Valentin Debarnot

Junior Professor

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About my work: *Interested in solving concrete **image processing problems,** I develop **machine learning** tools based on precise **modeling** of measurement systems and **mathematical analysis**. I have contributed to the improvement of reconstruction and calibration methods in **fluorescence microscopy** and **cryogenic electron tomography**.*

Professional experience

2025- current

CREATIS, University of Lyon | Junior professor (tenure track position)
My role as a junior group leader is to conduct independent, original research, while securing funding.
Supervision of PhD student: 2 co-supervisions.
Research:
- Tomography cryogenic microscopy.
- Signal processing, machine learning and deep learning.
- Medical imaging.

Teaching:
Lecturer. *INSA, Computer Science* (64h/year).

2021- 2024

University of Basel | Postdoctoral researcher, with Ivan Dokmanić
My role is to help organize the research group (3 postdocs, 8 phD students) by coordinating the various projects and proposing ambitious lines of research.
Supervision of PhD student: 2 co-supervisions and 4 light supervisions.
Supervision of Bachelor/Master student: 5 supervisions.
Research:
- Cryogenic microscopy (single particle and tomography). Robust machine learning algorithms for reconstruction and image analysis. References [J9, C9, C10].
- Incorporating physical a priori in machine learning algorithms, such as invariance. References [J10, J7, J8, CML1, C9].

Teaching:
- Lecturer. *Master of Data Sciences* of university of Basel (10h).
- Coordinator and teaching assistant. *Pattern Recognition* (8 credit points, 40 students) and *A Practical Introduction to Data Science* (4 credit points, 80 students). Creation of the content, supervision of 4 to 5 teaching assistants.

2017- 2021

ITAV (Institut des Technologies Avancées en sciences du Vivant), University of Toulouse, CNRS | PhD candidate, under supervision of Pierre Weiss and Thomas Mangeat
Summary: I have developed efficient algorithms for solving blind inverse problems in microscopy, i.e. when both the acquisition operator and the original signal are unknown. The proposed tools are mathematically analyzed and implemented within the Toulouse microscopy platform.
Supervision of Bachelor/Master student: 2 supervisions.
Research:
- Fluorescent microscopy. Development of scalable algorithms for microscope calibration and image reconstruction. References [T1,J3, J4, J5,J9,C3,C4,C6,C8].

- Blind inverse problems. Mathematical and empirical methods for solving blind inverse problems in microscopy. References [J6, C7].
- Image analysis. Development of image analysis software (segmentation, tracking, classification). References [C5].
- Inverse problems for imaging. Analysis of innovative imaging methods. References [J2,C1].

Teaching: INSA Toulouse, engineering school, 64h/year.

- Modeling (Bachelor, 45h). Multi-armed bandit algorithms, approximation in image processing, machine learning, neural networks for image processing.
- Numerical analysis (15h). Resolution of partial differential equations.
- Bibliography (4h).

2014 and 2015 (2 x 3 months) — **Stay in England**
Au pair and working in event company. I renew the experiment two years successively.

2011 – 2017 — **Private lessons**
High school tutoring in science (mathematics and physics). 10 students.

Education

2017 – 2020 — **PhD thesis** in applied mathematics, ITAV, CNRS, Toulouse, France.
Title: Computational microscopy.

2016 – 2017 — **Master 2 Research**, Paul Sabatier University, Toulouse, France. Major in probability, statistics.

2016 – 2017 — **Engineering degree**, INSA, Toulouse, France.
Major in apply mathematics and modeling.

2011 – 2012 — **Prépa (bachelor)**, Polytech, Blaise Pascal University, Clermont-Ferrand, France. Major in mathematics, computer science & physics.

References

Ivan Dokmanic (Professor): ivan.dokmanic@unibas.ch. Postdoc supervisor.
Anastasis Kratsios (Assistant Professor): kratsioa@mcmaster.ca. Co-author.
Pierre Weiss (CNRS researcher): pierre.armand.weiss@gmail.com. Internship and PhD thesis supervisor.
Thomas Mangeat (CNRS research Engineer): mangeatthomas@gmail.com. PhD thesis supervisor.
Emmanuel Soubies (CNRS researcher): emmanuel.soubies@irit.fr . Co-author.

Languages

French.
English.

Interest and activity

Running, cycling, bouldering.

Scientific activities

More than 20 scientific presentations in national and international venues.

List of publication

Preprints

[P1] Kishore, V., Debarnot, V., Righetto, R. D., Khorashadizadeh, A., Dokmanić, I. End-to-end localized deep learning for Cryo-ET, arxiv:2501.15246

Book and journals

[T1] V. Debarnot, Computational microscopy, Thèse, 2020. https://theses.hal.science/tel-03146497.

[J1] V. Debarnot, J. Fehrenbach, F. De Gournay, L. Martire, The Case of Neumann, Robin, and Periodic Lateral Conditions for the Semi-infinite Generalized Graetz Problem and Applications, SIAM Journal on Applied Mathematics, 78(4), 2227-2251 (2018).

[J2] V. Debarnot, J. Khan, P. Weiss, Multiview Attenuation Estimation and Correction, Journal of Mathematical Imaging and Vision 61 (2019).

[J3] V. Debarnot, P. Escande et P. Weiss, A scalable estimator of sets of integral operators, Inverse Problems 35.10 (2019).

[J4] V. Debarnot, P. Escande et P. Weiss, Learning low-dimensional models of microscopes, IEEE Transactions on Computational Imaging (2020).

[J5] T. Mangeat, S. Labouesse, M. Allain, A. Negash, E. Martin, A. Gu ́enol ̈e, R. Poincloux, C. Estibal, A. Bouissou, S. Cantaloube, E. Vega, T. Li, C. Rouvi`ere, S. Allart, D. Keller, V. Debarnot, X. B. Wang, G. Michaux, M. Pinot, R. Le Borgne, S. Tournier, M. Suzanne, J. Idier, et A. Sentenac, Super-resolved live-cell imaging using random illumination microscopy, Cell Reports Methods 1.1 (2021)

[J6] V. Debarnot et P. Weiss, Blind inverse problems with isolated spikes, Information and Inference: A Journal of the IMA 12.1 (2023).

[J7] A. Kratsios, V. Debarnot, et I. Dokmani ́c. Small transformers compute universal metric embeddings, Journal of Machine Learning Research 24.170 (2023)

[J8] S. Gupta, K. Kothari, V. Debarnot, et I. Dokmanic. Differentiable uncalibrated imaging, IEEE Transactions on Computational Imaging (2024).

[J9] V. Debarnot et P. Weiss. Deep-Blur : Blind Identification and Deblurring with Convolutional Neural Net- works, Biological Imaging.

[J10] V. Debarnot, V. Kishore, R.D. Righetto, I. Dokmanić, I. ICE-TIDE: Implicit Cryo-ET Imaging and Deformation Estimation, IEEE Transactions on Computational Imaging (2025).

[J11] A. Khorashadizadeh, V. Debarnot, T. Liu, I.Dokmanic. GLIMPSE: Generalized Local Imaging with MLPs, IEEE Transactions on Medical Imaging (2025).

Significant conferences

[CML1] A. Khorashadizadeh, A. Chaman, V. V. Debarnot, I. Dokmani ́c. FunkNN: Neural Interpolation for Func- tional Generation, The Eleventh International Conference on Learning Representations (ICLR, 2023).

Conferences

[C1] V. Debarnot, J. Kahn, et P. Weiss, Multiview Attenuation Computation and Correction, SPARS 17, (2017).

[C2] V. Debarnot, P. Escande, T. Mangeat, et P. Weiss, A scalable estimator of sets of integral operators, Proceedings of iTWIST'18, Paper-ID: 2, Marseille, France, (2018).

[C3] V. Debarnot, P. Escande, T. Mangeat, et P. Weiss, A scalable estimator of space varying blurs: Application in super-resolution, SPARS 19 (2019).

[C4] V. Debarnot, P. Escande, T. Mangeat, et P. Weiss, Blind-deblurring: learning based approach, Mathematics in Imaging (pp. MM1D-3). Optica Publishing Group, (2019).

[C5] V. Debarnot, et L. Lebrat, Segmentation: a data driven approach though neural network, IEEE 16th Inter- national Symposium on Biomedical Imaging (ISBI), (2019).

[C6] V. Debarnot, P. Escande, T. Mangeat, et P. Weiss, Learning low-dimensional models of microscopes, Quan- titative BioImaging Society (2020).

[C7] V. Debarnot, et P. Weiss, Deepblur: Blind identification of space variant psf, IEEE 18th International Sym- posium on Biomedical Imaging (ISBI) (pp. 1544-1547), (2021).
[C8] V. Debarnot, P. Escande, T. Mangeat et P. Weiss, Modelling a Microscope as Low Dimensional Subspace of Operators, 28th European Signal Processing Conference (EUSIPCO) (pp. 765-769), (2021).
[C9] V. Debarnot, V. Kishore, C. Shi, et I. Dokmanic, Manifold rewiring for unlabeled imaging, IEEE Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC) (pp. 1-8) (2022).
[C10] V. Debarnot, S. Gupta, K. Kothari, I. Dokmanic, Joint Cryo-ET Alignment and Reconstruction with Neural Deformation Fields, IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 1-5) (2023).
[C11] R. D. Righetto, L. Lamm, V. Debarnot, V. Kishore, I. Dokmanić, A. Martinez-Sanchez, B. Engel, T. Peng, Deep learning in cryo-ET : from image alignment to biological insights, IEEE 21st International Symposium on Biomedical Imaging (ISBI), (2024).
[C12] V. Debarnot, P. Escande, T. Mangeat, and P. Weiss, ICE-TIDE : Implicit Cryo-ET Imaging and De- formation Estimation, Computational Optical Sensing and Imaging (COSI). Optica Publishing Group, (2024).