Clémence Prévost

Post-doctoral fellow

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25 years old (born August 11th, 1997)

Education and research

2021–present **Post-doctoral fellow**, Centre de Recherche en Informatique, Signal et Automatique de Lille, CNRS UMR 9189

- **Topic:** *"Bayesian tensor approaches for inverse problems"*.
- **Supervision:** Pierre Chainais, Professor, Université de Lille; Rémy Boyer, Professor, Université de Lille.

2018–2021 **PhD in Signal Processing**, Centre de Recherche en Automatique de Nancy, CNRS UMR 7039

- **Title:** *"Multimodal data fusion by low-rank tensor approximations"*;
- **Supervision:** David Brie, Professor, Université de Lorraine; Konstantin Usevich, CNRS Research Fellow, Université de Lorraine.
- **Panel members:**

  Tülay Adali, Distinguished Professor, University of Maryland, Baltimore County (referee);

  Rémy Boyer, Professor, Université de Lille (referee);

  Mariya Ishteva, Assistant Professor, KU Leuven;

  Alain Richard, Professor, Université de Lorraine;

  Jean-Yves Tourneret, Professor, Université de Toulouse;

  Pierre Comon, Directeur de recherche CNRS, Université Grenoble-Alpes;

  Cédric Richard, Professor, Université Côte d'Azur;

  Eric Chaumette, Professor, ISAE-Supaéro.

2017–2018 **M.Sc. in System engineering**, *Université de Lorraine, Nancy, France*

- **M.Sc. thesis:** *"Low-rank structured matrix completion and its application to MRI reconstruction,"* under the supervision of David Brie and Konstantin Usevich.

2015–2018 **Mechanical and Electrical engineer**, *École Nationale Supérieure d'Electricité et de Mécanique (ENSEM), Nancy, France*, Digital system engineering (ISN)

Research

Research interests

My research mainly addresses the use of tensor decompositions for solving inverse problems in imaging. I focus on highlighting the statistical and computational advantages of tensors for applications ranging from hyperspectral unmixing in remote sensing to medical image reconstruction from multiple sources. My works are mainly cited by the remote sensing, array processing and tensor algebra communities.

Key words:, *inverse problems, tensor decompositions, data fusion, performance bounds, hyperspectral imaging, medical imaging, source separation, astronomical imaging.*

Fundings and awards

2023 **Application**, ***For Women in Science*** *grant organized by UNESCO and Fondation L'Oréal.*, This call grants 20,000€ to post-doctoral female researchers. Results to be announced in June 2023.

2022 **Ranked**, *French* **CNRS Research Fellow** *competition (approximated success rate of 15%). Ranked 6th on complementary list.*

2022 **Ranked**, *Belgian* **FNRS Postdoctoral Fellowship Researcher** *competition (approximated success rate of 15%). Ranked 1st on complementary list.*

2022 **Awarded**, ***Best PhD thesis*** *of doctoral school IAEM, University of Lorraine (France).*

2022 **Awarded**, ***3rd by the committee of the regional competition "Ma thèse en 180 secondes"***.

Community commitment

2022-2023 **Organizer**, *monthly scientific meetings "PhD Coffee" among non-permanent researchers at CRIStAL lab, Université de Lille (France)*

2018 **ENBIS**, *Ecole des Mines de Nancy: Technical chair for student reception during the induction week*

2019 **IEEE CAMSAP**, *Volunteer for the local organization of the conference (Le Gosier, Guadeloupe)*

Reviewing activity for international journals, including, *IEEE Transactions on Signal Processing, IEEE Transactions on Geoscience and Remote Sensing, IEEE Transactions on Image Processing, IEEE Journal of Selecting Topics in Signal Processing, Elsevier Signal Processing, Elsevier Digital Signal Processing, Taylor and Francis Geocarto International, IET Signal Processing, Optica Prism.*

Teaching

2022–2023 **Teaching assistant**, Ecole Centrale de Lille, Lille, France

  ○ **"Signal Processing" for UG** : tutorial and lab lead (13h – 2022–2023). *Fourier series, DFT, adaptive filtering.*

2021–2023 **Teaching assistant**, IMT Lille Douai, Lille, France

  ○ **"Regression" for PG** : lab lead (2021–2022). *Linear and polynomial regression using Python and Numpy.*

  ○ **"Particle filtering" (UV SDATA) for PG** : lab lead (6h – 2022–2023). *An introduction to Bayesian sampling using particle filtering, using Python and Numpy.*

2018–2021 **Teaching assistant**, IUT Nancy-Brabois, Department of Networks and Telecommunications (R&T), Nancy, France

  ○ **"Principle of radio transmission" (M2107) UG** : lab lead (16h – 2018–2019).

  ○ **"Principle of signal measurements" (M1107) UG** : lab lead (176h – 2018–2021).

Outreach activities

  ○ **Dec.2022: Internship supervisor to promote ED&I principles**. I was supervising a group of 10 middleschool female interns for a week, for the "Informatique au Féminin" ("Feminine Computer Science") event organized by the CRIStAL lab at the University of Lille (France).

- **Competitor in "My PhD thesis en 180 seconds" for the Grand-Est region**. 2021–2022. See **Awards** section.
- **PhD presentation**. "Prétexte" gathering between PhD and M.Sc students in Phi-Sciences, May 2019.

Skills

IT   MATLAB/Simulink, Python LaTeX, R

Codes   A collection of MATLAB codes and toolboxes reproducing the results of my papers, available online at http://cprevost4.github.io.

Language   French (fluent), English (fluent, TOEIC: 950/990), Czech (A2/B1)

References

- Prof. Pierre COMON, DR CNRS, Univ. Grenoble-Alpes: pierre.comon@gipsa-lab.fr
- Distinguished Prof.Tulay ADALI, Univ. Maryland Baltimore County: adali@umbc.edu
- Prof. Rémy BOYER, Univ. Lille: remy.boyer@univ-lille.fr

Publications

Hereafter, I detail my publications, sorted from newest to most ancient. By convention, the authors are sorted by decreasing level of contribution.

Articles in preparation

- "Non-local tensor sparse coding for semi-blind multi-image super-resolution in magnetic resonance imaging", **Prévost, C.**, Odille, F., *to be submitted in IEEE Transactions on Medical Imaging in Autumn 2023.*
- "Penalized nonnegative tensor decomposition for joint data fusion and spectral unmixing", **Prévost, C.**, Leplat, V., *to be submitted in June 2023.*

Submitted articles

- "On the efficiency of blind and non-blind estimation for coupled LL1 tensor models using the randomly-constrained Cramér-Rao bound", **Prévost, C.**, Usevich, K., Chaumette E., Brie D. and Comon, P. Submitted to *IEEE TSP* in October 2022 (preprint hal-03504402).
- "Super-résolution hyperspectrale et démélange conjoints : approche tensorielle sous contraintes de positivité et semi-aveugle basée sur la β-divergence", **Prévost, C.** and Leplat, V. Submitted to *2023 GRETSI (Colloque francophone de traitement de signal et des images).*

Journal articles

- "Constrained Cramér-Rao lower bounds for reconstruction problems formulated as coupled canonical polyadic decompositions", **Prévost, C.**, Usevich, K., Haardt, M., Comon, P. and Brie, D. *Elsevier Signal Processing, vol. 198 (2022), 108573.*
- "Hyperspectral super-resolution accounting for spectral variability: coupled tensor LL1-based recovery and blind unmixing of the unknown super-resolution image", **Prévost, C.**, Borsoi R. A., Usevich, K., Brie, D., Bermudez, J .M. and Richard, C. *SIAM Journal on Imaging Sciences vol. 15.1 (2022), 110-138.*
- "Coupled Tensor Decomposition for Hyperspectral and Multispectral Image Fusion with Inter-image Variability", Borsoi R. A., **Prévost, C.**, Usevich, K., Brie, D., Bermudez, J .M. and Richard, C. *IEEE Journal of Selected Topics in Signal Processing, vol. 15(3), 702-717, 2021.*

- "Hyperspectral super-resolution with coupled Tucker approximation: Identifiability and SVD-based algorithms", **Prévost, C.**, Usevich, K., Brie, D. et Comon, P. *IEEE Transactions on Signal Processing, vol. 68, p.931-946, 2021.*

Conference with proceedings

- "Nonnegative block-term decomposition with the beta-divergence: joint data fusion and blind spectral unmixing", **Prévost, C.** and Leplat, V. To appear in *2023 IEEE ICASSP*, Rhodes Island, Greece (preprint hal-03831661).

- "Fast fusion of hyperspectral and multispectral images: a Tucker approximation approach" - **Prévost C.**, Chainais P. and Boyer, R. *2022 IEEE International Conference on Image Processing (ICIP)*, Bordeaux, France.

- "Tensor-based image fusion accounting for inter-image variability: Recoverability and algorithms", Borsoi R. A., **Prévost, C.**, Usevich, K., Brie, D., Bermudez, J .M. and Richard, C. *2022 GRETSI (Colloque francophone de traitement de signal et des images)*, Nancy, France.

- "Factorisation tensorielle couplée en termes de rangs (L,L,1) : application conjointe à la super-résolution hyperspectrale et au démélange en présence de variabilité spectrale", **Prévost, C.**, Borsoi R. A., Usevich, K., Brie, D., Bermudez, J .M. and Richard, C. *2022 GRETSI (Colloque francophone de traitement de signal et des images)*, Nancy, France.

- "Super-résolution multi-images en IRM par approximation de Tucker couplée", **Prévost, C.**, Odille, F. *2022 GRETSI (Colloque francophone de traitement de signal et des images)*, Nancy, France.

- "Multi-frame super-resolution MRI using coupled low-rank Tucker approximation", **Prévost, C.** and Odille, F. *2022 IEEE European Signal Processing Conference (EUSIPCO)*, Belgrade, Serbia.

- "Coupled tensor models accounting for inter-image variability", Borsoi R. A., **Prévost, C.**, Usevich, K., Brie, D., Bermudez, J .M. and Richard, C. *2021 IEEE Asilomar Conference – Special session on advances in coupled matrix and tensor factorizations with applications to remote sensing*, online.

- "Cramér-Rao Lower Bounds with random equality constraints", **Prévost, C.**, Chaumette, E., Usevich, K., Brie, D. and Comon, P. *2020 IEEE ICASSP (International Conference on Acoustics, Speech and Signal Processing)*, online.

- "Cramér-Rao Bounds in the framework of hyperspectral super-resolution", **Prévost, C.**, Usevich, K., Haardt, M., Brie, D. and Comon, P., *2019 IEEE CAMSAP (international workshop on Computational Advances in Multi-Sensor Adaptative Processing)*, Guadeloupe, West Indies.

- "Approches tensorielles couplées pour la fusion aveugle d'images multispectrale et hyperspectrale", **Prévost, C.**, Usevich, K., Comon, P. and Brie, D. *2019 GRETSI (Colloque francophone de traitement de signal et des images)*, Lille, France.

- "Coupled tensor low-rank multilinear approximation for hyperspectral super-resolution", **Prévost, C.**, Usevich, K., Brie, D. and Comon, P. *2019 IEEE ICASSP (International Conference on Acoustics, Speech and Signal Processing)*, Brighton, UK.

Workshops and invited talks

I was invited to present my work in **13 workshops** in France and abroad. Hereafter is a list of selected talks, most representative of my work.

- **Nonnegative block-term decomposition with the beta-divergence: joint data fusion and blind spectral unmixing**. Interfacing Bayesian statistics, machine learning, applied analysis, and blind and semi-blind imaging inverse problems, Jan. 2023.

- **Tensor decompositions and how to use them: an introduction to tensor low-rank in inverse problems**. Winter edition of the Orion-B astrophysics consortium, Jan. 2023.

- **Hyperspectral super-resolution accounting for spectral variability: coupled tensor LL1-based recovery and blind unmixing of the unknown super-resolution image**. 3rd IMA Conference on Inverse Problems from Theory to Application, May 2022.

- **Multimodal data fusion by low-rank tensor approximations: applications in remote sensing**. S^3 Seminar, Laboratoire des signaux et systèmes, Feb. 2022.

- **Hyperspectral super-resolution accounting for spectral variability: coupled tensor LL1-based recovery and blind unmixing of the unknown super-resolution image**. GdR ISIS meeting on machine learning and data fusion, Jan. 2022.

- **Tensor approaches for hyperspectral super-resolution: an overview of methods**. Invited talk at Laboratoire des Sciences du Numérique de Nantes (LS2N), Feb. 2021.

- **Hyperspectral super-resolution via coupled Tucker decomposition**. Workshop on Low-Rank Models and Applications (LRMA), Sept. 2019.

- **Hyperspectral super-resolution via coupled Tucker decomposition**. 2019 Peyresq annual summer school organized by the French Signal Processing Research Group (GdR ISIS). *Theoretical course and talks (21h) information geometry and its applications to signal processing.*