

# Barbara PASCAL

## Curriculum Vitæ

Lille, France  
✉ [barbara.pascal@univ-lille.fr](mailto:barbara.pascal@univ-lille.fr)  
📄 <https://bpascal-fr.github.io>  
GitHub: [bpascal-fr](#)  
French citizen  
Born on December, 12<sup>th</sup> 1992



### Education

- 2020- **Post-doctoral researcher**, *CRISTAL*, University of Lille, France.
- 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

- Oct. 2020 - **Post-doctoral researcher**, *CRISTAL*, University of Lille, France, Under the supervision of Rémi Bardenet. 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. Regularized estimation of fractal attributes *via* convex minimization for texture segmentation. Reviewers: Bruno Torrèsani and Gabriel Peyré.
- 2020
- 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 **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.
- 2015
- Nov.-Dec. **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.
- 2014
- June-July **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.
- 2014

### Scientific production

#### Journal articles

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.OA]
1. **B. Pascal**, N. Pustelnik, P. Abry, J.-C. G  minard 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]

## Prepublications

6. G. Fort, **B. Pascal**, P. Abry, and N. Pustelnik,  
**"Covid19 Reproduction Number: Credibility Intervals by Blockwise Proximal Monte Carlo Samplers,"**  
Submitted, 2022.
5. P. Abry, G. Fort, **B. Pascal**, and N. Pustelnik,  
**"Temporal evolution of the Covid19 pandemic reproduction number: Estimations from proximal optimization to Monte Carlo sampling,"**  
Submitted, 2022. hal-03565440
4. **B. Pascal**, and R. Bardenet, **"A covariant, discrete time-frequency representation tailored for zero-based signal detection,"**  
Submitted, 2022. hal-03553433
3. 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,"**  
Submitted, 2021. hal-03371837
2. C.-G. Lucas, **B. Pascal**, N. Pustelnik, and P. Abry,  
**"Hyperparameter selection for the Discrete Mumford-Shah functional,"**  
Submitted, 2021. hal-03356059
1. **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,"**  
Accepted under minor revisions.  
*IEEE Transaction on Signal Processing*, 2021. hal-03348154

## Proceedings of international conferences

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

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/gsugar>)  
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

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 Applications, CRISTAL & 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 Marcellie (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 Chaux.
3. Image, Optimization and Probabilities (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, CRISTAL 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 internship**, *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 internship**, *Laboratoire de Physique*, École Normale Supérieure de Lyon, France, Loris Helmlinger, co-supervised with Nelly Pustelnik.  
 Texture segmentation on temporal series of multiphase flow images: attribute-oriented approaches v.s. deep learning.

## Commitments to the scientific community

### o Activité de peer reviewing

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

### o Groupe de lecture Équipe SIGMA du CRISTAL

**"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 Informaticiennes 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.*
- 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)*

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

### Université Claude Bernard Lyon 1

*Master of Applied Mathematics and Statistics*

- **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*

- **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)

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

## Master of Physics, concepts and applications

- **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

- **Signal processing - (Third year of bachelor)** ..... 2018-2019, 2019-2020  
Practical exercises ..... **8h**
  - Random variables
  - Spectral estimation
  - Random processes and estimation
  - Statistical tests
- **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

- **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) |          |                     |