

Pascal Monasse, PhD

Contact information

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Education

PhD in Mathematics

University Paris IX, September 1996 - June 2000

Master degree of mathematics (numerical analysis)

University Paris VI, Septembre 1994 - June 1995

Engineer degree

École Nationale des Ponts et Chaussées, Septembre 1991 - June 1995

Professional experience

[Sept. 2008 - Present] Research scientist, IMAGINE/LIGM, École des Ponts Paris-Tech, Université Paris-Est, France

- Scientific adviser to seven PhD students in computer vision.
- Work on computer vision, all aspects of 3-D stereo reconstruction
- Coordinator of ANR grant (ANR-09-CORD-003), project Callisto (326 k€)

[Sept. 2007 - Aug. 2008] Research scientist, CMLA, Ecole Normale Supérieure de Cachan, France

- Scientific advisor to two PhD students in image processing
- Participant of CNES project MISS, *high resolution satellite stereo imaging concerning all aspects of 3D reconstruction*

[**Sept. 2001 - July 2007**] Junior researcher (until 2004) then Senior researcher (leader of a team of three PhD researchers) at Cognitech Inc., Pasadena, California

- *Accurate, georeferenced topographic mosaic reconstruction from airborne video*: Principal Investigator with Dr. Lenny Rudin for this DARPA contract (GeoSpatial Representation and Analysis), phase I and II completed (contract of 3 M\$).
- Technical leader for development of *Cognitech GeoMeasure software, allowing automatic construction of planar mosaics from high-altitude airborne video (with optional use of GPS and inertial data)*, leadership of three programmers. This software was developed for the National Geospatial intelligence Agency (NGA), the US federal mapping agency, responsible among other tasks for technical maintenance of GPS (contract of 200 k\$).
- *Localization and tracking of airborne video in large database image*: scientific leader for this contract (400 k\$) for the US Navy (Naval Airfare Weapons Center, China Lake).
- *Real-time photogrammetric method for landing of UAV from video*, DARPA contract reserved for small business, phases I and II completed (contract of 1 M\$).
- *Photogrammetric 3-D reconstruction from stereo pairs*, US Navy contract (Office of Naval Research).
- Internal research for *Cognitech VideoInvestigator* software in image and video registration, photogrammetry, camera calibration, detection... This software is used by FBI, Scotland Yard, French Gendarmerie Nationale, the Hong Kong police, LAPD, NASA, US Navy, National Geospatial intelligence Agency...

[**July 2000 - Aug. 2001**] Research scientist at CMLA, ENS Cachan, France

- Development of a fast algorithm for extraction of continuous level lines in an image.
- Research in motion estimation in video with techniques of maximal flows in graphs.

[**Sept. 1995 - June 1996**] Military service as scientist at Matra Cap Systèmes, France. Development of a software kernel for image processing applications.

[**Apr. 1995 - Sept. 1995**] MSc internship at Laboratoire de Météorologie Dynamique, ENS Paris, France. Construction of wavelet bases on the interval with prescribed boundary conditions for solving PDE.

[**Apr. 1990 - June 1990**] Engineering internship class at Credome, Paris (group Publicis) on statistical optimization of commercials.

Research interests

- Computer vision
- Image processing

Prizes and awards

- Best student short paper for Pierre Moulon at the 10th European Conference on Visual Media Production (2013).
- Winner with IMAGINE group of ProVisG Mars 3D Challenge (2011), “testing and improving the state of the art in visual odometry and 3D terrain reconstruction in planetary exploration”, <http://www.provisg.eu/news/PROVisG-Mars-3D-Challenge>
- Cognitech’s PixL2GPS software (for dense GPS tagging of video frames) is the winner in the Aerospace, Defense and Security category for the American Technology Awards “The Termans” (2010) delivered by the TechAmerica Foundation. I was the scientific leader and main developer in this software product.
- “Top performer” at DARPA workshop (2007) ahead of teams of UCLA, Rensselaer Polytechnic Institute, University of Santa Barbara, University of North Carolina, University of South Carolina...
- Best paper award (1999) at the Second International Conference on Scale-Space Theories in Computer Vision, Corfu, Greece

Scientific publications

Book

1. Caselles, V. and Monasse, P. (2010). *Geometric description of images as topographic maps*. Number 1984 in Lecture Notes in Mathematics. Springer.

Book chapters

2. Dibos, F., Koepfler, G., and Monasse, P. (2003). *Total variation minimization for scalar/vector regularization*. In *Geometric Level Set Methods in Imaging, Vision and Graphics*. S. Osher and N. Paragios, eds., pages 121–140, Springer
3. Dibos, F., Koepfler, G., and Monasse, P. (2003). *Image Alignment*. In *Geometric Level Set Methods in Imaging, Vision and Graphics*. S. Osher and N. Paragios, eds., pages 271–295, Springer

Patents

4. Rudin, L.I., Mus, P., and Monasse, P. (2012). *System and method for pattern detection and camera calibration*. USPTO patent #8,106,968
5. Rudin, L.I., Morel, J.M., Monasse, P., and Cao, F. (2011). *System and method for three-dimensional estimation based on image data*. USPTO patent #8,014,588
6. Rudin, L.I., Lisani, J.L., Monasse, P., and Morel, J.M. (2009). *Object recognition based on 2D images and 3D models*. USPTO patent #7,587,082

Peer-reviewed journals

7. Moisan, L., Moulon, P. and Monasse, P. (2016) Fundamental matrix of a stereo pair, with a contrario elimination of outliers *Image Processing On Line*, 6:89–113. DOI: <https://doi.org/10.5201/ipol.2016.147>
8. Fernández Julià, L. and Monasse, P. (2015). Bilaterally weighted patches for disparity map computation. *Image Processing On Line*, 5:73–89. DOI: <http://dx.doi.org/10.5201/ipol.2015.123>
9. Xu, Y., Monasse, P., Géraud, T., and Najman, L. (2014). Tree-Based Morse Regions: A Topological Approach to Local Feature Detection. *IEEE Transactions on Image Processing*, 23(12):5612–5625
10. Tan, P. and Monasse, P. (2014). Stereo disparity through cost aggregation with guided filter. *Image Processing On Line*, 4:252–275. DOI: <http://dx.doi.org/10.5201/ipol.2014.78>
11. Kolmogorov, V., Monasse, P., and Tan, P. (2014). Kolmogorov and Zabih's graph cuts stereo matching algorithm. *Image Processing On Line*, 4:220–251. DOI: <http://dx.doi.org/10.5201/ipol.2014.97>
12. Tang, Z., Grompone von Gioi, R., Monasse, P., and Morel, J.-M. (2012). High-precision camera distortion measurements with a “calibration harp”. *Journal of the Optical Society of America A*, 29(10):2134–2143
13. Moisan, L., Moulon, P., and Monasse, P. (2012). Automatic homographic registration of a pair of images, with a contrario elimination of outliers. *Image Processing On Line*, 2:56–73. DOI: <http://dx.doi.org/10.5201/ipol.2012.mmm-oh>
14. Ciomaga, A., Monasse, P., and Morel, J.-M. (2011). Image visualization and restoration by curvature motions. *Multiscale Modeling and Simulation*, 9:834.

15. Monasse, P. (2011). Quasi-Euclidean epipolar rectification. *Image Processing On Line* DOI: http://dx.doi.org/10.5201/ipol.2011.m_qer
16. Caselles, V., Meinhardt, E., and Monasse, P. (2007). Constructing the tree of shapes of an image by fusion of the trees of connected components of upper and lower level sets. *Positivity*, Birkhäuser, 12(1):55–73
17. Ballester, C., Caselles, V., and Monasse, P. (2003) The Tree of Shapes of an Image. *ESAIM: Control, Optimisation and Calculus and Variations*, 9:1–18
18. Caselles, V., and Monasse, P. (2003). Grain filters. *Journal of Mathematical Imaging and Vision*, 17(3):249–270
19. Monasse, P., and Guichard, F. (2000). Scale-space from a level lines tree. *Journal of Visual Communication and Image Representation*, 11:224–236
20. Monasse, P., and Guichard, F. (2000). Fast computation of a contrast invariant image representation. *IEEE Transactions on Image Processing*, 9(5):860–872
21. Monasse, P., and Perrier, V. (1998). Orthonormal wavelet bases adapted for partial differential equations with boundary conditions. *SIAM Journal of Mathematical Analysis*, 29(4):1040–1065

Proceedings in refereed conferences

22. Barbanson, C., Almansa, A., Ferrec, Y., and Monasse, P. (2016) Relief computation from images of a Fourier transform spectrometer for interferogram correction *Fourier Transform Spectroscopy, in Proceedings of the OSA conference Light, Energy and the Environment*
23. Salaün, Y., Marlet, R., and Monasse, P. (2016) Robust and accurate line- and/or point-based pose estimation without manhattan assumptions *Proceedings of the European Conference on Computer Vision (ECCV)*, pp. 801–818
24. Colom, M., Kerautret, B., Limare, N., Monasse, P., and Morel, J.-M. (2015) IPOL: a new journal for fully reproducible research; analysis of four years development *Proceeding of the 7th IEEE International Conference on New Technologies, Mobility and Security (NTMS)*, pages 1–5
25. Tang, Z., Monasse, P., and Morel, J.-M. (2015) Improving the matching precision of SIFT In *Proceedings of the IEEE International Conference on Image Processing (ICIP)*, pages 5756–5760

26. Liu, Z., Monasse, P., and Marlet, R. (2014). Match selection and refinement for highly accurate two-view structure from motion. In *Proceedings of the 13th European Conference on Computer Vision (ECCV)*, number 8690 in Lecture Notes in Computer Science, pages 818–833. Springer.
27. Tang, Z. and Monasse, P. and Morel, J.-M. (2014). Reflexive symmetry detection in single image. In *Proceedings of the 8th International Conference Curves and Surfaces*, number 9213 in Lecture Notes in Computer Science. Springer.
28. Rudakova, V. and Monasse, P. (2014). Camera matrix calibration using circular control points and separate correction of the geometric distortion field. In *Proceedings of the 11th Conference for Computer and Robot Vision (CRV)*. IEEE.
29. Espuny, F., Monasse, P., and Moisan, L. (2014). A new a contrario approach for the robust determination of the fundamental matrix. In Huang, F. and Sugimoto, A., editors, *Proceedings of the PSIVT 2013 Workshop on Geometric Computation for Computer Vision (GCCV)*, number 8334 in Lecture Notes In Computer Science, pages 181–192. Springer.
30. Rudakova, V. and Monasse, P. (2014). Precise correction of lateral chromatic aberration in images. In Klette, R., Rivera, M., and Satoh, S., editors, *Proceedings of the 6th Pacific-Rim Symposium on Image and Video Technology (PSIVT 2013)*, volume 8333 of *Lecture Notes in Computer Science*, pages 12–22. Springer.
31. Espuny, F. and Monasse, P. (2014). Singular vector methods for fundamental matrix computation. In Klette, R., Rivera, M., and Satoh, S., editors, *Proceedings of the 6th Pacific-Rim Symposium on Image and Video Technology (PSIVT 2013)*, volume 8333 of *Lecture Notes in Computer Science*, pages 290–301. Springer.
32. Moulon, P., Monasse, P., and Marlet, R. (2013). Global fusion of relative motions for robust, accurate and scalable structure from motion. In *Proceedings of the International Conference on Computer Vision (ICCV)*, pages 3248–3255. Springer.
33. Moulon, P., Monasse, P., and Marlet, R. (2012). Adaptive structure from motion with a contrario model estimation. In *Proceedings of the IEEE Asian Conference on Computer Vision (ACCV)*, pages 257–270. Springer.
34. Grompone von Gioi, R., Monasse, P., Morel, J.-M., and Tang, Z. (2011). Lens distortion correction with a calibration harp. In *Proceedings of the 18th IEEE International Conference on Image Processing (ICIP)*, pages 617–620. IEEE.
35. Grompone von Gioi, R., Monasse, P., Morel, J.-M., and Tang, Z. (2010). Towards high-precision lens distortion correction. In *Proceedings of the*

- 17th IEEE International Conference on Image Processing (ICIP)*, pages 4237–4240. IEEE.
36. Ciomaga, A., Monasse, P., and Morel, J.-M. (2010). Level lines shortening yields an image curvature microscope. In *Proceedings of the 17th IEEE International Conference on Image Processing (ICIP)*, pages 4129–4132. IEEE.
 37. Monasse, P., Morel, J.-M., and Tang, Z. (2010). Three-step image rectification. In *Proceedings of the British Machine Vision Conference (BMVC)*, pages 89.1–89.10. BMVA Press.
 38. Aganj, E. and Monasse, P. (2009). Multi-view texturing of imprecise mesh. In *Proceedings of Asian Conference on Computer Vision (ACCV)*, pages 468–476. Springer.
 39. Courchay, J., Keriven, R., Monasse, P., and Pons, J.P. (2009). Dense and accurate spatio-temporal multi-view stereovision. In *Proceedings of Asian Conference on Computer Vision (ACCV)*, pages 11–22. Springer.
 40. Monasse, P. and Rudin, L., and Cao, F. (2007). Super-dense digital terrain elevation reconstruction through method of epipolar characteristics. In *Proceedings of Annual Conference of the American Society of Photogrammetry and Remote Sensing (ASPRS)*, volume 2, pages 429–439. Curran Associates, Inc.
 41. Rudin, L., Monasse, P., and Yu, P. (2005). Geometrical methods for accurate forensic videogrammetry, part II. Reducing complexity of Cartesian scene measurements via epipolar registration. In *SPIE Conference on Image and Video Communications and Processing*, volume 3, pages 272–283. International Society for Optics and Photonics.
 42. Rudin, L., Monasse, P., and Yu, P. (2005). Epipolar photogrammetry: a novel method for forensic image comparison and measurement. In *Proceedings of IEEE International Conference on Image Processing (ICIP)*, volume 3, pages 385–388.
 43. Lisani, J.L., Rudin, L., Monasse, P., Morel, J.M., and Yu, P. (2005). Meaningful automatic video demultiplexing with unknown number of cameras, contrast changes, and motion. In *Proceedings of IEEE Conference on Advanced Video and Signal Based Surveillance (AVSS)*, pages 604–608. IEEE.
 44. Lisani, J.L., Moisan, L., Monasse, P., and Morel, J.-M. (2000). Affine invariant mathematical morphology applied to a generic shape recognition algorithm. In *Proceedings of International Symposium of Mathematical Morphology (ISMM)*, volume 18, pages 91–98. Springer.
 45. Monasse, P. (1999). Contrast invariant registration of images. In *Proceedings of International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, volume 6, pages 3221–3224. IEEE.

Other publications

46. Moulon, P., Duisit, B., and Monasse, P. (2013). Global multiple view color consistency. *The 10th European Conference on Visual Media Production (CVMP)*.
47. Moulon, P. and Monasse, P. (2012). Unordered feature tracking made fast and easy. *The 9th European Conference on Visual Media Production (CVMP)*.
48. Monasse, P. and Perrier, V. (1995). Ondelettes sur l'intervalle pour la prise en compte de conditions aux limites. In *Comptes Rendus de l'Académie des Sciences*, Paris, I(312), pages 405-410.

Invited talks

49. *Image Processing On Line for reproducible research*, ICPR Workshop on Reproducible Research in Pattern Recognition, Cancún, Mexico, December 2016
50. “*Visualizing level lines and curvature in images*”, Computational Photography and Intelligent Cameras, IPAM, UCLA, February 2015
51. “*Calcul de courbures dans les images*”, plenary speaker at the MOCASIM Conference, Marrakesh, Morocco, November 2014
52. “*Geometric description of images as topographic maps*”, CEREMADE seminar, University Paris Dauphine, July 2013
53. “*Analyse topologique et visualisation des ensembles de niveau d'image*”, colloquium Mathématiques pour l'image, Orléans, France, June 2012
54. “*A geometric scheme for affine shortening and application to image curvature microscope*”, workshop Geometric flows in finite or infinite dimension, CIRM, Luminy, France, March 2011
55. “*Les images vues comme cartes topographiques*”, seminary Mthodes mathématiques du traitement d'images, University Pierre et Marie Curie, November 2010
56. “*Les mathématiques dans le traitement d'image et la vision tridimensionnelle*”, Maths Club, University Paris Diderot, April 2010
57. “*Représentation auto-duale d'une image en lignes de niveau*”, colloquium Morphologie mathématique: structures et connexions, in honor of Jean Serra's 70th anniversary, ESIEE, Marne-la-Vallée, France, April 2010

58. *“Filtrage des images par mouvements par courbure et filtrages non réguliers*, colloquium Image, EDP et Géométrie, Institut Fourier, Grenoble, France, December 2009
59. *“Geometric Description of Images as Topographic Maps”*, Lecture Series in Pattern Recognition, Institute of Automation, Chinese Academy of Sciences, Beijing, September 2009
60. *“Advances in algorithms and software tools for automatic geo-mosaic/geo-TIFF creation from video sensors”*, closed DARPA workshop on Geospatial Representation and Analysis, Arlington, Virginia, October 2007
61. *“Automatic 2-D and 3-D Georeferencing and Mosaicing from Video”*, closed DARPA workshop on Geospatial Representation and Analysis, Coeur d’Alene, Idaho, April 2007
62. *“Automatic 2-D and 3-D Georeferencing and Mosaicing from Video”*, closed DARPA workshop on Geospatial Representation and Analysis, Boothbay Harbor, Maine, August 2006
63. *Remote video-sensing of 3-D geometry through method of epipolar characteristics with cognitech’s sky-scanner*, closed DARPA workshop on Geospatial Representation and Analysis, Snoqualmie Falls, Washington, April 2006
64. *Computation theory for dense meaningful topographic mosaics*, closed DARPA workshop on Geospatial Representation and Analysis, San Diego, California, November 2005
65. Closed DARPA workshop on Geospatial Representation and Analysis, Savannah, Georgia, March 2005
66. Closed DARPA workshop at Office of Naval Research (US Navy), Washington, D.C., March 2003
67. *“Représentation morphologique d’images numériques et applications”*, seminary Algorithmique et Programmation, CIRM, Luminy, France, May 2001
68. *“Morphological representation of images and application to registration”*, lecture at School on Mathematical Problems in Image Processing, International Center for Theoretical Physics, Trieste, Italy, 2000

Service to the scientific community

Editorial activities

- Associate editor for the journal Image Processing On Line

Journal reviewer

- IEEE Transactions on Pattern Analysis and Machine Intelligence
- SIAM Multiscale Modeling and Simulation
- IEEE Transactions on Image Processing
- IEEE Transactions on Circuits and Systems for Video Technology
- Journal of Mathematical Imaging and Vision
- IEEE Signal Processing Letters
- Birkhäuser Journal of Evolution Equations
- Elsevier Image and Vision Computing
- Elsevier Journal of Visual Image Communication & Representation
- Elsevier Pattern Recognition
- Image Processing On Line
- Computer Vision and Image Understanding
- Journal of the Optical Society of America A
- Journal of Graphics Tools
- Journal of Selected Topics in Signal Processing
- IET Computer Vision
- GRETSI Traitement du Signal

Program committee at conferences

- International Conference on 3D Vision (2016)
- IEEE Asian Conference on Computer Vision (2016)
- IAPR International Conference of Pattern Recognition (2016)
- IEEE European Conference on Computer Vision (2016)
- IEEE Conference on Computer Vision and Pattern Recognition (2016)
- International Conference on 3D Vision (2015)
- IEEE International Conference on Computer Vision (2015)
- International Symposium on Mathematical Morphology (2015)
- Computer Vision and Pattern Recognition (2015)

- IEEE Asian Conference on Computer Vision (2014)
- International Conference on Pattern Recognition (2014)
- IEEE European Conference on Computer Vision (2014)
- Computer Vision and Pattern Recognition (2014)
- IEEE International Conference on Computer Vision (2013)
- IEEE Conference on Computer Vision and Pattern Recognition (2013)
- IEEE Asian Conference on Computer Vision (2012)
- IEEE European Conference on Computer Vision (2012) workshop on “Unsolved Problems in Optical Flow and Stereo Estimation”
- IEEE International Conference on Computer Vision (2011)
- IEEE European Conference on Computer Vision (2010)

PhD advisor

- Zhongwei Tang (2007-2011): co-direction with Jean-Michel Morel (50%), “High accuracy measurement in 3D stereo reconstruction”
- Pierre Moulon (2010-2014): co-direction with Renaud Marlet (50%), “Positionnement robuste et précis de réseaux d’images”
- Victoria Rudakova (2010-2014), “Vers l’étalonnage interne de caméra à haute précision”
- Zhe Liu (2011-2015): co-direction with Renaud Marlet (50%), “Robust, refined and selective matching for accurate camera pose estimation”
- Pauline Tan (2013-2016): co-direction with Antonin Chambolle (50%), “Précision de modèle et efficacité algorithmique : exemples du traitement de l’occultation en stéréovision binoculaire et de l’accélération de deux algorithmes en optimisation convexe”
- Yohann Salaun (2013-): co-direction with Renaud Marlet (50%)
- Bruno Conejo (2013-): co-direction with Jean-Philippe Avouac (50%)
- Laura Fernández Julià (2014-): co-direction with Marc Pierrot-Desseilligny (50%)
- Thibaud Briand (2014-): co-direction with Jean-Michel Morel (50%)

PhD committees

- Souleymane Kadri-Harouna “Ondelettes pour la prise en compte de conditions aux limites en turbulence incompressible”, INPG, Grenoble, France, September 13, 2010
- Eric Bughin “Vers une vectorisation automatique, précise et validée en stéréoscopie satellitaire en milieu urbain”, ENS Cachan, France, October 26, 2011
- Gui-Song Xia “Some geometric methods for the analysis of images and textures”, Telecom ParisTech, France, March 18, 2011
- Narut Soontranon “Appariement entre images de point de vue éloignés par utilisation de carte de profondeur”, Université de Picardie Jules Verne, France, October 21, 2013
- Yongchao Xu, “Tree-based shape spaces for applications in image processing and computer vision”, Université Paris Est, France, December 12, 2013
- Cyrielle Guérin, “Génération de modèles numériques de surface et détection de changements 3D à partir d’imagerie satellite stéréoscopique très haute résolution”, Université Paris Descartes, February 18, 2014 (reviewer)
- Baptiste Mazin, “Méthodes robustes pour l’estimation d’illuminants et la prise en compte de la couleur en comparaison d’images”, Telecom ParisTech, March 28, 2014 (reviewer)
- Carlo de Franchis, “Earth observation and stereo vision”, ENS Cachan, France, October 5, 2015 (reviewer)
- Edwin Carlinet, “A tree of shapes for multivariate images”, Université Paris-Est, November 27, 2015
- Vincent Tournadre, “Métrologie par photogrammétrie aéroportée légère, application au suivi d’évolution de digues”, Université Paris-Est, December 21, 2015

HDR committees

- Beatriz Marcotegui, “Contributions la segmentation d’image et de nuages de points. Application l’analyse de scnes urbaines”, Universit Blaise Pascal, October 9, 2015 (chairman of the committee)
- Gabriele Facciolo, “Geometry-aware patch modelling for 3D reconstruction and image denoising”, June 21, 2016

Teaching

- “Programming workshop”, March 2016 - April 2016, lecturer at École des Ponts ParisTech (15h)
- “Introduction to algorithmics”, Feb. 2016 - March 2016, coordinator and lecturer at École des Ponts ParisTech (2×30h)
- “Introduction to programming”, Sept. 2015 - Jan. 2017, coordinator and lecturer at École des Ponts ParisTech (2×30h)
- “3D computer vision”, Oct. 2014 - Nov. 2016, lecturer at master level at PSL-ITI (3×10h)
- “Algorithmics and Programmation”, Oct. 2009 - Mar. 2015, coordinator and lecturer for a course on computer science for all 140 undergraduate engineering students at École des Ponts ParisTech (6×70h)
- “Algorithmics and Programmation”, Oct. 2008 - Mar. 2009, lecturer for undergraduate engineering students at École des Ponts ParisTech (70h)
- “Modelling, Programmation and Simulation”, Oct. 2008 - Nov. 2016, lectures on advanced C++ programming for undergraduate engineering students at École des Ponts ParisTech (9×12h)
- “Vision and 3D reconstruction”, Oct. 2009 - Nov. 2016, lectures on computer vision for MSc Mathématiques, Vision, Apprentissage, Paris (8×15h)
- Oct. 1999, Tutorials of image processing for postgraduate students, Mathematisches Forschungsinstitut, Oberwolfach, Germany.
- Sept. 1997 - June 1999: Tutorials on optimization, differential calculus and calculus of variations, to undergraduate engineering students at the Ecole Nationale Supérieure des Mines de Paris.
- Sept. 1996 - June 1997: Tutorials of mathematical analysis (University Paris 9) and linear algebra (University Paris 8) to junior undergraduate students.
- Sept. 1992 - May 1993: Oral training in mathematics in Mathématiques Spéciales M, lycée Louis-le-Grand, Paris.