

Internship proposal

New approaches for analysis and visualization of single molecules and image stack data

Supervisors:

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Overview

Are you excited by the intersection of cutting-edge microscopy, data visualization, and virtual reality? This internship offers a unique opportunity to contribute to single molecule localization microscopy (SMLM), a powerful technique that reveals molecular dynamics and arrangements inside cells at nanometer resolution. The challenge lies in effectively visualizing and analyzing the enormous, high-dimensional datasets generated by SMLM, especially in the context of complex 3D cellular structures.

To address these challenges, our team has developed Genuage, a software platform for 3D and 4D visualization of single molecule data in both desktop and virtual reality environments. Your role will be to extend Genuage's capabilities, enabling it to handle large-scale microscopy image stacks and overlay them with single molecule data for richer analysis and visualization.

What You Will Do

As an intern, you will:

- Develop a visualization pipeline within Genuage for volume rendering of microscopy image stacks.
- Create a new representation mode that overlays 3D single molecule data onto the volumetric microscopy images.
- Implement efficient rendering techniques to handle massive datasets (millions of points) for desktop and VR environments.
- Build innovative tools in VR to enable interactive quantification, segmentation, and analysis of volume data.
- Explore the use of Graph Neural Networks (GNNs) to infer shapes and physical parameters from point clouds.

What You Will Gain

- Hands-on experience with data visualization, virtual reality, and microscopy.
- Advanced skills in software development for large-scale datasets and real-time rendering.
- Exposure to exciting interdisciplinary work combining biology, computer science, and physics.
- A chance to contribute to real-world research that pushes the boundaries of biological imaging.

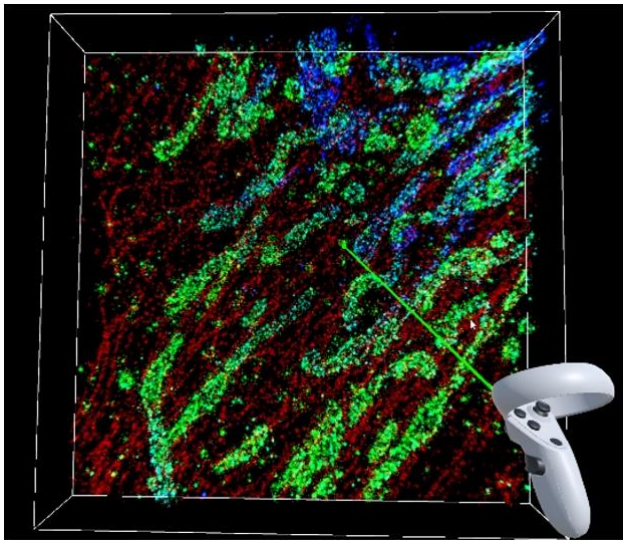
Who Can Apply

We are looking for students with strong programming and algorithmic skills, particularly in object-oriented programming. Knowledge of C# and Unity Engine, as well as experience with GPU execution and shaders, is a plus. Most importantly, you should be motivated to learn and contribute to developing state-of-the-art tools for biological research.

How to Apply

Interested candidates should send their CV and a short motivation letter to [bassam.hajj@curie.fr]. Come help us redefine the way we visualize and analyze biological data!

Figure: Representation of SMLM point cloud multicolor data in Genuage, a software for multidimensional point cloud representation and analysis that works both in Desktop and Virtual reality



modes.

References

- [1] Blanc, T., El Beheiry, M., Caporal, C. *et al.* Genuage: visualize and analyze multidimensional single-molecule point cloud data in virtual reality. *Nat Methods* **17**, 1100–1102 (2020). <https://doi.org/10.1038/s41592-020-0946-1>
- [2] Blanc, T. Verdier, H., Regnier L. *et al.* *Towards human in the loop analysis of complex point clouds ; advanced visualizations, quantifications and communication features in virtual reality.* *Front. Bioinform.*, 20 January 2022 Sec. Data Visualization <https://doi.org/10.3389/fbinf.2021.775379>