

# Barbara PASCAL

## Curriculum Vitæ

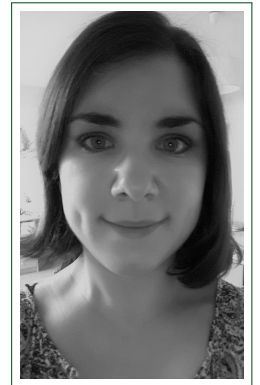
Nantes, France

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📄 <https://bpascal-fr.github.io>

GitHub: [bpascal-fr](#)

French citizen



## Education

- 2017-2020 **PhD Thesis in Signal and image processing**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France.
- 2016-2017 **Master of Physics, concepts and applications (Second year)**, *École Normale Supérieure de Lyon*, Lyon, France, *With honors* **Rank 3<sup>rd</sup> (over 27)**.
- July 2016 **Agrégation de Mathématique: highly competitive national exam to teach mathematics in high education**, *École Normale Supérieure de Lyon*, Option: Scientific computing – **Rank 52<sup>th</sup> (over 300)**.
- 2014-2015 **Master of Physics (First year)**, *École Normale Supérieure de Lyon*, Lyon, France, **Rank 2<sup>nd</sup> (over 46)**.
- 2013-2014 **Bachelor of Physics (Third year)**, *École Normale Supérieure de Lyon*, Lyon, France, *With honors* **Rank 7<sup>th</sup> (over 45)**.
- 2010-2013 **Classe préparatoire scientifique: two-year undergraduate intensive course in mathematics, physics and computer science**, *Lycée Blaise Pascal*, Clermont-Ferrand, France, Option: Computer science.
- July 2010 **Baccalauréat: general exam at the end of high school**, *Lycée René Descartes*, Cournon d’Auvergne, France, *With honors* – Scientific, Option: mathematics.

## Research

- 2022- **CNRS Researcher**, *Laboratoire des Sciences du Numérique de Nantes (LS2N)*, France.
- Oct. 2020 - **Post-doctoral researcher**, *CRISTAL*, University of Lille, France, Under the supervision of Rémi Bardenet.  
Sept. 2022 Determinantal Point Processes, zeros of Gaussian Analytic Functions and Time-Frequency transforms.
- Sept. **PhD Thesis in Signal and image processing**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Under the supervision of Patrice Abry and Nelly Pustelnik.  
2017-Sept. 2020 Regularized estimation of fractal attributes *via* convex minimization for texture segmentation.  
*Reviewers:* Bruno Torrèsani and Gabriel Peyré.
- Apr.-July 2017 **Master 2 internship in Signal and image processing**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Under the supervision of Patrice Abry and Nelly Pustelnik.  
Multifractal analysis and convex optimisation applied to texture segmentation.
- May-July 2015 **Master 1 internship in Mathematical Physics**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Under the supervision of Jean-Michel Maillet and Giuliano Niccoli.  
Integrable models, quantum R-matrices and links with classical integrability.
- Nov.-Dec. 2014 **Mater practical work**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Under the supervision of Antoine Naert, in collaboration with Juliette Monsel.  
Exchanges of energy with a dissipative thermostat.
- June-July 2014 **Bachelor internship in Experimental Physics**, *Institut Lumière Matière*, Université Lyon 1, France, Under the supervision of Bruno Issenmann.  
Effect of vibrations on a liquid trapped in a porous medium.

## Scientific production

### Journal articles

5. **B. Pascal**, and R. Bardenet,  
 “**A covariant, discrete time-frequency representation tailored for zero-based signal detection,**”  
*IEEE Transactions on Signal Processing (JCR)*, vol. 70, pp 2950–2961, 2022.  
 arXiv:2202.03835 [eess.SP]
4. **B. Pascal**, P. Abry, N. Pustelnik, S. Roux, R. Gribonval, and P. Flandrin,  
 “**Nonsmooth convex optimization to estimate the Covid-19 reproduction number space-time evolution with robustness against low quality data,**”  
*IEEE Transactions on Signal Processing (JCR)*, vol. 70, pp 2859–2868, 2022.  
 hal-03348154
3. **B. Pascal**, S. Vaiteer, N. Pustelnik, and P. Abry,  
 “**Automated data-driven selection of the hyperparameters for Total-Variation based texture segmentation,**”  
*Journal of Mathematical Imaging and Vision (JCR)*, pp 1-30, 2021.  
 arXiv:2004.09434 [stat.ML]
2. **B. Pascal**, N. Pustelnik, and P. Abry,  
 “**Strongly Convex Optimization for Joint Fractal Feature Estimation and Texture Segmentation,**”  
*Applied and Computational Harmonic Analysis (JCR)*, vol. 54, pp 303-322, 2021.  
 arXiv:1910.05246 [math.OC]
1. **B. Pascal**, N. Pustelnik, P. Abry, J.-C. Géminard and V. Vidal,  
 “**Parameter-free and fast nonlinear piecewise filtering. Application to experimental physics,**”  
*Annals of Telecommunications (JCR)*, vol. 75, no. 11, pp 655-671, 2020.  
 arXiv:2006.03297 [physics.data-an]

## Preprints

2. G. Fort, **B. Pascal**, P. Abry, and N. Pustelnik,  
 “**Covid19 Reproduction Number: Credibility Intervals by Blockwise Proximal Monte Carlo Samplers,**”  
 Submitted, 2022. hal-03611079
1. C.-G. Lucas, **B. Pascal**, N. Pustelnik, and P. Abry,  
 “**Hyperparameter selection for the Discrete Mumford-Shah functional,**”  
 Submitted, 2021. hal-03356059

## Proceedings of international conferences

5. H. Artigas, **B. Pascal**, G. Fort, P. Abry, and N. Pustelnik,  
 “**Credibility interval design for COVID19 reproduction number from nonsmooth Langevin-type Monte Carlo sampling,**”  
*EUSIPCO2022*, Belgrade, Serbia, July 29 - August, 2 2022.
4. P. Abry, G. Fort, **B. Pascal**, et N. Pustelnik,  
 “**Temporal evolution of the Covid19 pandemic reproduction number: Estimations from proximal optimization to Monte Carlo sampling,**”  
*IEEE EMBC*, Glasgow, Scotland, July 11 - 15, juillet 2022. hal-03565440
3. **B. Pascal**, V. Mauduit, P. Abry, and N. Pustelnik,  
 “**Scale-free texture segmentation: Expert feature-based versus Deep Learning strategies,**”  
*EUSIPCO2020*, Amsterdam, Netherlands, January 18-22, 2021.
2. **B. Pascal**, N. Pustelnik, P. Abry, M. Serres, and V. Vidal,  
 “**Joint estimation of local variance and local regularity for texture segmentation. Application to multiphase flow characterization,**”  
*IEEE ICIP*, Athens, Greece, October 7-10, 2018.
1. **B. Pascal**, N. Pustelnik, P. Abry, and J.-C. Pesquet,  
 “**Block-coordinate proximal algorithms for scale-free texture segmentation,**” *IEEE ICASSP*, Calgary, Alberta, Canada,

April 15-20, 2018.

## Proceedings of national conferences

5. **B. Pascal**, and R. Bardenet,  
“**Une famille de représentations covariantes de signaux discrets et son application à la détection de signaux à partir de leurs zéros,**”  
*GRETSI, GRETSI*, Nancy, France, September 6 - 9, 2022.
4. H. T.V. Le, **B. Pascal**, N. Pustelnik, M. Foare, and P. Abry,  
“**Algorithmes proximaux rapides déroulés pour l’analyse d’images fractales homogènes par morceaux,**”  
*GRETSI*, Nancy, France, September 6 - 9, 2022.
3. P. Abry, G. Fort, **B. Pascal**, and N. Pustelnik,  
“**Estimation et intervalles de crédibilité pour le taux de reproduction de la Covid19 par échantillonnage Monte Carlo Langevin proximal,**”  
*GRETSI*, Nancy, France, September 6 - 9, 2022.
2. T. Busser, **B. Pascal**, N. Pustelnik, P. Abry, M. Serres, R. Philippe, V. Vidal,  
“**Écoulement gaz-liquide dans un milieu poreux confiné: caractérisation par analyse d’images,**”  
*Rencontres du non-linéaire*, Lille, France, March 27<sup>th</sup> 2019.
1. **B. Pascal**, T. Busser, N. Pustelnik, P. Abry, and V. Vidal,  
“**Segmentation d’images texturées en grande dimension. Application à l’analyse d’écoulements multiphasiques,**”  
*GRETSI*, Lille, France, August 26 - 29, 2019.

## Communications in international conferences

3. **B. Pascal**, and R. Bardenet, *Invited mini-cours* ([https://github.com/bpascal-fr/mini-course\\_SP-and-GAF](https://github.com/bpascal-fr/mini-course_SP-and-GAF))  
“**Point processes and spatial statistics in time-frequency analysis,**”  
*Stochastic Geometry Days*, Dunkerque, France, November 15-19, 2021.  
PDF material, PYTHON notebooks and data available online
2. **B. Pascal**, N. Pustelnik, and P. Abry,  
“**Joint estimation of local variance and local regularity for texture segmentation,**”  
*Curves and Surfaces*, Arcachon, France, June 28 - July 4, 2018.
1. **B. Pascal**, N. Pustelnik, and P. Abry,  
“**Combining Local Regularity Estimation and Total Variation Optimization for Scale-Free Texture Segmentation,**”  
*SIAM IS*, Bologna, Italy, June, 5-8, 2018.

## Summer schools

1. **Sparsity for Physics, Signal and Learning** (Attendance), Paris, France, June 24-27, 2019.

## Softwares

4. **KRAVCHUK-TRANSFORM-AND-ITS-ZEROS**  
(<https://github.com/bpascal-fr/kravchuk-transform-and-its-zeros>)  
Computation of the Kravchuk transform, representation of the associated spectrogram on the “time-frequency sphere”.  
Signal detection test based on the spatial statistics of the zeros of the Kravchuk spectrogram.
3. **GEOSTO-PP-FOR-TF** (<https://github.com/bpascal-fr/GeoSto-PP-for-TF>)  
PYTHON demonstration notebooks and real data supporting the mini-course “*Point processes and spatial statistics*”

*in time-frequency analysis*". Zeros of the spectrogram of: complex white gaussian noise, noisy synthetic signals and gravitational wave data. Sampling of the zeros of the planar Gaussian Analytic Function.

2. **STEIN-PIECEWISE-FILTERING** (<https://github.com/bpascal-fr/stein-piecewise-filtering>)  
Toolbox for signal, multivariate signal and image denoising favoring piecewise smooth behaviors including an automated selection of hyperparameters *via* Stein-based strategies.
1. **GSUGAR** (<https://github.com/bpascal-fr/g sugar>)  
Automated and data-driven hyperparameter selection based on a generalized Stein estimator of the gradient of the quadratic error for texture segmentation (2D) or fractal process segmentation (1D).

## Invited seminars

12. Signal and Machine Learning seminar, Institut de Mathématiques de Marseille (I2M), France  
**"The Kravchuk transform: a novel covariant representation for discrete signals amenable to zero-based detection tests."**  
18 March 2022. Organizer : Caroline Chauv
11. Workshop on Point Processes and Applications, CRISAL & Laboratoire Paul Painlevé, University of Lille  
**"The Kravchuk transform: a novel covariant representation for discrete signals amenable to zero-based detection tests."**  
11 March 2022. Organizers : Mylène Maida and Michaël Fanuel.
10. Seminar of the Image team, Mathématiques Appliquées à Paris 5 (MAP5), University of Paris  
**"Analyse de données non stationnaires : représentations, théorie, algorithmes et applications."**  
7 March 2022. Organizer : Rémy Abergel.
9. Seminar of the Géométrie, Apprentissage, Information, Algorithmes (GAIA) pole, GISPA-Lab, Grenoble  
**"Processing nonstationary data: representations, theory, algorithms and applications."**  
December 16<sup>th</sup> 2021. Organizer: Guillaume Becq.
8. Seminar of the Signal Image et Son (SIMS) team, LS2N, Nantes  
**"Processing nonstationary data: representations, theory, algorithms and applications."**  
December 10<sup>th</sup> 2021. Organizer: Clément Huneau.
7. Statistics and Optimization seminar, Institut de Mathématiques de Toulouse  
**"Texture segmentation based on fractal attributes using convex functional minimization with generalized Stein formalism for automated regularization parameter selection"**  
October 12<sup>th</sup> 2021. Organizers: Mélisande Albert, Adrien Mazoyer, Pierre Weiss.
6. Workshop on Point Processes and Application,s CRISAL & Laboratoire Paul Painlevé, University of Lille  
**"A link between Majorana Stellar representation of pure spin states and Coulomb gas on the sphere"**  
May 28<sup>th</sup> 2021. Organizer: Mylène Maida.
5. Séminaire Cristolien d'Analyse Multifractale (SCAM), Centre de Mathématiques, Créteil, France  
**"Segmentation de textures à partir d'attributs fractals par minimisation de fonctionnelle, with réglage automatique des hyperparamètres"**  
February 4<sup>th</sup> 2021. Organizers: Stéphane Jaffard and Stéphane Seuret.
4. Signal and Image seminar, Institut de Mathématiques de Marchéille (I2M), France  
**"Texture segmentation based on fractal attributes using convex functional minimization with generalized Stein formalism for automated regularization parameter selection."**  
November 27<sup>th</sup> 2020. Organizers: Caroline Chauv.
3. Image, Optimization and Probabilités (IOP) seminar, Institut de Mathématiques de Bordeaux, France  
**"How scale-free texture segmentation turns out to be a strongly convex optimization problem?"**  
March 12<sup>th</sup> 2020. Organizers: Arthur Leclaire and Camille Male.
2. Seminar of the SIGMA team, CRISAL Lille, France  
**"How scale-free texture segmentation turns out to be a strongly convex optimization problem?"**  
March 3<sup>rd</sup> 2020. Organizers: Pierre-Antoine Thouvenin and Vincent Itier.

1. Image and Signal Processing Seminars, ICTEAM, Université Catholique de Louvain  
"How scale-free texture segmentation turns out to be a strongly convex optimization problem?"  
December 10<sup>th</sup> 2020. Organizer: Laurent Jacques.

## Internship supervision

- May-July 2021 **École Polytechnique 3<sup>rd</sup> year internship**, *Institut de Mathématiques de Toulouse*, Hugo Artigas, co-supervised with Gersende Fort, Nelly Pustelnik and Patrice Abry.  
Intervals of credibility for the Covid-19 Reproduction rate.
- Apr.-Aug. 2021 **Final year engineer intership**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Baptiste Desnos, co-supervised with Nelly Pustelnik and Patrice Abry.  
Unfolded proximal algorithms for deep learning texture segmentation.
- July-Sept. 2020 **Master 2 research internship**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Charles-Gérard Lucas, co-supervised with Patrice Abry and Nelly Pustelnik.  
Multivariate interface detection using Mumford-Shah-like functionals.
- June-July 2019 **Engineer intership**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Loris Helmlinger, co-supervised with Nelly Pustelnik.  
Texture segmentation on temporal series of multiphasic flow images: attribute-oriented approaches v.s. deep learning.

## Commitments to the scientific community

### ○ Activité de peer reviewing

- *IEEE Transactions on Signal Processing*.
- *IEEE Signal Processing Letters*.

### ○ Groupe de lecture Équipe SIGMA du CRISAL

#### "Determinantal Point Processes: theoretical bases and applications"

*Réunions bi-mensuelles en mode hybride sur d'un article de recherche présenté par un membre du groupe. Maintien d'une archive des séances passées (articles, présentation, résumés, notes) à destination du groupe.*

- Sept. 2021 - **Organizer**.  
Oct. 2020 - July 2021 **Co-organizer** with Arnaud Poinas.

### ○ Working group CRISAL & Paul Painlevé laboratory

#### "Point processes and applications"

*Weekly meetings to discuss major results in stochastic geometry and their applications.*

- Oct. 2020 - **Regular attendance**.

### ○ PhD students and post-doctoral researchers seminar SigMA Team, CRISAL

*Monthly meetings, in hybrid mode if necessary, for a presentation on a scientific or academic topic of broad interest.*

- Sept. 2021 - **Co-organizer** with Pierre Palud.  
Jan. 2020 - July 2021 **Co-organizer** with Quentin Mayolle.

## Scientific communication and initiatives toward the wide audience

- Scientific trainer for the Rendez-vous des Jeunes Mathématiciennes et Informatiennes *Inria Lille* (October, 16-17 2021). *Workshops in mathematics and data science for high school girls willing to embrace an ambitious scientific graduate studies projet.*
- Guide for the Académie des Sciences à Lyon, *Musée des Confluences* (February, 13-14 2020).  
*Accompaniment of high school classes through different scientific workshops.*

- o Participation to the *Réviser ton bac with la BmL !* program, in partnership with the association [ENSeigner](#) (April - June 2019). *Workshops to prepare the baccalauréat (high school final exam) proposed in Lyon public libraries.*

## Teaching

### École Centrale Lille

#### *Core training of engineering degree (3<sup>rd</sup> year of bachelor)*

- o **Measure theory and Lebesgue integration** ..... 2021-2022  
Practical exercises ..... **14h**

### Université Claude Bernard Lyon 1

#### *Master of Applied Mathematics and Statistics*

- o **Nonsmooth convex optimization - (Second year of master)** ..... 2018-2019, 2020-2021  
Lectures and numerical implementation (PYTHON) ..... **6h+1h30**  
From the lecture notes of Nelly Pustelnik

### École Normale Supérieure de Lyon

#### *Formation à l'Enseignement, Agrégation et Développement Professionnel: Master degree for teaching in high school*

- o **Préparation à l'agrégation de mathématiques: intensive preparation to the french examination for becoming high school teacher** ..... 2017-2018, 2018-2019, 2019-2020  
Correction of lessons during the training for final oral examination ..... **16h**  
– Training for oral exam      – Supervision and evaluation of the preparation and presentation of lessons

#### *Classes préparatoires à l'enseignement supérieur (CPES)*

- o **Mathematics** ..... 2017-2018, 2018-2019, 2019-2020  
Colles (oral examinations) ..... **28h**

#### *Master of Physics, concepts and applications*

- o **Signal and image processing - (First year of master)** ..... 2017-2018, 2018-2019, 2019-2020  
Practical and numerical implementation (MATLAB) ..... **8h**  
– Autoregressive processes, spectral v.s. parametric estimation      – Optimal filtering  
– Non-stationary signals      – Deconvolution and image processing

#### *Bachelor of Physics*

- o **Signal processing - (Third year of bachelor)** ..... 2018-2019, 2019-2020  
Practical exercises ..... **8h**  
– Random variables      – Spectral estimation  
– Random processes and estimation      – Statistical tests
- o **Introduction to L<sup>A</sup>T<sub>E</sub>X- (Third year of bachelor)** ..... 2017-2018, 2018-2019, 2019-2020  
Exercises and implementation (TEXMAKER, ZOTERO) ..... **6h**  
– Create a document      – Insert tables, figures and mathematical formula  
– Using BibTeX to generate a bibliography

#### *Master Complex Systems - IXXI*

- o **Statistical physics - (Second year of master)** ..... 2017-2018, 2018-2019, 2019-2020  
Practical exercises ..... **8h**

- Statistical ensembles
- Phase transitions
- Disordered systems

## — Linguistic skills

French Mother language  
English Professional level  
Spanish Rudiments

*Read, written, spoken*

## — Programming and office automation skills

Matlab	Deep knowledge	Pyhton	Numpy, Scipy, Keras
Latex	Deep knowledge, TikZ	Inkscape	Standard use
OS	Windows, macOS, Linux (Basics)		