HUBERT LETERME

Postdoctoral Researcher in Astrostatistics

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RESEARCH POSITIONS

Postdoctoral Researcher in Astrostatistics

Ensicaen (GREYC research institute) & CEA Paris-Saclay (Astrophysics division, CosmoStat team)

October 2023 – Present Caen, France

- **Advisors**: Jalal Fadili (Ensicaen) and Jean-Luc Starck (CEA).
- **Topic**: Reconstruction of mass maps from shear measurements using deep learning techniques, with a specific emphasis on uncertainty quantification.
- **Project**: TOSCA project, focusing on weak lensing statistics for cosmology, which explores the synergies between Euclid and SKAO. The project includes three partners in France (CEA Paris-Saclay, Nice-Côte-d'Azur Observatory and Ensicaen), and a collaboration with the University of Geneva, Switzerland.

EDUCATION

PhD in Applied Mathematics and Computer Science

Université Grenoble Alpes & Inria, Laboratoire Jean Kuntzmann

October 2019 – June 2023 Grenoble, France

- **Advisors**:
  - Valérie Perrier (Grenoble INP, Université Grenoble Alpes);
  - Karteek Alahari (Inria, Université Grenoble Alpes);
  - Kévin Polisano (CNRS, Université Grenoble Alpes).
- **Topic**: A Complex Wavelet Approach for Shift-Invariant Convolutional Neural Networks.
- **Teams**: Joint project between EDP (partial differential equations) and Thoth (computer vision, machine learning).
- **Scholarships**: LabEx PERSYVAL-Lab (ANR-11-LABX-0025-01), funded by the French program Investissement d'avenir; ANR grant MIAI (ANR-19-P3IA-0003).
- **Thesis defense**: June 14th, 2023. Jury members:
  - Nelly Pustelnik (CNRS, ENS de Lyon) – reviewer;
  - François Malgouyres (Université Toulouse III - Paul Sabatier) – reviewer;
  - Massih-Reza Amini (Université Grenoble Alpes) – president;
  - Joan Bruna (New York University) – examiner;
  - Gabriel Peyré (CNRS, ENS Paris) – examiner.

MSc in Industrial and Applied Mathematics (MSIAM)

Université Grenoble Alpes, Grenoble INP Ensimag

September 2018 – June 2019 Grenoble, France

Resumption of studies after a few years of professional experience.

- **First semester**: Fundamentals of Data Science. Courses in machine learning and deep learning, Bayesian inference, signal and image processing (wavelets), model reduction, model selection, data assimilation, high performance computing.
- **Second semester**: Research internship at Laboratoire Jean Kuntzmann, Grenoble, under the supervision of Valérie Perrier and Karteek Alahari. Topic: Wavelet-Inspired Neural Networks and Application to Image Classification.

Graduate Engineering School

École Centrale Paris (now CentraleSupélec – Université Paris-Saclay)

September 2009 – December 2012 Paris, France

The diploma received from French institutes of technology is equivalent to a master's degree.

- **Main subject area**: Industrial Engineering and Operations Research.
- **Other topics**: Seminars on Operational Management.

Exchange Semester (Erasmus Program)

KTH Royal Institute of Technology

January 2010 – June 2010 Stockholm, Sweden

- **Main subject area**: School of Industrial Engineering and Management.

RESEARCH ACTIVITIES

Publications, Preprints, Reports

[1] H. Leterme, J. Fadili, and J.-L. Starck. "Distribution-Free Uncertainty Quantification for Inverse Problems: Application to Weak Lensing Mass Mapping" (2024). Under review.

[2] H. Leterme, K. Polisano, V. Perrier, and K. Alahari. "From CNNs to Shift-Invariant Twin Models Based on Complex Wavelets". In: *2024 32nd European Signal Processing Conference (EUSIPCO)*. 2024.

[3] H. Leterme. "A Complex Wavelet Approach for Shift-Invariant Convolutional Neural Networks". Doctoral thesis. Université Grenoble Alpes, 2023.

[4] H. Leterme, K. Polisano, V. Perrier, and K. Alahari. "On the Shift Invariance of Max Pooling Feature Maps in Convolutional Neural Networks". 2023. arXiv: 2209.11740.

[5] H. Leterme, K. Polisano, V. Perrier, and K. Alahari. "Modélisation Parcimonieuse de CNNs Avec Des Paquets d'Ondelettes Dual-Tree". In: *ORASIS*. 2021.

Software

- `https://github.com/CosmoStat/cosmostat`. Contributor of the CosmoStat repository.
- `https://github.com/hubert-leterme/weaklensing_uq`. Python library, scripts and notebooks for distribution-free uncertainty quantification applied to weak lensing mass mapping. Used to reproduce the experiments from [1].
- `https://github.com/hubert-leterme/wcnn`. Python library for shift-invariant twin models based on complex wavelets. Used to reproduce the experiments from [2].

Oral Communications and Poster Presentations

Sep. 2024 **UQIPI24 Workshop**, *International Centre for Mathematical Sciences (ICMS), Edinburgh, UK*. Poster presentation: "Distribution-Free Uncertainty Quantification for Inverse Problems: Application to Weak Lensing Mass Mapping."

Aug. 2024 **32nd European Signal Processing Conference (EUSIPCO),** *Lyon, France.* Oral presentation of accepted paper [2].

Jun. 2024 **Joint ARGOS-TITAN-TOSCA Workshop,** *Fundation for Research and Technology Hellas (FORTH), Heraklion, Greece.* Oral presentation: follow-up on week lensing mass mapping with uncertainty quantification.

Apr. 2024 **z2C ("zero-to-cosmology") Workshop at CosmoStat,** *CEA Paris-Saclay, France.* Lecture on inverse problems and machine learning for cosmology, co-presented with Ezequiel Centofanti (CEA).

Feb. 2024 **Joint ARGOS-TITAN-TOSCA Workshop,** *CEA Paris-Saclay, France.* Oral presentation: follow-up on week lensing mass mapping with uncertainty quantification.

Jun. 2023 **PhD defense,** *Université Grenoble Alpes, France.* "A Complex Wavelet Approach for Shift-Invariant Convolutional Neural Networks."

Mar. 2023 **Conference "Interplay between AI and Mathematical Modelling in the Post-Structural Genomics Era,"** *Centre International de Rencontres Mathématiques (CIRM), Marseille, France.* Poster presentation: "On the Shift Invariance of Max Pooling Feature Maps in CNNs."

Nov. 2022 **3IA Doctoral Workshop,** *Université Grenoble Alpes*, *France.* Co-organized by the four French Artificial Intelligence Interdisciplinary Institutes (ANITI, 3iA Côte d'Azur, MIAI and PRAIRIE). Poster presentation: "On the Shift Invariance of Max Pooling Feature Maps in CNNs."

Jun. 2022 **Seminar,** *Rutgers University*, *New Jersey*, *USA*. Oral presentation: "How Shift Invariant Are Feature Extractors in CNNs?"

Nov. 2021 **International Collaborative Workshop** of Université Grenoble Alpes, Ruhr-Universität Bochum and University of Tsukuba, *virtual.* Oral presentation: "Sparsifying Convolutional Layers with Dual-Tree Wavelet Packets."

Sep. 2021 **ORASIS,** *Toulouse area*, *France.* French-speaking conference for young researchers in computer vision. Oral presentation of accepted paper [5].

Other Events Attended as Participant

Nov. 2023 SKA Workshop "Cosmology, Large-scale Structures and Galaxies," Paris Observatory, France.

Jun. 2022 CVPR 2022, New Orleans, Louisiana, USA.

May 2022 Kymatio Workshop 2022, École Centrale de Nantes, France.

May 2022 Signal Processing Methods for Machine Listening, CNRS, Paris, France.

Apr. 2021 Explainability and Interpretability of AI Methods for Computer Vision, CNRS, virtual.

Jan. 2021 Mathematics and Image Analysis (MIA'21), virtual.

Apr. 2019 StatLearn'19, Université Grenoble Alpes, France.

Membership in Scientific Collaborations

Jun. 2024 – Present Euclid consortium

OTHER WORK EXPERIENCE

2024 – Present Teaching assistant, Ensicaen, France. See "Teaching activities" for more details.

2019 – 2022 Teaching assistant, Grenoble INP Ensimag, France. See "Teaching activities" for more details.

2016 – 2018 Data analyst, AREP (SNCF Group), Paris, France.

2015 – 2016 Data Analyst, Air Liquide, Paris, France.

2013 – 2015 Supply Chain Analyst and Coordinator, Air Liquide Nordics, Malmö, Sweden.

RESPONSIBILITIES

2021 – 2022 Elected co-representative of PhD students on the laboratory council.

2020 – 2022 Co-organizer of a recurring PhD student seminar at LJK.

Jan. 2020 Co-organizer of the doctoral school's annual PhD Student Day.

TEACHING ACTIVITIES

Mathematical Analysis for Engineers

Grenoble INP Ensimag – Université Grenoble Alpes
First year of graduate engineering school

2019-2022 (3 academic years), 1st semester Grenoble, France

Teaching volume: 30.5 hours per academic year.

- Tutorial classes (18.5 hours): basics of integration, Fourier transform, normed vector spaces.
- Practical work with Jupyter Notebook (two groups, 6 hours per group): floating-point arithmetic, computation of integrals, Fourier series and Gibbs phenomenon, Gerschgörin theorem.

Image Processing

Grenoble INP Ensimag – Université Grenoble Alpes
Second year of graduate engineering school

2019-2022 (3 academic years), 2nd semester

Grenoble, France

Practical work, implementation in C.
Teaching volume: 12 hours per academic year.

Mathematics for Computer Science

Ensicaen
Second year of graduate engineering school

2024, 1st semester

Caen, France

Tutorial classes and practical work.
Teaching volume: 17 hours.