1-year Post-doctoral position available at CEA Grenoble

“Compressed sensing methods for spectroscopic electron tomography”

Applications are invited for a Post-doctoral position funded by CEA in the context of an interdisciplinary project involving experts in: (1) electron tomography at CEA Grenoble/DRT/LETI (Zineb Saghi), (2) magnetic resonance imaging at CEA Saclay/NeuroSpin (Philippe Ciuciu) and (3) cosmology at CEA Saclay/Dap/CosmoStat (Jean-Luc Starck). The position is for 1 year. The starting date will ideally be on January 15, 2019.

Research field: compressed sensing, electron tomography, spectral un-mixing, energy dispersive X-ray analysis, electron energy loss spectroscopy.

Profile: Eligible qualifications for this position include:

- PhD in tomography or related 3D technique.
- Solid background in convex optimization and inverse problem solving (e.g., compressed sensing, deconvolution, image restoration or reconstruction);
- Proficiency in Python and C or C++. Experience in GPU and/or multi-CPU parallel programming (e.g. using CUDA);
- Excellent written and verbal communication skills in English;
- Strong interpersonal skills, assertive and proactive.

Research Topic:
Electron tomography (ET) is a well-established technique for the 3D morphological characterization at the nanoscale. ET applied to spectroscopic modes for 3D structural and chemical analysis has become a hot topic but necessitates long exposure times and high beam currents. To reduce the total electron dose, a dataset is often acquired with low signal-to-noise ratio spectra and large angular increments. Principal component analysis (PCA) is generally used for spectral denoising, and compressed sensing (CS) approaches have recently been explored for 3D reconstruction, assuming structures are sparse in the image gradient domain (“Total variation minimization”, TVM). Both approaches have shown limitations; PCA induces information loss when applied to extremely sparse X-ray spectra, and TVM produces poor results for data with non-piecewise constant structures.

The main goal of this project is to explore advanced sparsity-based algorithms, based on i.e. 3D curvelet, ridgelet and shearlet transforms, in order to improve the resolution of spectroscopic ET and reduce significantly the dose. Novel CS-inspired methods such as GMCA or sparse PCA will also be tested for dimensionality reduction and spectral un-mixing.
The code will be written in Python, using the library Hyperspy (hyperspy.org), and the PySAP toolbox (Python Sparse data Analysis Package) developed by P. Ciuciu and J-L. Starck. State-of-the-art microscopes available at the Nanocharacterization Platform (PFNC) will be used to generate STEM-EELS and STEM-EDX tomographic datasets.

**Location & Resources:** The successful candidate will be located at CEA Grenoble, with short stays at NeuroSpin (CEA Saclay). He/she will have access to the computing facilities at CEA Grenoble and NeuroSpin.

**Applications deadline:** October 15, 2018. Please send a CV, a short cover letter and contact details of three referees.

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