

# Gabriel PEYRÉ

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## Contacts

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## Vita

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- 2009 Director GDR MSPC  
<http://www.ceremade.dauphine.fr/~peyre/mspc/>
- 2009 Scientific leader of ANR project NatImages  
<http://www.ceremade.dauphine.fr/~peyre/natimages/>
- 2006 CNRS Researcher, Ceremade, Université Paris–Dauphine.
- 2003–2005 PhD thesis under the supervision of Prof. STÉHANE MALLAT.
- 2003 Master of Sc. in Mathematics, Mathematics, Vision, Learning, With honors.
- 2002 Agrégation de Mathématiques.
- 2001 B.Sc. of Mathematics, Université de Rennes 1, with honors.
- 2001 B.Sc. of Computer Science, Université de Rennes 1, with honors.
- 2000–2003 École Normale Supérieure de Cachan.

## Research Interests

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My research is focussed on the mathematical modeling of images and texture, with applications in image processing, numerical analysis and biological vision.

Improving the state of the art in image processing requires to capture the geometry of edges and textures. The tools developed adapt the representation to the complexity of the structures of the images. This leads to faster and more efficient algorithms to solve inverse problems such as super-resolution and compressed sensing. These adaptive representations could also open the door to a better understanding of the cortical processes that are at the heart of biological vision.

## Responsibilities

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- Scientific leader of ANR project NatImages  
<http://www.ceremade.dauphine.fr/~peyre/natimages/>
- Director of GDR MSPC  
<http://www.ceremade.dauphine.fr/~peyre/mspc/>
- Associate editor, SIAM Journal on Imaging Sciences (SIIMS).
- Co-editor of the special issue “Mathematical Image Analysis 2009” in Journal of Mathematical Imaging and Vision.
- PhD reporter for Yanniv Gur (Tel Aviv University, March 2009), Boris Mailhé (INRIA, Rennes, Dec. 2009), Jean-Marie Mirebeau (Paris 6, Dec. 2010), Bruno Galerme (ENS Cachan, Dec. 2010).
- PhD defense committee of Xavier Delaunay (CNES, Toulouse, Nov. 2008), Pierre Maurel (ENS, Paris, Dec. 2008), Nicolas Thorstensen (ENPC, Dec. 2009), Sheraz Khan (Ecole Polytechnique, Jan. 2010), François-Xavier Dupé (ENSICAen, Jan. 2010), Emilien Tlapale (INRIA Sophia, Jan. 2011), Arnaud Woiselle (CEA Saclay, Dec. 2010)
- Member of the recruiting committees for “Maitre de conference” of Paris 6 (numerical analysis), Paris 7 (statistics), May 2009, Paris-Est (Mai 2010, signal processing), ENSICAen (Mai 2010, signal processing), Paris 5 (Mai 2011, applied mathematics),
- Major contributor for the third edition of “A Wavelet Tour of Signal Processing” of S. Mallat, Jan. 2009,  
<http://www.ceremade.dauphine.fr/~peyre/wavelet-tour/>
- Author of the teaching material “A Numerical Tour of Signal Processing”, Jan. 2009,  
<http://www.numerical-tours.com>

## Students

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- PhD co-advisor of Nicolas Schmidt, Oct. 2009-Sept. 2012 (co-advisor: Y. Fregnac, UNIC), and of Hugo Raguet, Oct. 2010-Sept. 2013 (co-advisor : Y. Fregnac, UNIC).
- Post-doc advisor of Sebastien Bougleux Jan-Sept 2008 (co-advisor: Laurent Cohen) ; Pierre Maurel, Jan-Sept 2009 (co-advisor: J.F. Aujol) ; Julien Rabin, Jan-Sept 2010 ; Miyoun Jung, Sept. 2010-Aug 2011 (co-advisor: Laurent Cohen).
- Master 2 internship advisor of Nicolas Schmidt (MVA, ENS Cachan), April-Sept. 2009 ; Hugo Raguet (MVA, ENS Cachan), Avril-Sept. 2010.
- 2nd year “grande ecole” internship advisor of Thomas Duluc (ENSTA) and Antoine Grolleau (ENSTA), April-Aug. 2007 ; Laurent Sigal (École Polytechnique) April-Aug. 2010.

## Organization of Workshops and Conferences

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- Co-organization (with Y. Fregnac) of the Tauc 2010 conference “From Mathematical Image Analysis to Neurogeometry of the Brain”  
<http://www.ceremade.dauphine.fr/~peyre/mspc/mspc-tauc-10/>
- Co-organization (with M. Elad and P. Milanfar) of the mini-symposium “Recent Advances in Sparse and Non-local Image Regularization” in SIAM Conference on Imaging Science 2010, Chicago, April 2010  
<http://www.ceremade.dauphine.fr/~peyre/is10/>
- Organization of the conference “Mathematics and Image Analysis 2009”, Paris, Dec. 2009  
<http://www.ceremade.dauphine.fr/~peyre/mia09/>
- Co-organization (with P. Mamassian) of the joint GDR MSPC / Vision workshop, Paris, Nov. 2009

- <http://www.ceremade.dauphine.fr/~peyre/mspc-vision-09/>
- Organization of the mini-symposium “Compressed Sensing” in SMAT’09, May 2009, Nice
  - Organization of the graduate course “Méthodes variationnelles et parcimonieuses en traitement du signal et des images”, IHP, Paris, March 2008.  
<http://www.ceremade.dauphine.fr/~peyre/cours-ihp-2008/>
  - Organization of the workshop “An interdisciplinary approach to Textures and Natural Images Processing”, IHP, Paris, Jan. 2007.  
<http://www.ceremade.dauphine.fr/~peyre/workshop-textures/>
  - Co-organizer of the mini-symposium “Geometry of Images and Higher Dimensional Signals” in SIAM Conference on Imaging Science 2006, Minneapolis.

## Teaching

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Years 2008-2009 & 2009-2010:

- *Shape and surface processing with manifold methods* (with L. Cohen), Master (M2), “Mathematical Vision Apprentissage”, ENS Cachan, ~21h.
- *Image Processing*, École des Ponts Paritech, 2nd year students, ~21h.
- *Advanced Signal Processing*, École Centrale Paritech, 3rd year students, ~21h.
- *Mesh Processing* (with P. Alliez and J.P. Pons), École Nationale des Ponts et Chaussées, 2nd year students, ~6h.
- *CNES Wavelet Training*, CNES, Toulouse, Apr. 2009, ~15h.

## Publications

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### Articles in Journals

- [1] P. Maurel, J.F. Aujol, and G. Peyre. Locally parallel texture modeling. *to appear in SIAM Journal of Imaging Science*, 2011.
- [2] G. Peyre, M. Pechaud, R. Keriven, and L.D. Cohen. Geodesic methods in computer vision and graphics. *Foundations and Trends in Computer Graphics and Vision*, 5(3-4):197–397, 2010.
- [3] G. Carlier, M. Comte, I. Ionescu, and G. Peyre. A projection approach to the numerical analysis of limit load problems. *to appear in Mathematical Models and Methods in Applied Sciences*, 2010.
- [4] J. Fadili and G. Peyre. Total variation projection with first order schemes. *to appear in IEEE Transactions on Image Processing*, 2010.
- [5] L. Demanet and G. Peyre. Compressive wave computation. *to appear in Foundation of Computational Mathematics*, 2010.
- [6] G. Peyre, J. Fadili, and J-L. Starck. Learning the morphological diversity. *SIAM Journal of Imaging Science*, 3(3):646–669, 2010.
- [7] F. Benmansour, G. Carlier, G. Peyre, and F. Santambrogio. Derivatives with respect to metrics and applications: Subgradient marching algorithm. *Numerische Mathematik*, 116(3):357–381, 2010.
- [8] G. Peyre. Best basis compressed sensing. *IEEE Transaction on Signal Processing*, 58(5):2613–2622, 2010.
- [9] C. Dossal, G. Peyre, and J. Fadili. A numerical exploration of compressed sampling recovery. *Linear Algebra and Applications*, 432(7):1663–1679, 2010.

- [10] F. Benmansour, G. Carlier, G. Peyre, and F. Santambrogio. Numerical approximation of continuous traffic congestion equilibria. *Networks and Eterogeneous Media*, 3(4):605–623, 2009.
- [11] G. Peyre. Texture synthesis with grouplets. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 4(32):733–746, 2010.
- [12] G. Peyre. Manifold models for signals and images. *Computer Vision and Image Understanding*, 113(2):249–260, February 2009.
- [13] G. Peyre. Sparse modeling of textures. *Journal of Mathematical Imaging and Vision*, 34(1):17–31, 2009.
- [14] G. Carlier, M. Comte, and G. Peyre. Approximation of maximal cheeger sets by projection. *ESAIM: Mathematical Modelling and Numerical Analysis*, 43(1):131–150, 2009.
- [15] G. Peyre. Image processing with non-local spectral bases. *SIAM Multiscale Modeling and Simulation*, 7(2):703–730, 2008.
- [16] G. Peyre and L. D. Cohen. Heuristically driven front propagation for fast geodesic extraction. *International Journal for Computational Vision and Biomechanics*, 1(1):55–67, 2008.
- [17] G. Peyre and S. Mallat. Orthogonal bandlet bases for geometric images approximation. *Communications on Pure and Applied Mathematics*, 61(9):1173–1212, 2008.
- [18] S. Mallat and G. Peyre. A review of bandlet methods for geometrical image representation. *Numerical Algorithms*, 44(3):205–234, 2007.
- [19] G. Peyre and L. D. Cohen. Geodesic remeshing using front propagation. *Int. J. Comput. Vision*, 69(1):145–156, 2006.
- [20] G. Peyre and S. Mallat. Surface compression with geometric bandelets. *ACM Transactions on Graphics*, 24(3):601–608, July 2005.

## Preprints

- [21] C. Dossal, M.L. Chabanol, G. Peyre, and J. Fadili. Sharp support recovery from noisy random measurements by l1 minimization. Technical report, 2011.
- [22] G. Peyre and J. Fadili. Learning analysis sparsity priors. Technical report, 2010.
- [23] G. Peyre. A review of adaptive image representations. Technical report, 2010.
- [24] G. Peyre. The numerical tours of signal processing - advanced computational signal and image processing. Technical report, 2010.
- [25] J. Rabin, G. Peyre, J. Delon, and M. Berton. Wassertein barycenter and its applications to texture mixing. Technical report, 2010.
- [26] L. Jacques, L. Duval, C. Chaux, and G. Peyre. A panorama on multiscale geometric representations, intertwining spatial, directional and frequency selectivity. Technical report, 2010.
- [27] G. Peyre, S. Bougleux, and L. D. Cohen. Non-local regularization of invers problems. Technical report, 2009.
- [28] A. Ion, N. M. Artner, G. Peyre, W. G. Kropatsch, and L. D. Cohen. Matching 2d and 3d articulated shapes using eccentricity. Technical report, 2009.
- [29] M. Pechaud, G. Peyre, and R. Keriven. Extraction of vessels networks over an orientation domain. Technical report, 2009.

## Books

- [30] G. Peyre. *L'algebre discrete de la transformee de Fourier*. editions Ellipses Marketing, 2004.
- [31] V. Beck, J. Malick, and G. Peyre. *Objectif Agregation, 2nd edition*. editions H et K,, 2004.

## Proceedings of Conferences in English

- [32] J. Rabin, G. Peyre, and L. D. Cohen. Geodesic shapes and surfaces retrieval via optimal mass transport. In *Proc. of ECCV'10*, 2010.
- [33] T. Oleskiw, G. Peyre, and J. Elder. On growth and formlets: Sparse multi-scale coding of planar shape. In *Proc. of CVPR'10*. IEEE, June 2010.
- [34] N. Schmidt, G. Peyre, Y. Fregnac, and P. E. Roland. Separation of traveling waves in cortical networks using optical imaging. In *Proc. of ISBI'10*, April 2010.
- [35] N. Ouarti and G. Peyre. Best basis denoising with non-stationary wavelet packets. In *Proc. of ICIP'09*, pages 3825–3828, November 2009.
- [36] J. Fadili and G. Peyre. Total variation projection with first order schemes. In *Proc. of ICIP'09*, pages 1325–1328, November 2009.
- [37] C. Dossal, G. Peyre, and J. Fadili. Challenging restricted isometry constants with greedy pursuit. In *Proc. of ITW'09*, pages 475–479, October 2009.
- [38] S. Bougleux, G. Peyre, and L. D. Cohen. Image compression with anisotropic geodesic triangulations. In *Proc. of ICCV'09*, pages 2343–2348, October 2009.
- [39] P. Maurel, J-F. Aujol, and G. Peyre. Locally parallel textures modeling with adapted hilbert spaces. In *Proc. of EMMCVPR'09*, volume 5681/2009, pages 429–442. Springer LNCS, September 2009.
- [40] M. Pechaud, G. Peyre, and R. Keriven. Extraction of tubular structures over an orientation domain. In *Proc. of CVPR'09*, pages 336–342. IEEE, 2009.
- [41] C. Dossal, G. Peyre, and J. Fadili. A numerical exploration of compressed sampling recovery (conf. version). In *Proc. of SPARS'09*, 2009.
- [42] S. Bougleux, G. Peyre, and L. D. Cohen. Anisotropic geodesics for perceptual grouping and domain meshing. In D. A. Forsyth, P. H. S. Torr, and A. Zisserman, editors, *Proc. of ECCV'08*, volume 5303 of *Lecture Notes in Computer Science*, pages 129–142. Springer, 2008.
- [43] G. Peyre, S. Bougleux, and L. D. Cohen. Non-local regularization of inverse problems. In D. A. Forsyth, P. H. S. Torr, and A. Zisserman, editors, *Proc. of ECCV'08*, volume 5304 of *Lecture Notes in Computer Science*, pages 57–68. Springer, 2008.
- [44] A. Ion, N. M. Artner, G. Peyre, S. B. L. Marmol, W. G. Kropatsch, and L. D. Cohen. 3d shape matching by geodesic eccentricity. In *Proc. of Search in 3D*, pages 1–8, 2008.
- [45] G. Peyre. Dynamic texture synthesis with grouplets. In *Proc. of MAPMO*, pages 103–117, 2009.
- [46] G. Peyre, J. Fadili, and J-L. Starck. Learning adapted dictionaries for geometry and texture separation. In *Proc. of SPIE Wavelet XII*, volume 6701, page 67011T, 2007.
- [47] G. Peyre, E. LePennec, C. Dossal, and S. Mallat. Geometric estimation with orthogonal bandlet bases. In *Proc. of SPIE Wavelet XII*, pages 67010M.1–67010M.10, 2007.

- [48] A. Ion, G. Peyre, Y. Haxhimusa, S. Peltier, W. G. Kropatsch, and L. D. Cohen. Shape matching using the geodesic eccentricity transform - a study. In *Proc. of OAGM'07*, 2007.
- [49] G. Peyre. Non-negative sparse modeling of textures. In F. Sgallari, A. Murli, and N. Paragios, editors, *Proc. of SSVM'07*, volume 4485 of *Lecture Notes in Computer Science*, pages 628–639. Springer, 2007.
- [50] G. Peyre. Best basis compressed sensing (conf. version). In F. Sgallari, A. Murli, and N. Paragios, editors, *Proc. of SSVM'07*, volume 4485 of *Lecture Notes in Computer Science*, pages 80–91. Springer, 2007.
- [51] G. Peyre. Texture synthesis and modification with a patch-valued wavelet transform. In F. Sgallari, A. Murli, and N. Paragios, editors, *Proc. of SSVM'07*, volume 4485 of *Lecture Notes in Computer Science*, pages 640–651. Springer, 2007.
- [52] G. Peyre. Random sensing of geometric images. In *Neurocomp'06*, pages 91–94, 2006.
- [53] G. Peyre and L. D. Cohen. Landmark-based geodesic computation for heuristically driven path planning. In *Proc. of CVPR'06*, pages 2229–2236. IEEE Computer Society, 2006.
- [54] G. Peyre and L. D. Cohen. Heuristically driven front propagation for geodesic paths extraction. In N. Paragios, O. D. Faugeras, T. Chan, and C. Schnörr, editors, *Proc. of VLSM'05*, volume 3752 of *Lecture Notes in Computer Science*, pages 173–185. Springer, 2005.
- [55] G. Peyre and L. D. Cohen. Geodesic computation for adaptive remeshing. In *Proc. of CVPR'05 (video)*, page 1193. IEEE Computer Society, 2005.
- [56] G. Peyre and L. D. Cohen. Surface segmentation using geodesic centroidal tessellation. In *Proc. of 3DPVT'04*, pages 995–1002. IEEE Computer Society, 2004.
- [57] G. Peyre and S. Mallat. Discrete bandelets with geometric orthogonal filters. In *Proc. of ICIP'05*, pages 65–68, 2005.
- [58] G. Peyre and L. D. Cohen. Geodesic re-meshing and parameterization using front propagation. In *Proc. of VLSM'03*, pages 33–40, 2003.

### Book Chapters

- [59] G. Peyre. *MATAPLI*, volume 94, chapter Un exploration numérique du traitement des signaux, des images et des surfaces. SMAI, 2011.
- [60] G. Peyre and L. D. Cohen. *Advances in Computational Vision and Medical Image Processing: Methods and Applications*, volume 13, chapter Geodesic Methods for Shape and Surface Processing, pages 29–56. Springer, 2008.
- [61] G. Peyre and L. D. Cohen. *Progress in Nonlinear Differential Equations and Their Applications*, volume 63, chapter Geodesic Computations for Fast and Accurate Surface Remeshing and Parameterization, pages 157–171. Springer, 2005.
- [62] S. Mallat and G. Peyre. *Journee annuelle de la SMF*, chapter Traitement geometrique des images par bandelettes. SMF, june 2006.
- [63] G. Peyre. Advanced signal and image processing, 2010.
- [64] G. Peyre. A numerical tour of signal processing, 2010.

## Proceedings of Conferences in French

- [65] G. Peyre and J. Fadili. Algorithmes de premier ordre pour la projection sur une contrainte de variation totale. In *Gretsi'09*, October 2009.
- [66] P. Maurel, J.F. Aujol, and G. Peyre. Extraction de textures localement paralleles par un espace de hilbert adapte. In *Gretsi'09*, October 2009.
- [67] S. Bogleux, G. Peyre, and L. D. Cohen. Compression d'images par triangulations geodesiques anisotropes. In *Gretsi'09*, October 2009.
- [68] C. Dossal, G. Peyre, and J. Fadili. Une exploration numerique des performances de l'echantillonnage compresse. In *Gretsi'09*, October 2009.
- [69] C. Dossal and G. Peyre. Critère d'identifiabilite pour la minimisation l1. In *Gretsi'07*, 2007.
- [70] G. Peyre, J. Fadili, and J-L. Starck. Apprentissage de dictionnaires parcimonieux adaptes pour la separation d'images. In *Gretsi'07*, 2007.
- [71] E. LePennec, C. Dossal, and G. Peyre. Estimation geometrique d'images et bases de bandelettes orthogonales. In *Gretsi'07*, 2007.
- [72] G. Peyre and L. D. Cohen. Remaillage geodesique par propagation de fronts. In *RFIA'04*, 2004.