Nelly PUSTELNIK

CNRS researcher
Laboratoire de Physique de l'Ens de Lyon
46, allée d'Italie – 68007 Lyon, FRANCE
(+33)4 72 72 86 49
nelly.pustelnik@ens-lyon.fr
http://perso.ens-lyon.fr/nelly.pustelnik
Nationality: French
Born: 12-11-1984

Biography

2011 – now **CNRS researcher** – CR1 (since 2016) – Laboratoire de Physique, UMR CNRS 5672
Ens de Lyon, France
(Team: Signals, Systems, and Physics)

2010 – 2011 **Post-Doc position** – Laboratoire IMS, UMR CNRS 5218
Université Bordeaux, France
(Team: Signal and Image processing)

2007 – 2010 **PhD** – Laboratoire d'Informatique Gaspard Monge, UMR CNRS 8049
Université Paris-Est, France
(Team: Signal and Communication, Advisors: J.-C. Pesquet and C. Chaux)

Main contributions

Optimization

- **Proximal algorithms**: deal with non-Lipschitz function by means of a minorant approximation, epigraphical projection aiming to deal with a large class of non-linear convex constraints using piecewise constant minorant, PPXA+ algorithm providing a generalization of several proximal algorithms and allowing us to integrate inertial terms, compute proximity operator of a sum of two functions.
- **On-the-fly algorithm**: detect multivariate change-point.
Collaborations with J.C Pesquet (LIGM, Paris) and L. Condat (Gipsalab, Grenoble).

Design convex criterion to extract information in signals/images/graphs

- **Multifractal analysis**: joint estimation of the local regularity and regression weights by means of total variation and wavelet leaders.
Collaboration with H. Wendt (IRIT) and P. Abry (LPENSL) .
- **Spectral analysis**: revisit the empirical mode decomposition by means of multicomponent formulation, ℓ_1-norm and constraints over the extremum. Highlight relations with texture-geometry decomposition. Extension to image analysis.
Collaboration with P. Flandrin (LPENSL) and P. Borgnat (LPENSL).
- **Image restoration**: incorporate noise prior to derive efficient reconstruction strategies in Positron Emission Tomography and in Structured Illumination Microscopy.
Collaborations with C. Comtat (CEA) and J. Boulanger (Institut Curie).

Publications summary

➤ Accepted/published international journals: 16
➤ International conferences: 32
➤ National journal: 1
➤ National conferences: 6
➤ Google Scholar h-index: 12 (613 citations)

PhD students / Post-doctoral students

➤ **Post-doctoral student** (2016): **M. Jiu**, Laboratoire de Physique de l'Ens de Lyon / TOTAL.
Subject: Sparse classification.
Associated publications: 1 international conference (IEEE MLSP).

➤ **PhD student** (2013-2016): **J. Frécon**, Laboratoire de Physique de l'Ens de Lyon.
Co-advisor 50% in collaboration with P. Abry (LPENSL).
Subject: Optimization methods for scale-free process analysis.
Associated publications: 2 international journals (IEEE TSP), 4 international conferences (EUSIPCO 2014, IEEE ICIP 2015, IEEE ICASSP 2016, IEEE IVMSP 2016), 1 submitted journal paper in IEEE TSP, 1 submitted conference paper in IEEE ICASSP 2017. Several MATLAB toolboxes in preparation.

➤ **PhD student** (2012-2015): **G. Chierchia**, Télécom ParisTech.
Co-advisor 50% in collaboration with Pesquet-Popescu (Télécom ParisTech).
Subject: Epigraphical decomposition to deal with non-linear convex constraints. Application to image reconstruction, supervised classification, and anomaly detection.
Associated publications: 2 international journals (IEEE TIP, SIVP), 4 international conferences (IEEE ICASSP 2012, IEEE ICASSP 2013, IEEE ICASSP 2014, SPARS'2015), 1 submitted paper in JMLR, 1 MATLAB toolbox under licence Cecill-B.

➤ **Agrégé préparateur** (2012-2015): **J. Schmitt**, Laboratoire de Physique de l'Ens de Lyon.
Subject: Empirical mode decomposition for image analysis.
Associated publications: 1 international journal (IEEE TIP), 2 international conferences (IEEE ICASSP 2014, EUSIPCO 2015), 1 MATLAB toolbox under licence Cecill-B.

Tutorial/summer school

➤ 2015: **BigOptim summer school**: Monotone operators and convex optimization.
➤ 2014: **Tutorial IEEE ICASSP**: Monotone operators theory for signal and image processing.
➤ 2013: **Peyresq summer school**: Monotone operators theory.

Teaching

➤ 2015-2017: **Introduction to convex optimization**, CPE Lyon, 4th year ETI, 17h.
➤ 2014-2017: **Optimization and networks**, Ens de Lyon, M2 Complex Systems, 14h.
➤ 2014-2017: **Optimization for large scale statistics applied to genomic**, Université Lyon 1, M2 Mathematical Engineering, 8h.
➤ 2013-2016: **Signal processing**, Ens de Lyon, M1 Material Sciences, 24h.
➤ 2007-2010: **Signal and image processing**, 64h/year, Monitorat Université Paris-Est.

Research projects

➤ 2016-2017 **Leader of TOTAL funding**: Predictive model for special fuel manufacturing.
➤ 2015-2016 **Member of Defi IMAG'in OPTIMISME**: Large scale optimisation.
➤ 2014-2017 **Member of ANR GRAPHSIP**: Graph signal processing.
➤ 2013-2015 **Leader of "Projet Jeunes Chercheurs GdR ISIS" – GALILEO**:
Signal/image clustering based on scale invariant analysis and non-smooth optimization.
➤ 2013-2016 **Member of ANR ASTRES**:
Analysis, Synthesis and Transformations by Reassignment, EMD and Synchrosqueezing.
➤ 2012-2013 **Member of PEPS Bio-Maths-Info**:
Proximal algorithms for Structured Illumation Microscopy.
➤ 2007-2010 **Member of ANR OPTIMED**:
Splitting algorithms for solving large size medical imagery problems.

Scientific responsibilities

- ➤ Since 2016 **IEEE SPL Associate Editor.**
- ➤ Since 2016 **IEEE MLSP Technical Commitee.**
- ➤ Since 2015 **EURASIP Signal and Data Analytics for Machine Learning Special Area Team.**
- ➤ Since 2015 **GdR ISIS direction committee** – French research group in signal and image processing.
  Responsable for interactions with other French research groups (GdR).
  Responsable for international relations.
  Responsable of "Gazette du GdR ISIS".
- ➤ Since 2013 **Assistant professor selection committees**
  Recruitment for 5 assistant professor positions in French universities.

Expertise activity

- ➤ **Reviewer for international journals**: IEEE Trans. on Image Processing, IEEE Trans. on Signal Processing, SIAM Journal on Imaging Sciences, Inverse problems (since 2010).
- ➤ **Reviewer for international conferences**: IEEE ICASSP, IEEE ICIP, IEEE ISBI (since 2013).
- ➤ **Area chair**: EUSIPCO 2015 : Signal and image processing applications.
- ➤ **TPC**: EUSIPCO 2012-2014.
- ➤ **Best reviewer award**: EUSIPCO 2014.
- ➤ **Reviewer for ANR**: 2 projects (2015).
- ➤ **Reviewer for PhD funding**: Université de Caen, France (2014).

Conferences/workshops organization

- ➤ **STATOS 2016**: Organizing committee as "Program committee".
- ➤ **IEEE IVMSP 2016**: Organizing committee as "Publication Chair".
- ➤ **IEEE ICIP 2014**: Organizing committee as "IEEE Student Activities Chairs".
- ➤ **GRETSI 2015** (national conference): Organizing committee.
- ➤ **GdR ISIS** (national meetings): Responsable for "Action Optimisation".
  Organization of 6 meetings (since 2014).
- ➤ **SIERRA** (regional meetings): Signal and image processing meetings.
  Organization, webmaster (2013-2015).

Publications

➤ **Accepted/published international journals**

1. G. Michau, N. Pustelnik, P. Borgnat, P. Abry, A. Nantes, A. Bhaskar, E. Chung, "*A primal-dual algorithm for link dependent origin destination matrix estimation*," accepted to **IEEE Transactions on Signal and Information Processing over Networks**, 2016.

2. N. Pustelnik, H. Wendt, P. Abry, N. Dobigeon, "*Local regularity, wavelet leaders and total variation based procedures for texture segmentation*," accepted to **IEEE Trans. on Computational Imaging**, 2016.

3. J. Frecon, G. Didier, N. Pustelnik, and P. Abry, "*Non-Linear Wavelet Regression and Branch and Bound Optimization for the Full Identification of Bivariate Operator Fractional Brownian Motion*," accepted to **IEEE Trans. on Signal Processing**, 2016.

4. J. Spilka, J. Frecon, R. Leonarduzzi, N. Pustelnik, P. Abry, M. Doret, "*Sparse Support Vector Machine for Intrapartum Fetal Heart Rate Classification*," accepted to **IEEE Journal of Biomedical and Health Informatics**, 2016.

5. J. Frecon, N. Pustelnik, P. Abry, and L. Condat, "*Fast and On-the-fly Approximation of Multivariate Total Variation Minimization*," accepted to **IEEE Trans. on Signal Processing**, 2016.

6. N. Pustelnik, A. Benazza-Benhayia, Y. Zheng, J.-C. Pesquet, "*Wavelet-based Image Deconvolution and Reconstruction*," accepted to **Wiley Encyclopedia of Electrical and Electronics Engineering**, 2016. Tutorial paper.

7. G. Chierchia, N. Pustelnik, J.-C. Pesquet, B. Pesquet-Popescu, "*Epigraphical splitting for solving constrained convex formulations of inverse problems with proximal tools*," **Signal, Image and Video Processing**, vol.9, no. 8, pp.1737–1749, Nov. 2015.

8. G. Chierchia, N. Pustelnik, B. Pesquet-Popescu, J.-C. Pesquet, "*A Non-Local Structure Tensor Based Approach for Multicomponent Image Recovery Problems*," **IEEE Trans. Image processing**, Vol. 23, no. 12, pp. 5233–5248, Oct. 2014.

9. J. Schmitt, N. Pustelnik, P. Borgnat, P. Flandrin, and L. Condat, "*A 2-D Prony-Huang Transform: A New Tool for 2-D Spectral Analysis*," **IEEE Trans. Image processing**, Vol. 23, no. 12, pp. 5531–5544, Oct. 2014.

10. C.R. Johnson, P. Messier, W.A. Sethares, A.G. Klein, C. Brown, A.H. Do, P. Klausmeyer, P. Abry, S. Jaffard, H. Wendt, S. Roux, N. Pustelnik, N. van Noord, L. van der Maaten, E. Potsma, J. Coddington, L.A. Daffner, H. Murata, H. Wilhelm, S. Wood, M. Messier, "*Pursuing automated classification of historic photographic papers from raking light photomicrographs*," **Journal of the American Institute for Conservation**, to appear, 2014.

11. N. Pustelnik, P. Borgnat, P. Flandrin "*Empirical Mode Decomposition revisited by multicomponent non smooth convex optimization*," **Signal Processing**, Vol. 102, pp. 313–331, Sept. 2014.

12. Y. Berthoumieu, Ch. Dossal, N. Pustelnik, F. Turcu et Ph. Ricoux, "*An evaluation of the sparsity degree for sparse recovery with deterministic measurement matrices*," **Journal of Mathematical Imaging and Vision**, Vol. 48, pp. 266–278, 2013.

13. J.-C. Pesquet and N. Pustelnik, "*A Parallel Inertial Proximal Optimization Method*," **Pacific Journal of Optimization**, Vol. 8, No. 2, pp. 273–305, Apr. 2012.

14. N. Pustelnik, J.-C. Pesquet, and C. Chaux, "*Relaxing Tight Frame Condition in Parallel Proximal Methods for Signal Restoration*," **IEEE Transactions on Signal Processing**, Vol. 60, No. 2, pp. 968–973, Feb. 2012.

15. N. Pustelnik, C. Chaux, and J.-C. Pesquet, "*Parallel ProXimal Algorithm for image restoration using hybrid regularization*," **IEEE Transactions on Image Processing**, Vol. 20, No. 9, pp. 2450-2462, Sep. 2011.

16. L. M. Briceño-Arias, P. L. Combettes, J.-C. Pesquet, and N. Pustelnik, "*Proximal algorithms for multicomponent image processing*," **Journal of Mathematical Imaging and Vision**, Vol. 41, No. 1, pp. 3-22, Sep. 2011.

➤ **International conferences**

1. G. Chierchia, N. Pustelnik, J.-C. Pesquet "*Random primal-dual proximal iterations for sparse multi-class SVM,*" **IEEE MLSP**, Vietri sul Mare, Salerno, Italy, Sep. 13-16, 2016

2. M. Jiu, N. Pustelnik, M. Chebre, S. Janaqi, P. Ricoux "*Multiclass SVM with graph path coding regularization for face classification,*" **IEEE MLSP**, Vietri sul Mare, Salerno, Italy, Sep. 13-16, 2016.

3. J. Frecon, N. Pustelnik, H. Wendt, L. Condat, and P. Abry "*Multifractal-based texture segmentation using variational procedure,*" **IEEE IVMSP**, Bordeaux, France, Jul., 11-12 2016.

4. J. Frecon, R. Fontugne, G. Didier, N. Pustelnik, K. Fukuda, and P. Abry "*Non-linear regression for bivariate self-similarity identification - Application to anomaly detection in Internet traffic based on a joint scaling analysis of packet and byte counts,*" **IEEE ICASSP**, Shanghai, China, Mar, 20-25 2016.

5. P. Flandrin, N. Pustelnik, P. Borgnat, "*On Wigner-based sparse time-frequency distributions*," **IEEE CAMSAP**, Cancun, Mexico, Dec. 13-16 2015.

6. J. Frecon, N. Pustelnik, H. Wendt, and P. Abry "*Multivariate optimization for multifractal-based texture segmentation,*" **IEEE ICIP**, Quebec City, Canada, Sept, 27-30 2015.

7. J. Schmitt, E. Horne, N. Pustelnik, S. Joubaud, P. Odier "*An improved variational mode decomposition method for internal waves separation,*" **EUSIPCO**, Nice, France, Aug. 31- Sep. 4 2015.

8. J. Spilka, J. Frecon, R.F. Leonarduzzi, N. Pustelnik, P. Abry, M. Doret "*Intrapartum Fetal Heart Rate classification from Trajectory in Sparse SVM feature space,*" **IEEE EMBC**, Milan, Italy, Aug. 25-29 2015.

9. R.F. Leonarduzzi, J. Spilka, J. Frecon, H. Wendt, N. Pustelnik, S. Jaffard, P. Abry, M. Doret "*P-leader multifractal analysis and sparse SVM for intrapartum fetal acidosis detection,*" **IEEE EMBC**, Milan, Italy, Aug. 25-29 2015.

10. G. Chierchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu, "*An Epigraphic Splitting Technique for Sparse Multiclass SVM,*" **SPARS**, Cambridge, UK, July 6-9, 2015.

11. G. Michau, P. Borgnat, N. Pustelnik, P. Abry, A. Nantes, E. Chung, "*Estimating link-dependen origin-destination matrices from sample trajectories and traffic counts*," **IEEE ICASSP**, Brisbane, Australia, April 19-24, 2015

12. N. Pustelnik, P. Abry, H. Wendt, and N. Dobigeon, "*Inverse problem formulation for regularity estimation in images*," **IEEE ICIP**, La Défense, Paris, France, October 27-30, 2014. Top 10% papers.

13. J. Frecon, N. Pustelnik, N. Dobigeon, H. Wendt, and P. Abry, "*Hybrid Bayesian variational scheme to handle parameter selection in total variation signal denoising*," **EUSIPCO**, Lisbon, Portugal, Sept, 1-5 2014.

14. J. Schmitt, N. Pustelnik, P. Borgnat, and P. Flandrin, "*2D Hilbert-Huang Transform*," **IEEE ICASSP**, Florence, Italy, May 4-9, 2014

15. G. Cherchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu, "*Epigraphic proximal projection for sparse Multiclass SVM*," **IEEE ICASSP**, Florence, Italy, May 4-9, 2014.

16. J. Boulanger, N. Pustelnik, L. Condat, "*Non-smooth convex optimization for an efficient reconstruction in structured illumination microscopy*," **IEEE ISBI**, Beijing, China, April 28-May 2, 2014.

17. L. Condat, J. Boulanger, N. Pustelnik, S. Sahnoun, L. Sengmanivong "*A 2-D spectral analysis method to estimate the modulation parameters in structured illumination microscopy*," **IEEE ISBI**, Beijing, China, April 28-May 2, 2014.

18. N. Saulig, N. Pustelnik, P. Borgnat, P. Flandrin, and V. Sucic, "*Instantaneous counting of components in nonstationary signals*," **EUSIPCO**, Marrakech, Morocco, Sept. 9-13, 2013. Invited paper.

19. N. Pustelnik, H. Wendt, and P. Abry, "*Local regularity for texture segmentation : combining wavelet leaders and proximal minimization*," **IEEE ICASSP**, Vancouver, Canada, May 26-31, 2013.

20. G. Cherchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu, "*An epigraphical convex optimization approach for multicomponent image restoration using non-local structure tensor*," **IEEE ICASSP**, Vancouver, Canada, May 26-31, 2013

21. N. Pustelnik, P. Borgnat, and P. Flandrin, "*A multicomponent proximal algorithm for Empirical Mode Decomposition*," **EUSIPCO**, Bucharest, Romania, August, 27-31, 2012.

22. N. Pustelnik, C. Dossal, F. Turcu, Y. Berthoumieu, and Ph. Ricoux, "*A greedy algorithm to extract sparsity degree for l1/l0-equivalence in a deterministic context*," **EUSIPCO**, Bucharest, Romania, August, 27-31, 2012.

23. G. Cherchia, N. Pustelnik, J.-C. Pesquet, and B. Pesquet-Popescu, "*A proximal approach for constrained cosparse modelling*," **IEEE ICASSP**, Kyoto, Japan, March 25-30, 2012.

24. C. Chaux, C. Comtat, J.-C. Pesquet, and N. Pustelnik, "*Dynamic PET Reconstruction using Parallel ProXimal Algorithm*," **SIAM Conference on Optimization**, Darmstadt, Germany, May 16-19, 2011. Invited paper.

25. N. Pustelnik, C. Chaux, J.-C. Pesquet, and C. Comtat, "*Parallel Algorithm and Hybrid Regularization for Dynamic PET Reconstruction*," **IEEE MIC** , Knoxville, Tennessee, Oct. 30 - Nov. 6 2010.

26. L. M. Briceño-Arias, P. L. Combettes, J.-C. Pesquet, and N. Pustelnik, "*Proximal method for geometry and texture image decomposition*," **IEEE ICIP**, Honk Kong, 26-29 Septembre 2010.

27. N. Pustelnik, J.-C. Pesquet, and C. Chaux, "*Proximal methods for image restoration using a class of non-tight frame representations*," **EUSIPCO**, Aalborg, Danmark, 23-27 August 2010.

28. C. Chaux, J.-C. Pesquet, and N. Pustelnik, "*Frame-based proximal algorithms for Poisson data recovery*," **SIAM Conference on Imaging Science**, Chicago, Illinois, April 12-14 2010. Invited paper.

29. N. Pustelnik, C. Chaux, J.-C. Pesquet, F. C. Sureau, E. Dusch, and C. Comtat, "*Adapted Convex Optimization Algorithm for Wavelet-Based Dynamic PET Reconstruction*," **Fully3D** , Beijing, China, September 5-10, 2009.

30. L. Chaari, N. Pustelnik, C. Chaux, and J.-C. Pesquet, "*Solving inverse problems with overcomplete transforms and convex optimization techniques*," **SPIE**, San Diego, California, USA , August 2-6, 2009. (Invited)

31. N. Pustelnik, C. Chaux, and J.-C. Pesquet, "*A wavelet-based quadratic extension method for image deconvolution in the presence of Poisson noise*," **IEEE ICASSP**, Taipei, Taiwan , April 19-24, 2009.

32. N. Pustelnik, C. Chaux, and J.-C. Pesquet, "*A constrained forward-backward algorithm for image recovery problems*," **EUSIPCO**, Lausanne, Switzerland, August 25-29, 2008.

➤ **National journals**

1. L. Chaari, E. Chouzenoux, N. Pustelnik, C. Chaux et S. Moussaoui, "*OPTIMED : Optimisation itérative pour la résolution de problèmes inverses de grande taille*," **Traitement du signal**, Vol. 28, No. 3-4, pp. 329-374, 2011.

➤ **National conferences**

1. L. Condat, N. Pustelnik "*Segmentation d'image par optimisation proximale,*" **GRETSI**, Lyon, France, September 8-11, 2015.

2. J. Frecon, N. Pustelnik, H. Wendt, and P. Abry, "*Variation totale multivariée pour la détection de changement du spectre multifractal,*" **GRETSI**, Lyon, France, September 8-11, 2015.

3. G. Michau, P. Borgnat, N. Pustelnik, P. Abry, A. Nantes, E. Chung "*Estimating link-dependent origin-destination matrices from sample trajectories and traffic counts,*" **GRETSI**, Lyon, France, September 8-11, 2015.

4. N. Pustelnik, H. Wendt, and P. Abry, "*Régularité locale pour l'analyse de texture : le mariage des coefficients dominants et de la minimisation proximale*," **GRETSI**, Brest, France, September 3-6, 2013.

5. N. Pustelnik, J.-C. Pesquet, and C. Chaux, "*Bancs de filtres et méthodes proximales pour la restauration d'images*," **GRETSI**, Bordeaux, France, September 5-8, 2011.

6. N. Pustelnik, C. Chaux, and J.-C. Pesquet, "*Extension des algorithmes imbriqués pour la résolution de problmèes d'optimisation convexe en imagerie*," **GRETSI**, Dijon, France, September 8-11, 2009.

➤ **Workshops**

2016: **Team meeting** (LBBE, Lyon), **Mathias 2016** (Workshop TOTAL, Paris).

2015: **SMILE workshop** (Paris), **GdR ISIS** (Paris).

2014 : **Workshop CNES** (Toulouse), **Grenoble Optimization Day**, **Mathias 2014** (Workshop TOTAL, Paris), **Convegno Italo-Francese** (Sestri-Levante), **Séminaire LM2S** (Troyes)

2013 : **GDR Multifractales workshop** (Porquerolles), **Mathias 2013** (Workshop TOTAL, Paris), **Team meeting** (Toulouse), **Worshop at Intitute for Pure & Applied Mathematics** (Los Angeles, U.S.A)

2012 : **Journées Bordelaises d'Analyse Mathématique des Images**, **Team meeting** (Marseille), **MIA** (Paris),

2011: **Mathias 2011 (Workshop TOTAL)**, **TOTAL Image processing meeting**.

2010: **GdR ISIS** (Paris), Team meeting (Polytechnic Institute of New York), **GdR MOA** (Paris).

2009: **GdR MOA** (Paris).