Charles-Gérard LUCAS

French citizen, born on October 6^{th} 1995

clucas2@sdsu.edu charlesglucas.github.io charlesglucas

Research experience

Dec. 2023 - now	**Post-doctoral researcher**, *Department of Mathematic & Statistics, San Diego State University*, San Diego, California, USA.
Activity	*Empirical wavelet transform: theoretical developments and applications.*
Supervisor	Jérôme Gilles.
Oct. 2020 - Oct. 2023	**PhD Thesis in Physics**, *Laboratoire de Physique, École Normale Supérieure de Lyon*, Lyon, France.
Title	Multivariate self-similarity: estimation of the self-similarity exponents, bootstrap test for the equality of exponents and applications
Supervisors	Patrice Abry, Herwig Wendt.
May. 2020 - Sept. 2020	**Master 2 Internship**, *Laboratoire de Physique, École Normale Supérieure de Lyon*, Lyon, France.
Supervisor	Nelly Pustelnik, Barbara Pascal, Patrice Abry.
Title	*Contour detection using Mumford-Shah.*
Keywords	Image processing, inverse problem, proximal algorithms, risk estimator.
Apr. 2019 - Sept. 2019	**Master 2 Internship**, *Cosmology and Statistics Laboratory (CosmoStat), CEA Saclay*, Gif-sur-Yvette, France.
Supervisor	Morgan Schmitz, Jean-Luc Starck.
Title	*Point Spread Function modeling in astronomy.*
Keywords	Image processing, inverse problem, proximal algorithms, wavelets.
Oct. 2018 - Mar. 2019	**Master 2 Project**, *Laboratoire de Traitement d'image Médicale (LaTIM), IMT Atlantique*, Brest, France.
Supervisor	Chafiaa Hamitouche.
Title	*Analysis of morpho-functional signatures obtained using dual quaternions on a group of patients who are candidates for a knee arthroplasty.*
Keywords	Morpho-functional modeling, dual quaternions, Lie algebra, dynamic time warping.
Jul. 2018	**Bachelor Internship**, *Laboratoire de Traitement d'image Médicale (LaTIM), IMT Atlantique*, Brest, France.
Supervisor	John Puentes.
Title	*Segmentation of megakaryocytes in biopsy images.*
Keywords	Image processing, pattern recognition.

Education

2020 - 2023 **PhD Thesis in Physics, specialty Signal and Image Processing**, *École Normale Supérieure de Lyon*, Lyon, France.

2019 - 2020 **Master 2 Mathematics and applications, course Optimization**, *Université Paris-Saclay*, Palaiseau, France. Equivalent to a Master of Science degree in Applied Mathematics.

2018 - 2019 **Master 2 Signal, Image, Systems, Automatic (SISEA), course Image processing**, *Université de Rennes 1*, Rennes, France. Equivalent to a Master of Science degree in Image Processing.

2016 - 2019 **Diplôme d'Ingénieur Généraliste**, *IMT Atlantique*, Brest, France. Equivalent to Master of Science degree in Telecommunication Engineering.

2016 - 2018 **Licence & Master 1 Mathématiques Fondamentales**, *Université de Bretagne Occidentale*, Brest, France.
Equivalent to a Bachelor of Science degree in Fundamental Mathematics.

2013 - 2016 **Classe Préparatoire MP**, *Lycée Jeanne d'Albret*, Saint-Germain-en-Laye, France. Intensive preparation for the national competitive entrance examination to leading French Engineering Schools, specializing in Mathematics and Physics.

Publications & communications

Preprint

1. Charles-Gérard Lucas and Jérôme Gilles. Multidimesional empirical wavelet transform. *arXiv preprint arXiv:2405.06188*, 2024

Journal papers

3. Charles-Gérard Lucas, Gustavo Didier, Herwig Wendt, and Patrice Abry. Multivariate selfsimilarity: Multiscale eigenstructures for selfsimilarity parameter estimation. *IEEE Transactions on Signal Processing*, To appear, 2024

2. Charles-Gérard Lucas, Barbara Pascal, Nelly Pustelnik, and Patrice Abry. Hyperparameter selection for Discrete Mumford–Shah. *Signal, Image and Video Processing*, 17(5):1897–1904, 2023

1. Patrice Abry, Nelly Pustelnik, Stéphane Roux, Pablo Jensen, Patrick Flandrin, Rémi Gribonval, Charles-Gérard Lucas, Éric Guichard, Pierre Borgnat, and Nicolas Garnier. Spatial and temporal regularization to estimate COVID-19 reproduction number R(t): Promoting piecewise smoothness via convex optimization. *Plos one*, 15(8):e0237901, 2020

Conference papers

6. Charles-Gérard Lucas, Patrice Abry, Herwig Wendt, and Gustavo Didier. Epileptic seizure prediction from eigen-wavelet multivariate selfsimilarity analysis of multi-channel EEG sig-

nals. In *2023 31th European Signal Processing Conference (EUSIPCO)*, pages 970–974, Helsinki, Finland, 2023. IEEE

5. Charles-Gérard Lucas, Patrice Abry, Herwig Wendt, Gustavo Didier, and Oliver Orejola. Bootstrap based test for the unimodality of estimated Hurst exponents. performance assessment in a high-dimensional analysis setting. In *XXVIVème Colloque Francophone de Traitement du Signal et des Images (GRETSI 2023)*, Grenoble, France, 2023

4. Charles-Gérard Lucas, Herwig Wendt, Patrice Abry, and Gustavo Didier. Multivariate time-scale bootstrap for testing the equality of selfsimilarity parameters. In *XXVIIIème Colloque Francophone de Traitement du Signal et des Images (GRETSI 2022)*, Nancy, France, 2022

3. Charles-Gérard Lucas, Patrice Abry, Herwig Wendt, and Gustavo Didier. Drowsiness detection from polysomnographic data using multivariate selfsimilarity and eigen-wavelet analysis. In *2022 44th Annual International Conference of the IEEE Engineering in Medicine & Biology Society (EMBC)*, pages 2949–2952, Glasgow, Scotland, 2022. IEEE

2. Charles-Gérard Lucas, Patrice Abry, Herwig Wendt, and Gustavo Didier. Counting the number of different scaling exponents in multivariate scale-free dynamics: Clustering by bootstrap in the wavelet domain. In *ICASSP 2022-2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, pages 5513–5517, Singapore, 2022. IEEE

1. Charles-Gérard Lucas, Patrice Abry, Herwig Wendt, and Gustavo Didier. Bootstrap for testing the equality of selfsimilarity exponents across multivariate time series. In *2021 29th European Signal Processing Conference (EUSIPCO)*, pages 1960–1964, Dublin, Ireland, 2021. IEEE

Seminar talks

5. Computational Science Research Center (CSRC)
Multivariate self-similarity: estimation of the self-similarity exponents and application
San Diego, California, USA, September 19^{th} 2024

4. FracText, Institut des Mondes Anglophone, Germanique et Roman (IMAGER
Identification of the original or translated nature of a text
Créteil, France, September 29^{th}-30^{th} 2022

3. Journée des doctorants du Laboratoire de Physique, ENS de Lyon
Testing pairwise equality of multivariate self-similarity exponent estimation
Lyon, France, June 22^{nd} 2022

2. Journées du GDR AMA - CNRS
Clustering self-similarity exponents of multivariate time series by a wavelet-domain bootstrap
Porquerolles, France, September 27^{th}-30^{th} 2021

1. Journée des doctorants du Laboratoire de Physique, ENS de Lyon
Multivariate self-similarity exponent estimation
Lyon, France, May 18^{th} 2021

Summer school

1. Harmonic and Multifractal Analyses: from Mathematics to Quantitative Neurosciences
   Participation, Montréal, Canada, July 3^{rd} - 14^{th} 2023

Softwares

4. EWT 2D Mapping (`mathworks.com/matlabcentral/fileexchange/42141-empirical-wavelet-transforms`)
   Matlab toolbox Matlab 2D empirical wavelet transform from Gabor and Shannon wavelet kernels using mapping estimation.

3. OFBM Tools (`github.com/charlesglucas/ofbm_tools`)
   Matlab toolbox for operator fractional Brownian motion (ofBm) analysis. Estimation and counting of scaling parameters of multivariate self-similar signals.

2. SUGAR D-MS (`github.com/charlesglucas/sugar_dms`)
   Matlab toolbox for joint denoising and contour detection of images. Minimization of the Discrete Mumford-Shah functional with automatic selection of hyperparameters.

1. RCA (`github.com/charlesglucas/rca`)
   Python Toolbox for both Point Spread Function (PSF) estimation and galaxy image deconvolution simultaneously using star images.

Internship supervision

May 2024 - now	**Master thesis** of Sam Persaud, *Department of Mathematics, SDSSan Diego State University*, San Diego, California, USA, co-supervised with Jérôme Gilles.
Sujet	Automatic selection of the hyperparameters of the Diffeomorphic Demons for diffeomorphism estimation.

Commitments in the Scientific Community

5. Volunteer for European Signal Processing Conference (Eusipco), Lyon, France
   Helper in the organization team
   International conference organized by Patrice Abry and Maria Sabrina Greco.
   August 26^{th}-30^{th} 2024

4. PhD student seminars in Laboratoire de Physique, ENS de Lyon
   Co-organizer with Thomas Basset
   Regular research talks from the PhD students in Physics.
   November 2022 - September 2023

3. PhD student reprensentative of Laboratoire de Physique, ENS de Lyon
   Elected
   October 2022 - September 2023

2. Volunteer for Conference on Complex Systems (CCS), Lyon, France
   Helper in the organization team

International conference organized by Pierre Borgnat and Márton Karsai.
October 25^{th}-29^{th} 2021

1. PhD Day of Laboratoire de Physique, ENS de Lyon
Co-organizer with Thomas Basset
Day of research talks of first and second year PhD students in Physics.
June 22^{nd} 2022

Teaching experience

San Diego State University

Bachelor

- Advanced Calculus I (26h) 2024 - 2025
Lectures, practical exercices and written examinations
Real numbers, sequences and limits, limits of functions of a real variable, continuity of functions, derivatives.

École Normale Supérieure (ENS) de Lyon

Master of Complex Systems

- Complex networks - Second year (12h) 2021 - 2022, 2022 - 2023
Practical exercices and numerical implementation (Python)
Fundamentals of Network Science, e.g., classic random models, centralities, small-world phenomenon ; Advances topics, e.g., dynamic networks, graph algorithmic, community detection, machine learning on graphs.

École supérieure de chimie, physique, électronique de Lyon (CPE Lyon)

Master of Chemical Engineering

- Random Signal Processing - First year (16h) 2022 - 2023
*Practical exercices and numerical implementation (*Matlab*)*
Random signals, spectral estimation, quadratic detection, linear prediction.

Université Claude Bernard Lyon 1

Bachelor of Mathematics

- Introduction to numerical analysis - Second year (12h) 2021 - 2022, 2022 - 2023
Practical exercices, numerical implementation (Python) and written examinations
Polynomial interpolation, quadrature method, root-finding algorithms, numerical methods for differential equations.

- Geometric algebra - Second year (40h) 2021 - 2022
Practical exercices and written examinations
Inner product, orthogonality, orthogonal projection on finite-dimensional subspaces, affine hyperplane in Euclidean spaces, vectorial isometry in Euclidean spaces, vectorial endomorphism in Euclidean spaces.

- Linear and bilinear algebra, matrix analysis - Third year (12h) 2021 - 2022
  Practical exercices
  Quadratic forms, endomorphism in Euclidean space, endomorphism in Hermitian space, linear systems.

- Fundamentals of mathematics - First year (24h) 2020 - 2021
  Colles (oral examinations)
  Complex numbers, sequences and limits, real-valued functions of a real variable, limits and continuity, derivation of real-valued functions, integer arithmetic, polynomials.

- Basic mathematical techniques - First year (40h) 2020 - 2021
  Lectures, practical exercices and written examinations
  Riemann integration, first and second order linear differential equations, complex numbers, vector spaces, geometry in the plane and in space.

Skills

Computing	MATLAB, Python, LaTeX
Graphics editor	Inkscape
Languages	French (native), English (advanced), Spanish (advanced), Arabic (beginner)