Image Processing for Spatial Transcriptomics

Postdoctoral or Research Engineer Position

The École Normale Supérieure (ENS) of Lyon is currently seeking a highly talented postdoctoral researcher or research engineer specializing in image data analysis. The successful candidate will join the Spatial-Cell-ID initiative, contributing to the development of innovative pipelines for the analysis of MERFISH data. The primary focus of this position will encompass image registration, RNA spot detection, 3D MERFISH decoding, and cell segmentation, with the overarching goal of unravelling the biology of single cells within their native tissue environments. The project will be carried out in collaboration with the CREATIS laboratory, which has extensive experience in artificial intelligence for image analysis.

Spatial-Cell-ID is a new national spatial transcriptomics facility funded by the French "EquipEx+" excellence initiative and led by the École Normale Supérieure of Lyon (ENSL). Spatial-Cell-ID gathers teams with the goal of studying cellular identity and its spatial heterogeneity within tissues, organs, or biological systems in normal and pathological contexts, leveraging the latest advancements in spatial transcriptomics. Spatial transcriptomics technologies were designated "Method of the Year 2020" by the Nature Methods journal and are currently revolutionizing our ability to study complex biological systems [1]. Spatial-Cell-ID offers equipment for spatial transcriptomics that integrates imaging, sequencing, and data analysis technologies, which in synergy will provide access to the transcriptome of any single cell within its native spatio-temporal environment. It hosts a comprehensive selection of technologies, including single-cell transcriptomics, untargeted spatial transcriptomics (e.g., Slide-seq), and targeted spatial transcriptomics (e.g., MERFISH), associating state-of-the-art technological platforms of the University of Lyon.

Environment The **École Normale Supérieure de Lyon** (ENSL) is an elite French public higher education institution that trains professors, researchers, senior civil servants as well as business and political leaders. The ENSL brings together several laboratories at the cutting edge of science. The recruited post-doc or research engineer will be working at the **Institut de génomique fonctionnelle de Lyon IGFL** in the **Enriquez team**. The project will be carried out in close collaboration with the CREATIS laboratory, a recognized medical imaging research center, which has extensive experience in artificial intelligence for image analysis. The appointed candidate will work in a highly interdisciplinary environment composed of biologists, microscopists, biophysicists, and computer scientists who will assist him/her in the different aspects of this project.

Research Project The appointed candidate will develop innovative pipelines for the analysis of MERFISH data [2]. While MERFISH was originally designed to acquire the transcriptome in 2D tissue sections, we will study 3D models such as leg muscle in Drosophila. Our objective is therefore to push beyond the current state-of-the-art of MERFISH pipelines by developing a novel methodology for 3D MERFISH. A challenge will be to resolve hundreds of different transcripts by performing multiple rounds of single-molecule fluorescence in situ hybridization that need to be registered and decoded. Our algorithms will be based on recent deep learning strategies that bridge the gap between black-box neural networks and handcrafted interpretable image processing

pipelines [3]. Such approaches are usually able to cope with reduced amounts of data compared to their black-box counterparts
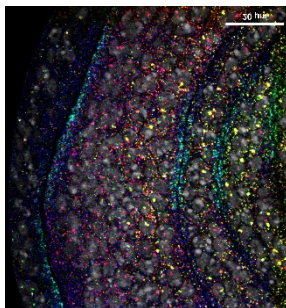
Profile:

- Ph.D. or equivalent experience in Biology, Physics or Mathematics is required.
- Proficiency in programming languages, particularly Python, applied to image data analysis.
- Experience in deep learning for image analysis/computer vision is a plus.
- Experience in confocal and super-resolution imaging is a plus.
- Excellent communication and collaboration skills. English is the working language.

**Desired starting date:** As soon as possible (flexible date)
Contract duration: 2 years with a possibility of extension
Salary: Remuneration based on experience (from 2000€/ to 3000€/month)

Instructions for applicants: Applications should include a CV, a cover letter, and contact details for 3 referees to be sent to: Jonathan Enriquez (jonathan.enriquez@ens-lyon.fr) & Nicolas Ducros (Nicolas.Ducros@insa-lyon.fr). **Please use the email subject "Spatial-Cell-ID".** For further information please contact the same addresses. Applications will be considered upon submission.

MERFISH
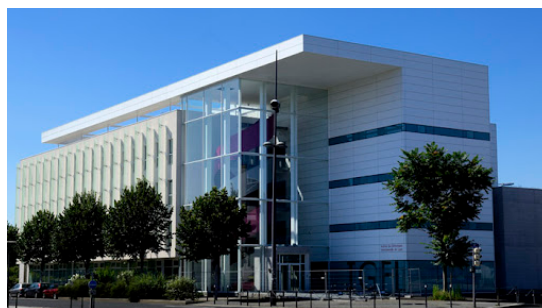
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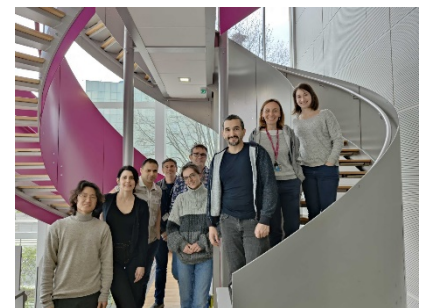
**MERFISH
working group team**

References:

1. Marx, V. "Method of the Year: spatially resolved transcriptomics," *Nat Methods* **18**, 9–14 (2021).
2. Chen, K. H., *et al*. "Spatially resolved, highly multiplexed RNA profiling in single cells," *Science* **348**, (2015).
3. V. Monga, Y. Li and Y. C. Eldar, "Algorithm Unrolling: Interpretable, Efficient Deep Learning for Signal and Image Processing," *IEEE Signal Processing Magazine*, **38**, 2, 18-44, 2021