’Hères, 2008.
 - (2007) On the L^p -distorsion of finite quotients of amenable groups. To appear in Positivity.
 - (2007) Isoperimetric profile of subgroups and probability of return of random walks on elementary solvable groups. Preprint.

- (2006) Large scale Sobolev inequalities on metric measure spaces and applications. *Rev. Mat. Iberoam.* 24 (2008), no. 3, 825–864.
- (2006)(with Yves Cornulier) Quasi-isometrically embedded free sub-semigroups. *Geom. Topol.* 12 (2008), 461-473.
- (2006) Quantitative property A, Poincaré inequalities, L_p -compression and L_p -distortion for metric measure spaces. *Geom. Dedicata* 136 (2008), 203–220.
- (2006) Asymptotic isoperimetry on groups and uniform embeddings into Banach spaces. To appear in *Comment. Math. Helv.*
- (2005) Asymptotic isoperimetry of balls in metric measured spaces. *Publicaciones Matemáticas* 50, 2, 315-348.
- (2005) Volume of spheres in metric measured spaces and in groups of polynomial growth. *Bull. Soc. Math. France* 135 (2007), no. 1, 47–64.

• **Isometric actions of groups on a Hilbert space**

- (2009) (with Yves Cornulier) A characterization of relative Kazhdan Property T for abelian groups. Preprint.
- (2007) Coarse embeddings into a Hilbert space, Haagerup Property and Poincaré inequalities. *Journal of Topology and Analysis* Vol. 1 (2009), 87–100.
- (2006)(with Yves Cornulier and Alain Valette) Isometric group actions on Hilbert spaces: growth of cocycles. *Geom. Funct. Anal.* 17 (2007), 770-792.
- (2006)(with Yves Cornulier and Alain Valette) Isometric group actions on Hilbert spaces: structure of orbits. *Canad. J. Math.* 60 (2008), no. 5, 1001–1009.
- (2006)(with Yves Cornulier and Alain Valette) Isometric group actions on Banach spaces and representations vanishing at infinity. *Transform. Groups* 13 (2008), no. 1, 125–147.

• **L^p -cohomology**

- (2009) (with Yves Cornulier) Contracting automorphisms and L^p -cohomology in degree one. Preprint.

- (2006) Vanishing of the first reduced cohomology with values in a L_p -representation. *Annales de l’institut Fourier*, 59 no. 2 (2009), p. 851-876.
- **Rigidity for topological manifold**
 - (2009) (with Erik Guentner and Guoliang Yu) Decomposition Complexity and topological rigidity. Preprint.
- **On the coarse Novikov conjecture**
 - (2009) (avec Erik Guentner and Guoliang Yu) Operator Norm Localization for linear groups and applications to K-theory. Preprint.
 - (2007) (avec Xiaoman Chen, Xianjin Wang, Guoliang Yu) Metric sparsification and operator norm localization. *Advances in Math.* 218 (2008), 1496-1511.
- **Left-inverses for infinite matrices**
 - (2009) The Schur algebra is not spectral in $B(\ell^2)$ (short note). Preprint.
 - (2009) Left inverses for matrices in the weighted Schur algebra. Preprint.

International conferences and workshops

Invited speaker

- **Between groups and foliations**, Bilbao, Mai 2010.
- **Workshop on von Neumann algebras and group actions**, University of Copenhagen , February 2010.
- **Workshop in Analysis and Probability**, TAMU, Texas. August 2009.
- **Affine Isometric Actions of Discrete Groups**, Ascona, Switzerland, June 2009.
- **Théorie de l’échantillonnage et applications (SAMPPTA’09)**, CIRM, Luminy, France, May 2009.
- **Workshop on Groups, Embeddings and Applications**, University of Hawaii, Honolulu. March 2009.
- **Von Neumann Algebras and Ergodic Theory of Group Actions**, Institut de Mathématiques, Oberwolfach. October 2008.

- **The Sixth Annual NCGOA Spring Institute**, Vanderbilt University, May 2008.
- **Topics in Geometric Group Theory**, Mathematical Sciences Research Institute, Berkeley. November 2007.
- **Geometry and Algorithms**, Université de Heriot-Watt, Edinburgh. April 2007.
- **Geometric linearization of graphs and groups**, Lausanne. January 2007.
- **The Fourth East Coast Operator Algebras Symposium**, Georgia Institute of Technology, Atlanta, October 2006.
- **The property of rapid decay**, Université de Palo Alto, Californie (USA). January 2006.
- **Heat Kernels, Stochastic Processes and Functional Inequalities**, Institut de Mathématiques, Oberwolfach. December 2005.
- **Asymptotic and Probabilistic Methods in Group Theory**, Geneva, June 2005.

Organizer

Workshop on Analysis on Groups, March 2008 in Puerto Rico.

Non-speaker

- **Geometry, Rigidity, and Group Actions** (on behalf of Bob Zimmer's 60'th birthday), University of Chicago. September 2007.
- **GDR: Analyse fonctionnelle et harmonique, et applications** Institut Fourier, Grenoble, September 2005.
- **De la Topologie à la Géométrie Symplectique**, Université de Nantes, June 2005.
- **4th School on Analysis and Geometry in Metric Spaces**, Trento, May 2005.
- **Conference on the occasion of Pierre de la Harpe's 60th birthday**, Geneva, October 2004.

- **Geometric group theory, random walks, harmonic analysis**, Cortona (Italie), June 2004.
- **Invariants de quasi-isométrie**, Les Diablerets (Suisse), March 2004.

Mini-course

- **Series of 10 lectures on random walks on groups and amenability (course for graduate students)**. Université de Fudan, Shanghai. August 2007.
- **Series of 3 lectures during the semester "Limits of graphs in group theory and computer science"**. Bernoulli Center, Lausanne. June 2007.

Seminar and colloquium talks

- **Séminaire Algèbres d'Opérateurs, Université de Chevaleret**, January 2010 (A. Zuk, G. Skandalis).
- **Non-commutative geometry Seminar, Vanderbilt University**, December 2009 (G. Kasparov, R. Willett and G. Yu).
- **Topology and Group Theory Seminar, Vanderbilt University**, December 2009 (B. Hughes, M. Sapir).
- **Séminaire de Théorie Ergodique de l'université de Rennes**, November 2009 (B. Bekka).
- **Seminario de sistemas dinámicas, Universidad de Montevideo, Uruguay**, September 2009.
- **Colloquium talk**, University of Oklahoma, May 2009.
- **Subfactor Seminar, Vanderbilt University**, December 2008.
- **Séminaire Algèbres d'Opérateurs, Université de Chevaleret**, January 2008 (A. Zuk, G. Skandalis).
- **Séminaire de géométrie et dynamique, UMPA, Lyon**. November 2007.
- **Topology and Group Theory Seminar, Vanderbilt University**, September 2007 (B. Hughes, M. Sapir).

- **Geometric group Theory seminar, Texas A&M University, October 2007** (S. Grigorchuk, G. Pisier).
- **Topology and Group Theory Seminar, Vanderbilt University, October 2006** (B. Hughes, M. Sapir).
- **Geometric group Theory seminar, Texas A&M University, October 2006** (S. Grigorchuk, G. Pisier).
- **Séminaire d'Analyse Harmonique, Université de Paris-XI (Orsay), June 2006** (F. Haglund, P. Pansu).
- **Séminaire d'Analyse à l'université de Cergy-Pontoise, June 2006** (F. Germinet).
- **Séminaire de Théorie Ergodique de l'Université d'Orléan, June 2006** (C. Anantharaman)
- **Séminaire de Géométrie Riemannienne à l'école polytechnique, June 2006** (G. Courtois).
- **Séminaire de Géométrie-Dynamique, université de Lille, June 2006** (M. Bourdon).
- **Séminaire Algèbres d'Opérateurs, université de Penn-State, May 2006** (N. Higson, J. Roe).
- **Séminaire de Théorie Ergodique de l'université de Rennes, April 2006** (B. Bekka).
- **Séminaire d'Algèbre et de Topologie de l'université de Nantes, March 2006** (G. Carron).
- **Séminaire d'Analyse Harmonique, Université de Paris-XI, March 2006** (F. Haglund, P. Pansu).
- **Séminaire Algèbres d'Opérateurs, Université de Chevaleret, March 2006** (E. Blanchard, G. Skandalis).
- **Séminaire d'Analyse Fonctionnelle, Chevaleret, March 2006** (O. Guédon).
- **Séminaire de Géométrie des Groupes, université de Genève, February 2006** (P. de la Harpe).

- **Journée spéciale Géométrie Des Groupes, université de Neuchâtel**, January 2006 (A. Valette).
- **Séminaire de mathématiques de l'Institut Fourier**, Grenoble, December 2005 (H. Pajot).
- **Séminaire d'analyse harmonique, université de Paris-XI** , novembre 2005 (F. Haglund, P. Pansu).
- **Séminaire de Probabilité, université de Marseille**, October 2005 (C. Pittet).
- **Séminaire d'analyse harmonique, université de Paris-XI** , May 2005 (F. Haglund, P. Pansu).