Postdoctoral research position
Algebraic and tensor methods for polarimetric phase retrieval

Duration: 24 months, starting in 2024.

Location: Nancy, France.

The postdoctoral researcher will join the Multidimensional Signals Group at the Centre de Recherche en Automatique de Nancy (CRAN) which is a joint research laboratory between CNRS and Université de Lorraine.

Supervision:

- Julien Flamant (CNRS researcher)
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Project outline: The postdoctoral position is funded by Agence Nationale de la Recherche (ANR) through the JCJC grant ATEMPORAL. The main goal to develop new algebraic and tensor tools for phase retrieval problems [1]. The focus of the project is on polarimetric phase retrieval problems, which arise when considering light polarization in computational imaging applications, such as coherent diffraction imaging. Polarization is a powerful imaging modality that attracts a growing interest in many fields such as astronomy, material science or experimental biology as it encodes unique features (e.g., anisotropy) that are inaccessible to conventional imaging.

It has been shown recently [2] that the algebraic structure of 1D polarimetric phase retrieval makes it amenable to direct (i.e., non-iterative) solutions based on approximate greatest common divisor (GCD) computations [3]. These approaches offer an exciting alternative to standard phase retrieval algorithms [4] since they provide fast and accurate solutions in noiseless scenarios, and can provide good warm starting points for descent algorithms in noisy contexts.

Nonetheless, algebraic approaches are currently limited by two factors: 1) they are restricted to the 1D case, and 2) they lack the accuracy and scalabilty to cope with realistic optical imaging settings. Our aim is to fill this gap by exploiting the natural tensor representation of polarized images, and by devising new, computationally efficient, robust to noise, approximate GCD approaches. Experimental demonstration of the relevance of the proposed methodology will be conducted through collaboration with the COMiX team at Institut Fresnel (Marseille, France).

Candidate profile: A prospective applicant should have a Ph.D. in signal processing, machine learning, applied mathematics or a related discipline. Experience with inverse problems/phase retrieval, and structured linear/multilinear algebra will be a plus. He/she should have good English communication skills (written and oral) and ample experience with programming in Matlab or Python.

Employment terms: The net salary ranges from 2400€ to 3200€, depending on the candidate's experience. The position also includes standard insurance, paid leave and other social benefits for CNRS employees. The postdoctoral researcher will be provided with all necessary computing resources and funding for travel to conferences or research visits.

Application procedure Applications will be collected until June 2024, and then until a suitable candidate is found. The postdoc starting date is flexible, the target period being the second half of 2024. Applicants are requested to send by email a CV, list of publications, and contact details of two references, preferably in PDF.

Please send enquiries to julien.flamant@cnrs.fr and konstantin.usevich@cnrs.fr.

References

[1] Y. Shechtman, Y. C. Eldar, O. Cohen, *et al.*, "Phase retrieval with application to optical imaging: A contemporary overview," *IEEE Signal Processing Magazine*, vol. 32, no. 3, pp. 87–109, 2015.

[2] J. Flamant, K. Usevich, M. Clausel, *et al.*, "Polarimetric Fourier phase retrieval," *SIAM Journal of Imaging Sciences*, vol. 17, no. 1, pp. 632–671, 2024.

[3] K. Usevich and I. Markovsky, "Variable projection methods for approximate (greatest) common divisor computations," *Theoretical Computer Science*, vol. 681, pp. 176–198, 2017.

[4] A. Fannjiang and T. Strohmer, "The numerics of phase retrieval," *Acta Numerica*, vol. 29, pp. 125–228, 2020.