

# Instrumentation for deep learning hyperspectral optics

Postdoctoral fellowship

**CREATIS laboratory** (Lyon, France) opens a postdoctoral position funded for one year.

**Keywords** Single-pixel imaging, compressive video imaging, instrumentation development.

**Background** Our group is particularly interested in developing computational imaging systems that combine advances in hardware and software [1, 2, 3].

Single-pixel imaging is a paradigm that enables two-dimensional imaging from a point detector. It leads to high-performance optical imaging systems (e.g., hyperspectral and/or time-of-flight measurements) at very low cost. Single-pixel cameras comprise a single point detector that is coupled with a spatial light modulator. By performing a sequence of optical measurements for different modulation patterns, it is possible to recover the image of the observed scene provided that ad-hoc reconstruction algorithms are implemented [4]. Successful applications of single-pixel imaging include three-dimensional imaging [5], hyperspectral imaging [6], fluorescence microscopy [7], infrared imaging [8] and terahertz imaging [9]. Compressive imaging also generated the interest of large private companies [10].

**Project** We aim to develop a fast single-pixel camera for fluorescence-guided surgery. Fluorescence-guided surgery is an imaging technique that helps surgeons to perform safer and less invasive surgery. While quantitative fluorescence imaging requires to exploit the full spectrum, there are no traditional hyperspectral cameras with sufficient spectral resolution. Therefore, current solutions are based on point measurements only. A single-pixel camera could bring high spectral resolution together with high spatial resolution. However, current single-pixel cameras are still too slow to operate in real time.

**Context** The position is funded for one year by the French National Research Agency (ANR). The position offers excellent opportunities for travel in France and abroad.

**Skills** We are looking for an enthusiastic and autonomous candidate who can develop optical instrumentation. The applicant must hold a PhD in Physics or Electrical Engineering with a specialization in optics or photonics and have a strong interest in medical imaging. Strong programming skills in Labview and Python are required. Knowledge of signal processing and/or machine learning is a bonus.

**How to apply?** Send CV, motivation letter, and academic records to [nicolas.ducros@creatis.insa-lyon.fr](mailto:nicolas.ducros@creatis.insa-lyon.fr), [bruno.montcel@creatis.insa-lyon.fr](mailto:bruno.montcel@creatis.insa-lyon.fr), and [peyrin@esrf.fr](mailto:peyrin@esrf.fr).

**Salary** Salary depends on experience and is negotiable

## References

- [1] Rousset, F. *et al.* Adaptive basis scan by wavelet prediction for single-pixel imaging. *IEEE Transactions on Computational Imaging* **3**, 36–46 (2017).
- [2] Rousset, F. *et al.* A semi nonnegative matrix factorization technique for pattern generalization in single-pixel imaging. *IEEE Transactions on Computational Imaging* **4**, 284–294 (2018).
- [3] Rousset, F. *et al.* Time-resolved multispectral imaging based on an adaptive single-pixel camera. *Opt. Express* **26**, 10550–10558 (2018).
- [4] Candes, E. J. & Wakin, M. B. An introduction to compressive sampling. *IEEE Signal Processing Magazine* **25**, 21–30 (2008).
- [5] Sun, M.-J. *et al.* Single-pixel three-dimensional imaging with time-based depth resolution. *Nature Communications* **7**, 12010 (2016).
- [6] Pian, Q. *et al.* Compressive hyperspectral time-resolved wide-field fluorescence lifetime imaging. *Nature photonics* **11**, 411–414 (2017).
- [7] Studer, V. *et al.* Compressive fluorescence microscopy for biological and hyperspectral imaging. *Proceedings of the National Academy of Sciences of the United States of America* **109**, E1679–E1687 (2012).
- [8] Radwell, N. *et al.* Single-pixel infrared and visible microscope. *Optica* **1**, 285–289 (2014).
- [9] Watts, C. M. *et al.* Terahertz compressive imaging with metamaterial spatial light modulators. *Nature Photonics* **8**, 605–609 (2014).
- [10] Miao, X. & Amirparviz, B. Single pixel camera. Google LLC, US Patent US9071739B2 (2015).