

# Linking and analyzing correlative datasets

[Perrine.paul-gilloteaux@univ-nantes.fr](mailto:Perrine.paul-gilloteaux@univ-nantes.fr)

Nantes Université, CHU Nantes, CNRS, Inserm, BioCore, SFR Bonamy, Nantes, France

Nantes Université, CNRS, INSERM, l'institut du thorax, Nantes, France.



**Inserm**

La science pour la santé  
From science to health



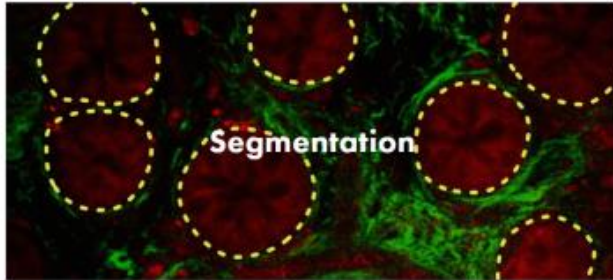
# Linking and analyzing correlative datasets

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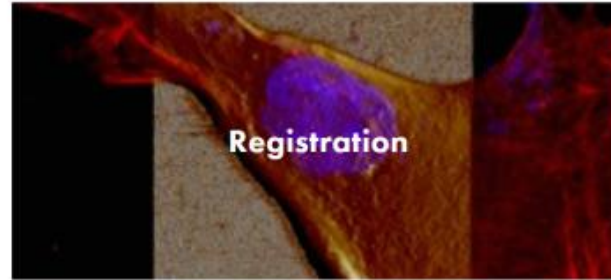
Nantes Université, CNRS, INSERM, l'institut du thorax, Nantes, France.





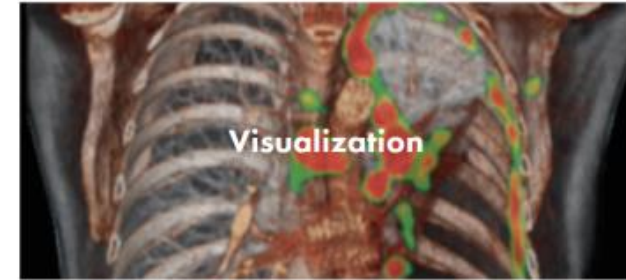
**Segmentation**

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of segmentation is to change the representation of an image into something that is more meaningful and easier to analyze.



**Registration**

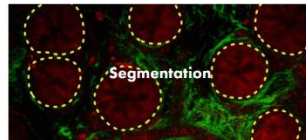
Image registration is the process of transforming different sets of data into one coordinate system. Data may be multiple images, data from different sensors, times, depths, or viewpoints.



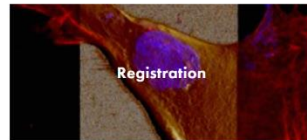
**Visualization**

Visualization is a group of techniques for creating images, diagrams, or animations to communicate a message. These techniques are of huge importance in the field of correlation software, as usually there's a need to mix different kinds of images

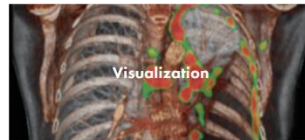
Use the buttons below to search the **Biolmage Informatics Index** for correlation software — for *segmentation*, *registration*, and *visualization*, spanning both biological and preclinical imaging.



Segmentation



Registration



Visualization

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of segmentation is to change the representation of an image into something that is more meaningful and easier to analyze.

Image registration is the process of transforming different sets of data into one coordinate system. Data may be multiple images, data from different sensors, times, depths, or viewpoints.

Visualization is a group of techniques for creating images, diagrams, or animations to communicate a message. These techniques are of huge importance in the field of correlation software, as usually there's a need to mix different kinds of images

LIST SEGMENTATION SOFTWARE FROM BIII.EU

LIST REGISTRATION SOFTWARE FROM BIII.EU

LIST VISUALIZATION SOFTWARE FROM BIII.EU

17 multimodal (70 other) results



**Image registration in Matlab with Image Processing Toolbox**

Align two images using intensity correlation, feature matching, or control point mapping Together, Image Processing Toolbox™ and Computer Vision Toolbox™ offer four image registration solutions: inte...



**BIRL**

BIRL stands for "Benchmark on Image Registration methods with Landmark validation". BIRL is a cross-platform framework for comparison of image registration methods with landmark validation (registrati...



**Registrationshop**

It is an interactive front-end visualization for registration software based on Elasis (VTK/ITK)...



**simpleElastix**

quote: > Elastix cite{Klein2010} is an open source, command-line program for intensity-based registration of medical images that allows the user to quickly configure, test, and compare different ...



**eC-CLEM**

This plugin allows to compute a similarity (translation/rotation/scaling and flipping) transform from pair of points. It is updating the transformed image interactively such that the user get immediat...



**CMTK**

A software toolkit for computational morphometry of biomedical images, CMTK comprises a set of command line tools and a back-end general-purpose library for processing and I/O...



**Fiji CMTK GUI**

Working version of a simple GUI frontend for CMTK image registration tools in Fiji...



**Correlia**

Correlia is an open-source ImageJ/FIJI plug-in for the registration of 2D multimodal microscopy data-sets. The software is developed at ProVIS - Centre for Correlative Microscopy and is specifically ...



**MSRC Registration Toolbox**

This python toolbox performs registration between 2-D microscopy images from the same tissue section or serial sections in several ways to achieve imaging mass spectrometry (IMS) experimental goals. ...



**elastix**

Elastix is a toolbox for rigid and nonrigid registration of (medical) images. Elastix is based on the ITK library, and provides additional algorithms for image registration. The software can be run...



**DeepCLEM**

This Fiji plugin is a python script for CLEM registration using deep learning, but it could be applied in principle to other modalities. The pretrained model was learned on chromatin SEM images and fl...



**Bigwarp**

Bigwarp is a tool for manual, interactive, landmark-based deformable image alignment. It uses the BigDataViewer for visualization and navigation, and uses a Thin Plate Spline implemented in Java to bu...



**VIBE-Z**

The Virtual Brain Explorer (ViBE-Z) is a software that automatically maps gene expression data with cellular resolution to a 3D standard larval zebrafish (Danio rerio) brain. It automatically detects ...



**Landmark Correspondences**

The plugin Landmark Correspondences calculates a transformation between two corresponding landmark clouds and renders a transformed image. The landmarks are read from point selections over two images....



**Amira**

Amira is 3D visualization and analysis software for life sciences. " Amira software is a powerful, multifaceted 3D platform for visualizing, manipulating, and understanding life sciences data from ...



**Epina Image Lab**

Epina ImageLab is a Microsoft Windows-based multisensor imaging tool for processing and analyzing hyperspectral images. It is a modular system consisting of a basic engine, a graphical user interface....



**Imaris**

Imaris is a software for data visualization, analysis, segmentation and interpretation of 3D and 4D microscopy images. It performs interactive volume rendering that lets users freely navigate even ver...

# APPROACHES FOR AUTOMATIC AND SEMI REGISTRATION

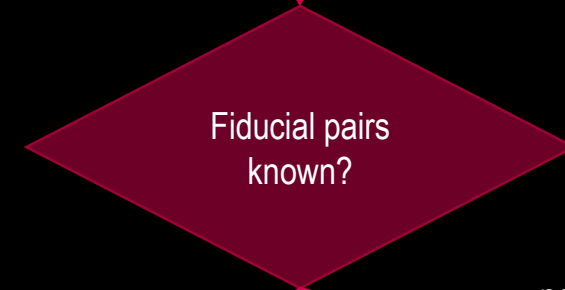
Intensity based

**Fiducial**= any stuff you or the computer can recognise in both images and that will be used for registration

**Not Fiducial**= any stuff NOT USED for registration

« Fiducial » based

EXTRACTION OF « FIDUCIAL »=  
Automatic or manual segmentation.



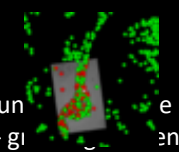
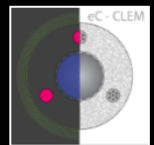
yes

no

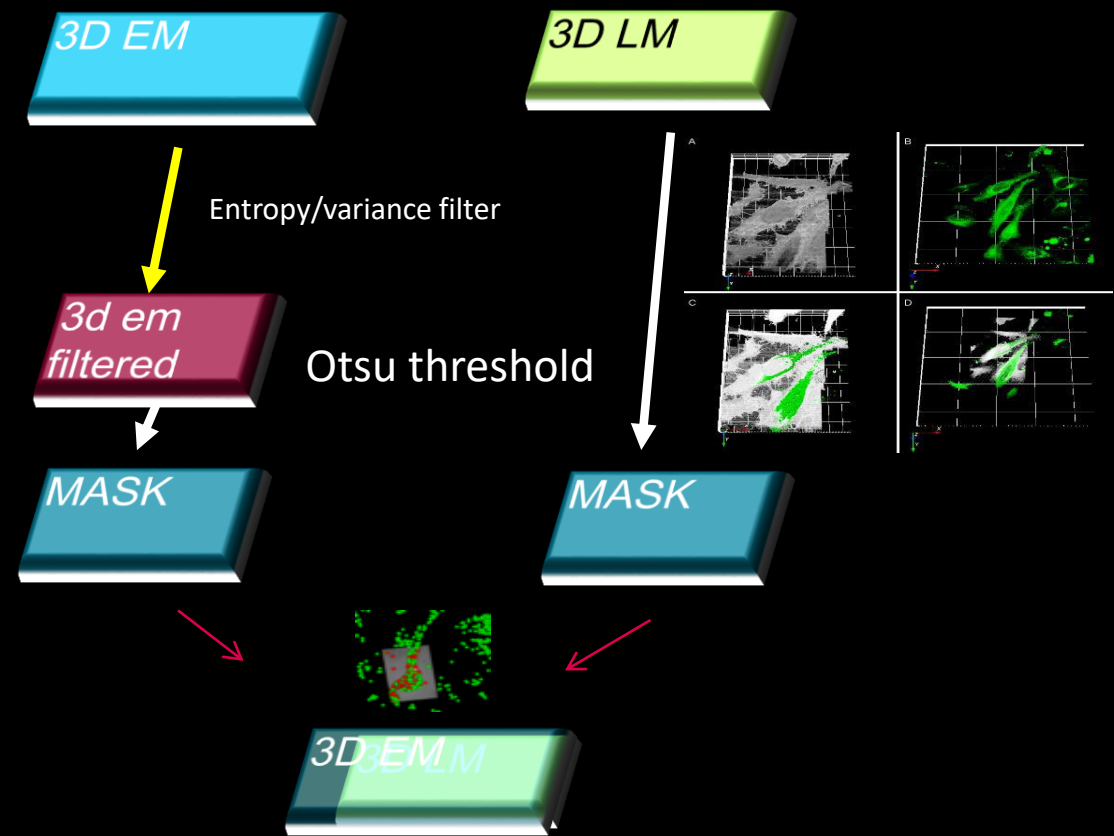
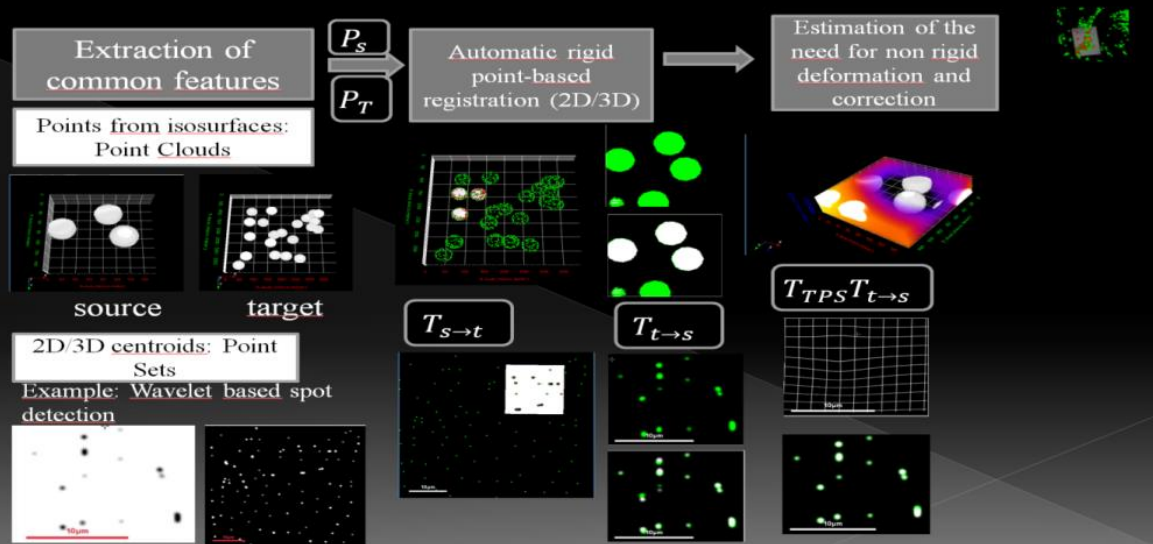
Compute and apply transfo

Propose matching

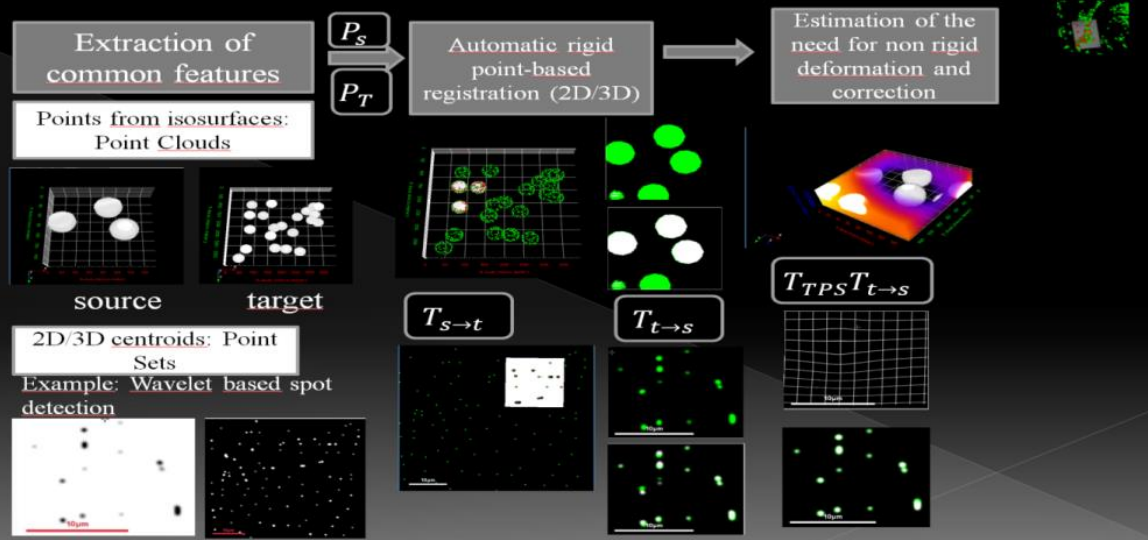
Compute and apply transfo



# Generic approach for automatic registration



# GENERIC APPROACH FOR AUTOMATIC REGISTRATION



3D EM

3D LM

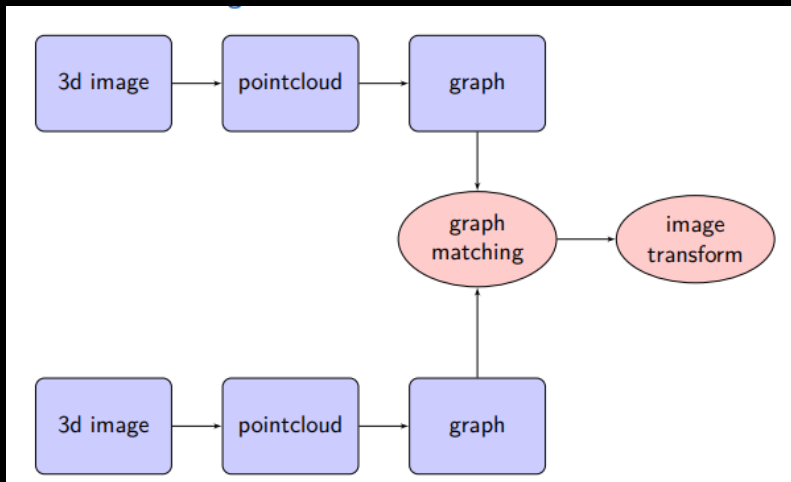
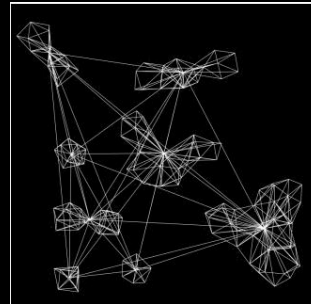
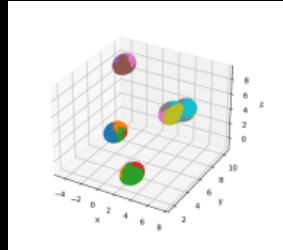
Wavelet Spot detection

Wavelet Spot detection

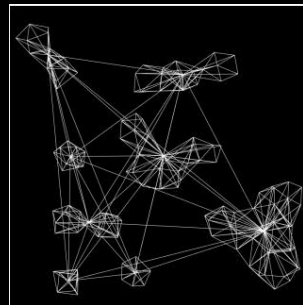
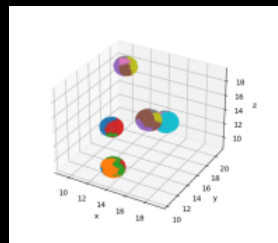
3D<sub>3</sub>EMLM

# Graphs from clusters vertices

## Super Clusters



Graph Matching use information from super clusters and edges

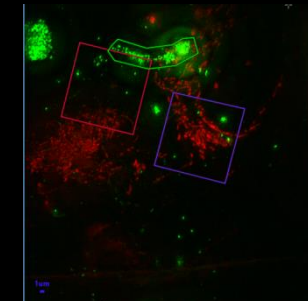
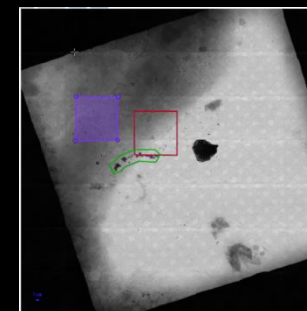
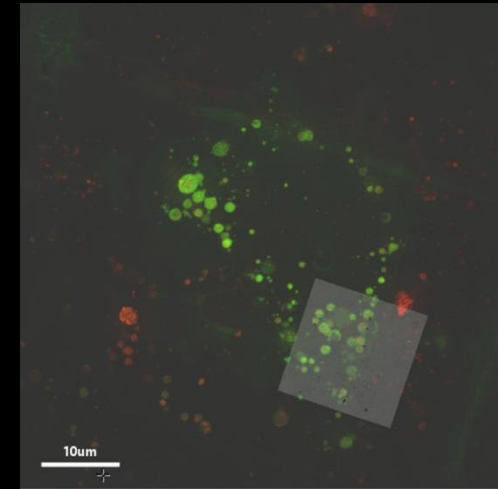
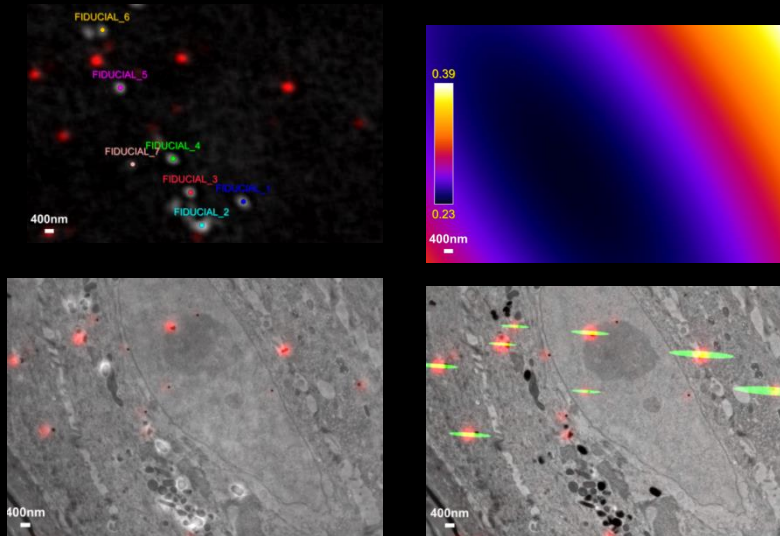


Stephan Kunne

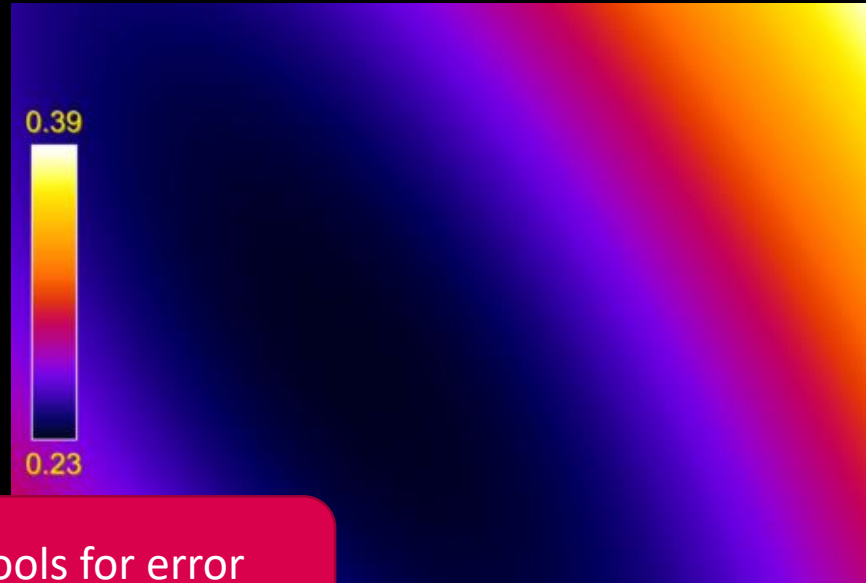
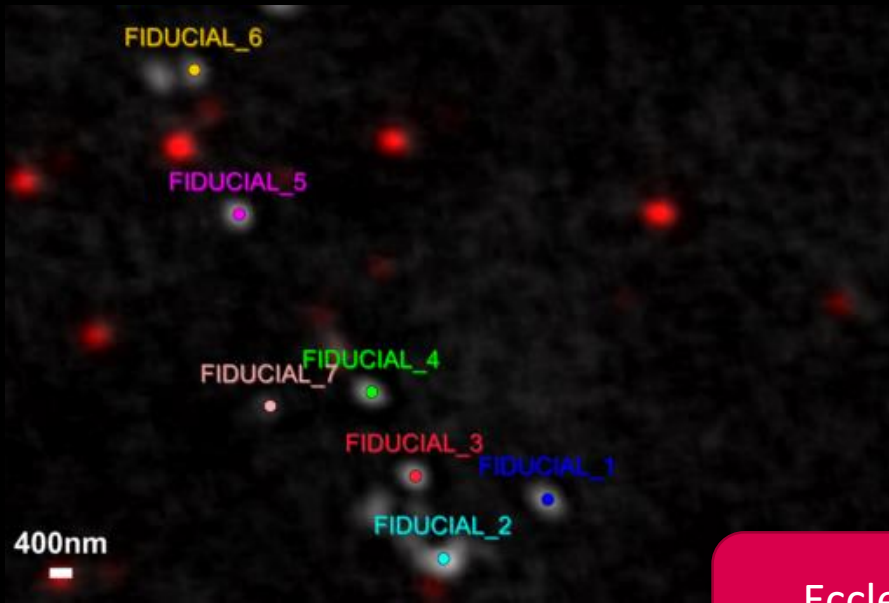


## Ec-clemv2 another plugin of ICY for the new version

- MUCH MORE FASTER
- LESS GREEDY in memory
- New tools for error estimation (colocalization like)
- New Tools to ease your correlative WF constructions (CASCADED TRANSFORM)
- New Tool for visualization

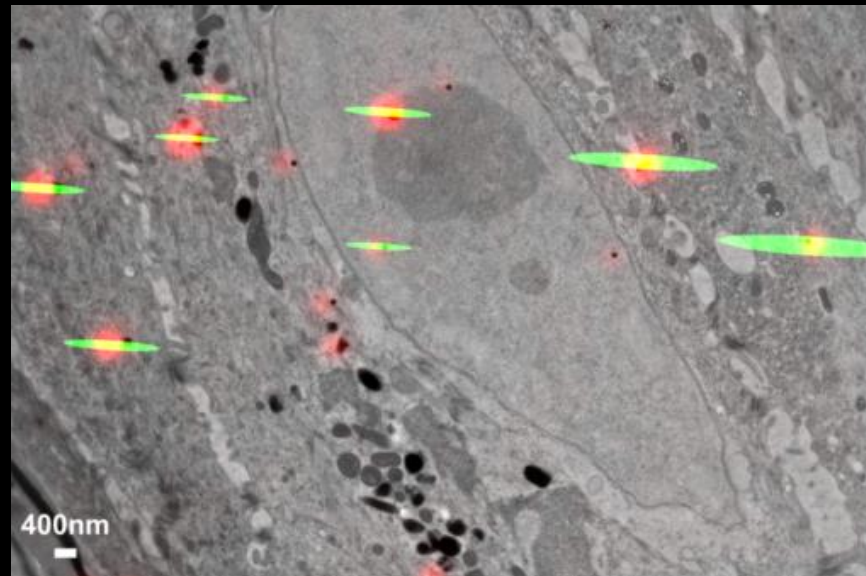
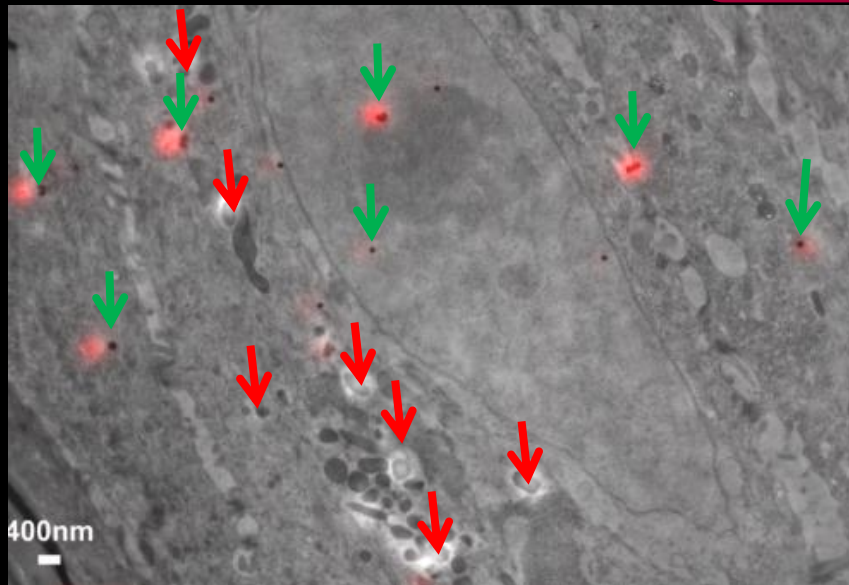
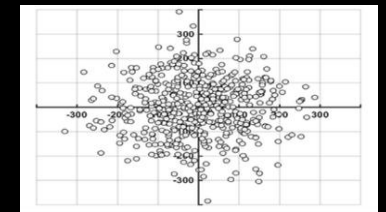


	Name	Conto...	Interior (px)	Area (u...	Mean Inte...	Mean Int...	Max Inte...	Max Intens...	Texture contr...	Texture contrast ...	Texture homogeneity (c...	Texture homogeneity (c...
■	Polygon2D	710.08	20316.5	79.361	13492.1	358.91	154107.3	8919.14	37.886	37.532	0.63182	0.59267
■	Polygon2D	1015.9	64424.5	251.66	7813.26	68.502	124714.1	3707.97	14.366	1.9072	0.78402	0.85863
■	Polygon2D	1011.11	63754	249.04	20290.6	58.312	231600.6	3159.71	66.098	0.99523	0.53865	0.88852

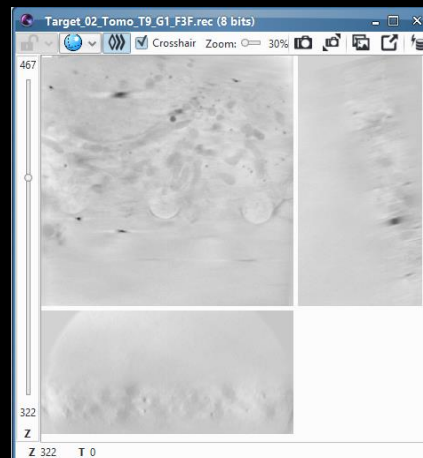
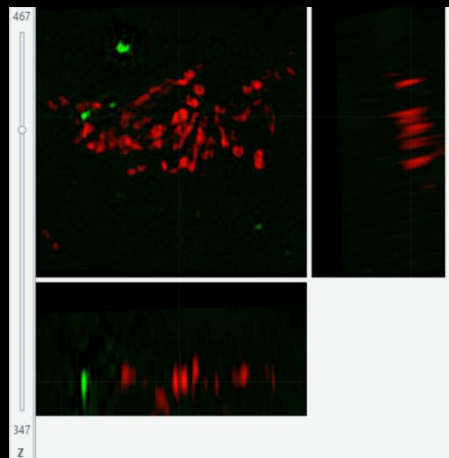
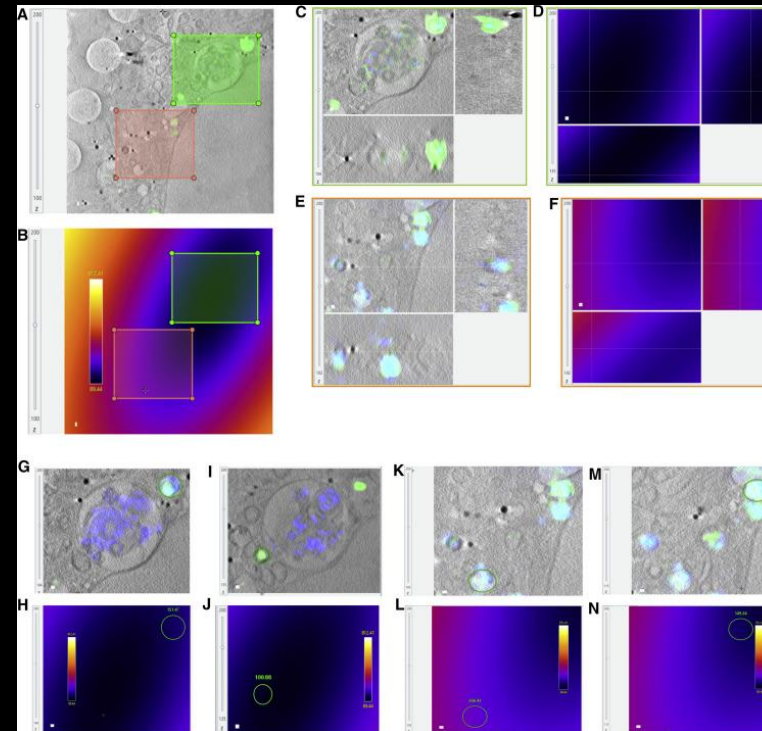
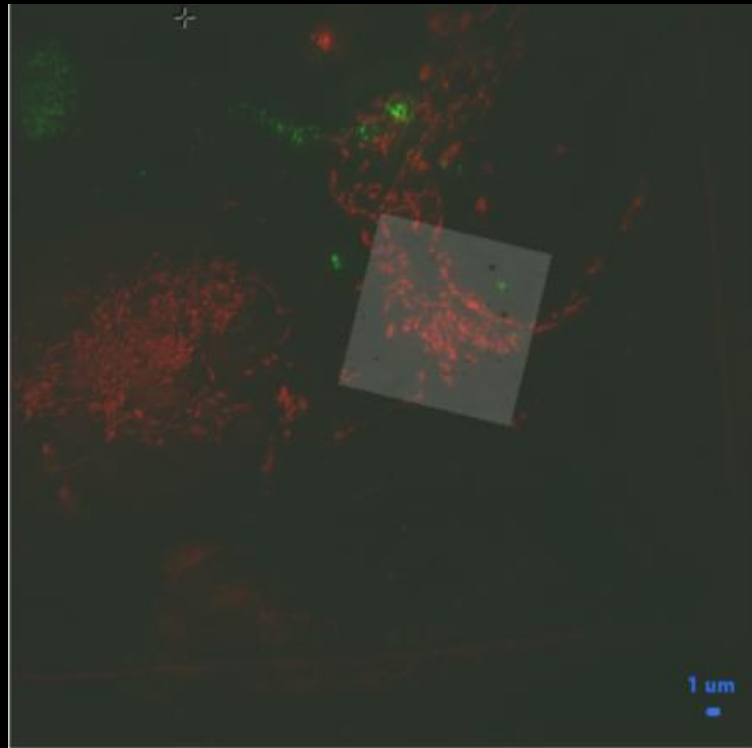


Ecclem Tools for error estimation

Expectation of the distribution of accuracy at each point



Computed confidence ellipses at 95% (Fisher)



Resource  
**3D Correlative Cryo-Structured Illumination  
 Fluorescence and Soft X-ray Microscopy  
 Elucidates Reovirus Intracellular Release Pathway**

Ilias Kounatidis,<sup>1,10</sup> Megan L. Stanifer,<sup>2,10</sup> Michael A. Phillips,<sup>1,3,4,10</sup> Perrine Paul-Gilloteaux,<sup>5,6</sup> Xavier Hellgenstein,<sup>7</sup> Hongchang Wang,<sup>7</sup> Chidinma A. Okolo,<sup>8</sup> Thomas M. Fish,<sup>1</sup> Matthew C. Spink,<sup>1</sup> David I. Stuart,<sup>1,4</sup> Ian Davis,<sup>3</sup> Steeve Boulant,<sup>8,9</sup> Jonathan M. Grimes,<sup>1,4</sup> Ian M. Dobbie,<sup>3</sup> and Maria Harkioliaki<sup>1,11,\*</sup>

<sup>1</sup>Diamond Light Source, Harwell Science and Innovation Campus, Didcot OX11 0DE, UK

<sup>2</sup>Department of Infectious Diseases, Molecular Virology, Heidelberg University Hospital, 69120 Heidelberg, Germany

<sup>3</sup>Micron Advanced Imaging Consortium, Department of Biochemistry, University of Oxford, South Parks Road, Oxford OX1 3QU, UK

<sup>4</sup>Division of Structural Biology, The Henry Wellcome Building for Genomic Medicine, Roosevelt Drive, Oxford, OX3 7BN, UK

<sup>5</sup>Université de Nantes, CNRS, INSERM, l'institut du thorax, Nantes, France

<sup>6</sup>Nantes Université, CHU Nantes, Inserm, CNRS, SFR Santé, Inserm UMS 016, CNRS UMS3556, Nantes, France

<sup>7</sup>CryoCapCell, 155 Boulevard de l'hôpital, 75013 Paris, France

<sup>8</sup>Department of Infectious Diseases, Virology, Heidelberg University Hospital, 69120 Heidelberg, Germany

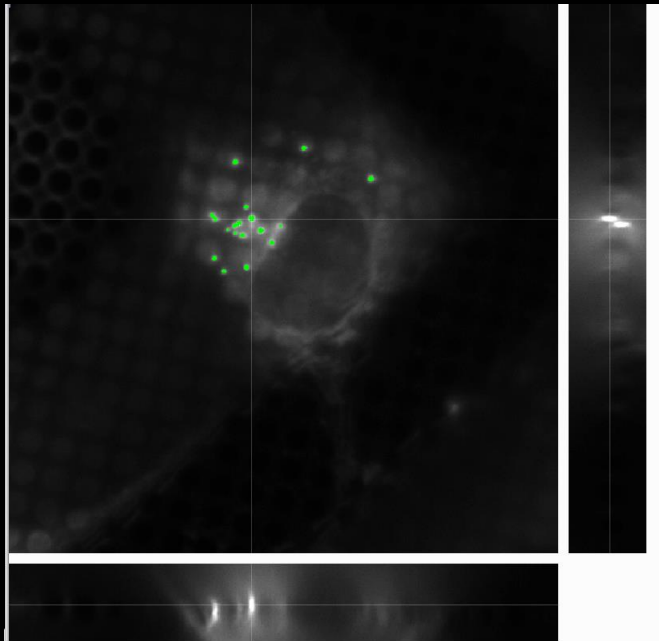
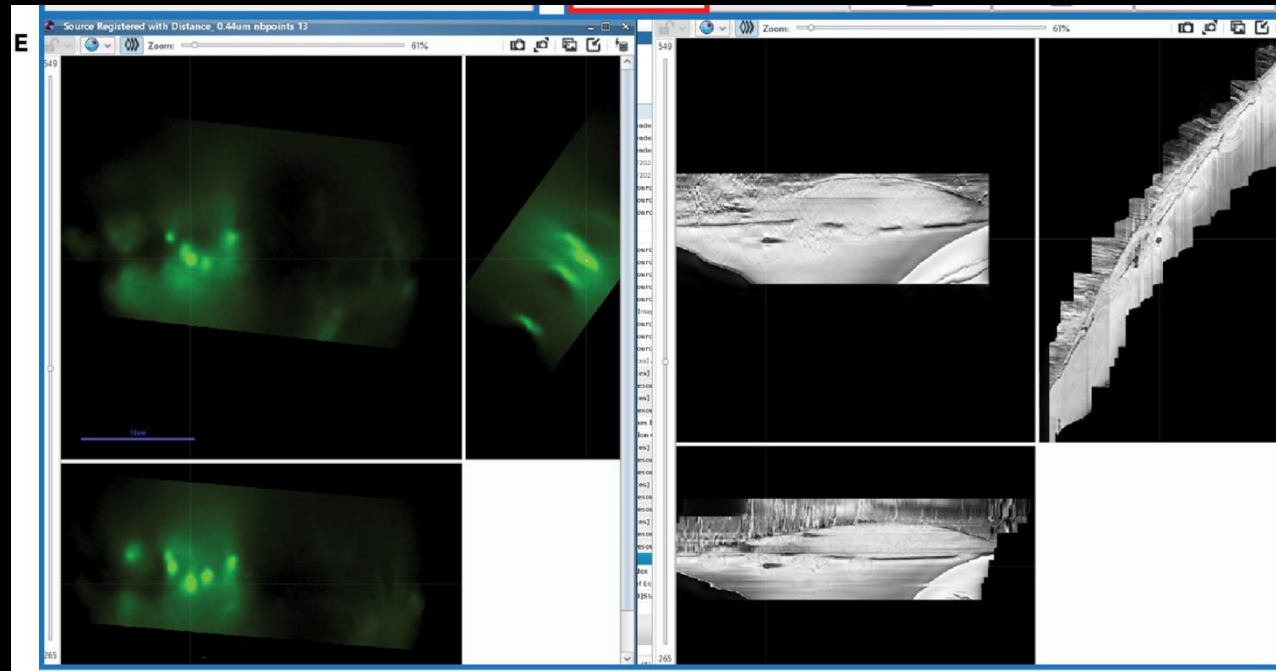
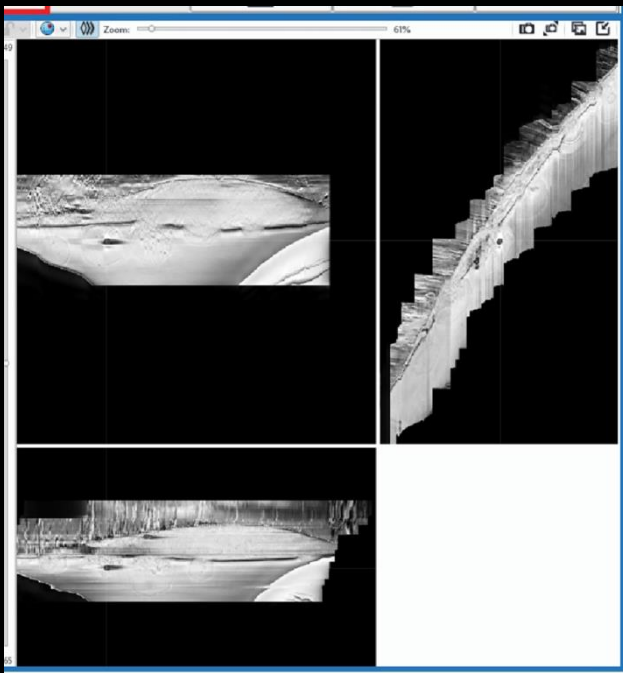
<sup>9</sup>Research Group "Cellular polarity and viral infection," German Cancer Research Center (DKFZ), 69120 Heidelberg, Germany

<sup>10</sup>These authors contributed equally

<sup>11</sup>Lead Contact

\*Correspondence: maria.harkioliaki@diamond.ac.uk

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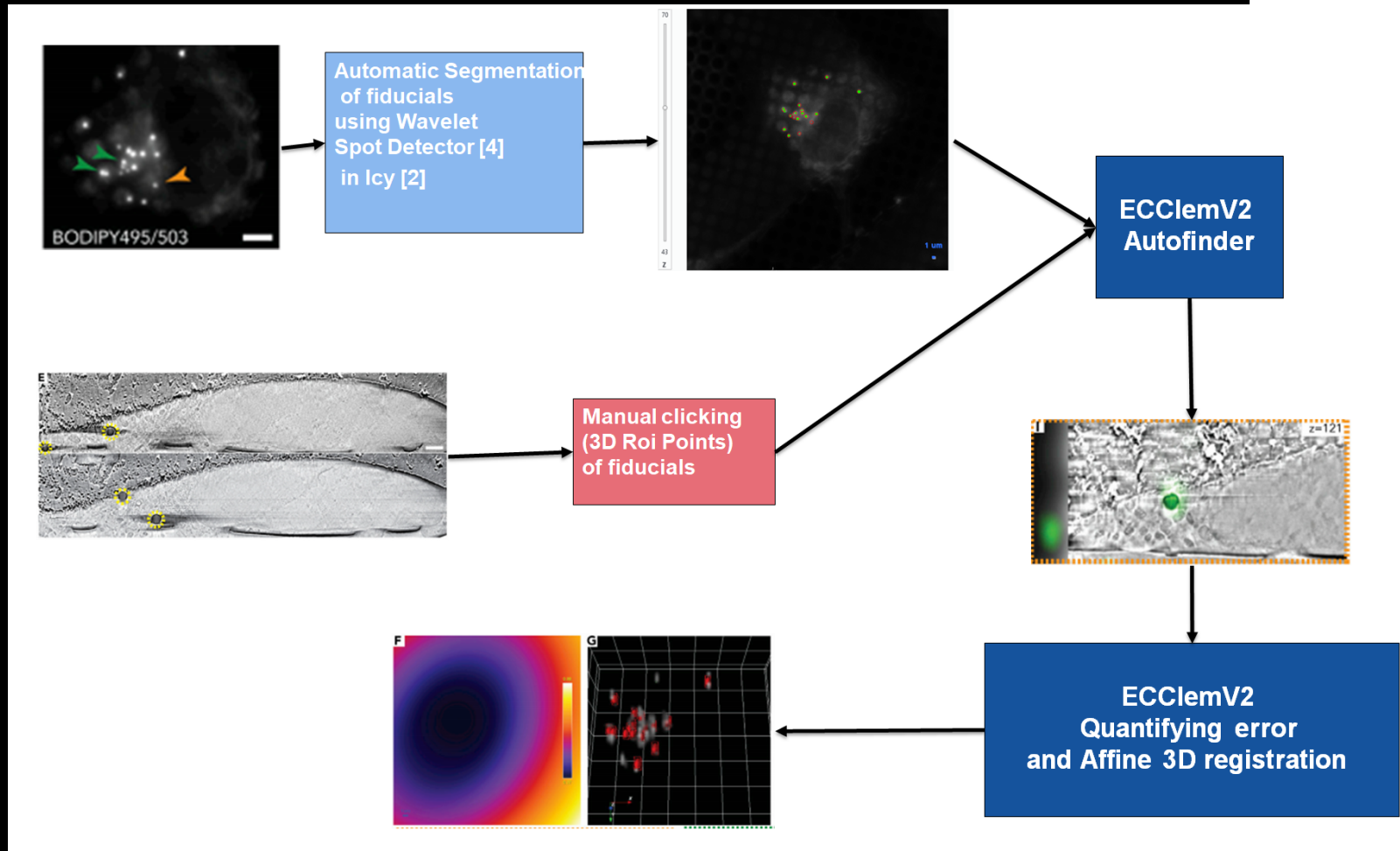
Article

## *In situ* fiducial markers for 3D correlative cryo-fluorescence and FIB-SEM imaging

Nadav Scher<sup>1</sup>, Katya Rechav<sup>2</sup>, Perrine Paul-Gilloteaux<sup>3</sup>, Ori Avinoam<sup>1,4</sup> [ORCID](#) [Email](#)

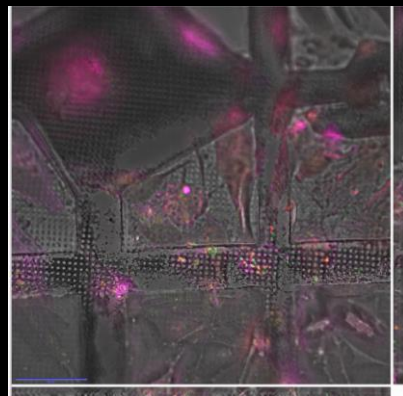
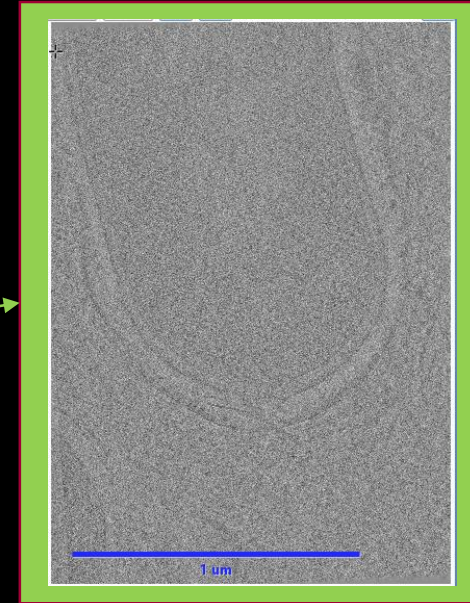
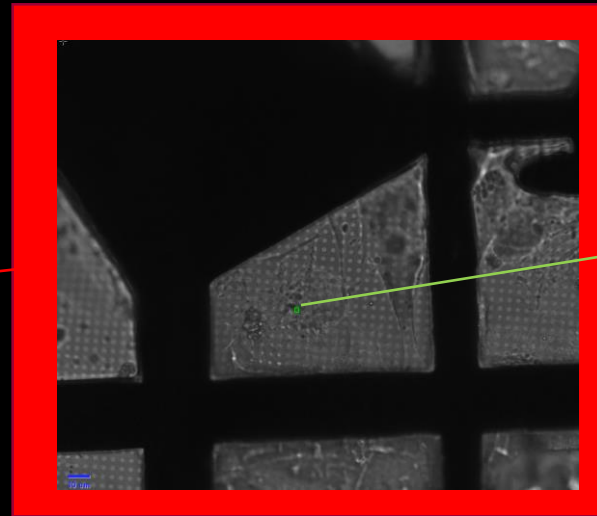
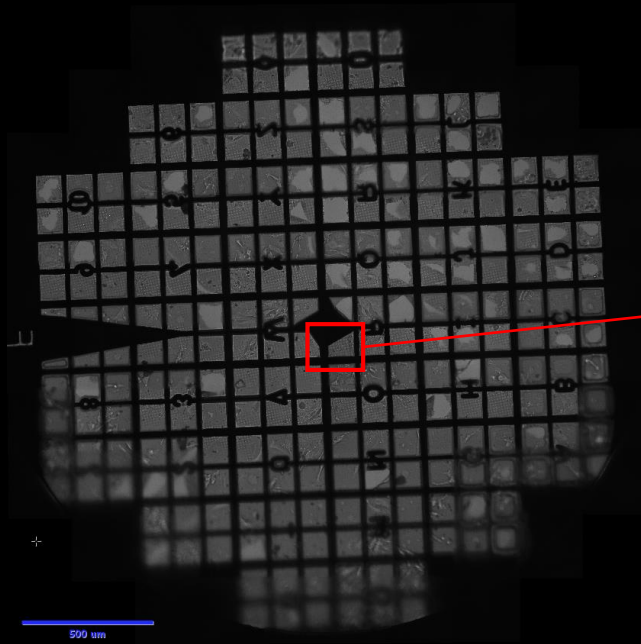


# EXample of created workflow: Cryo FIB SEM and Cryo WF



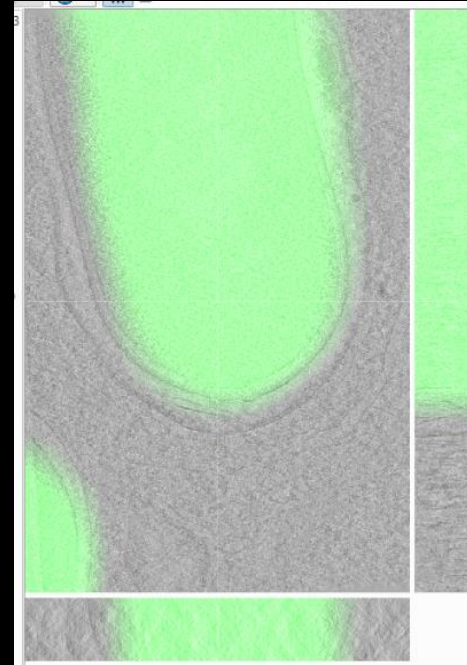
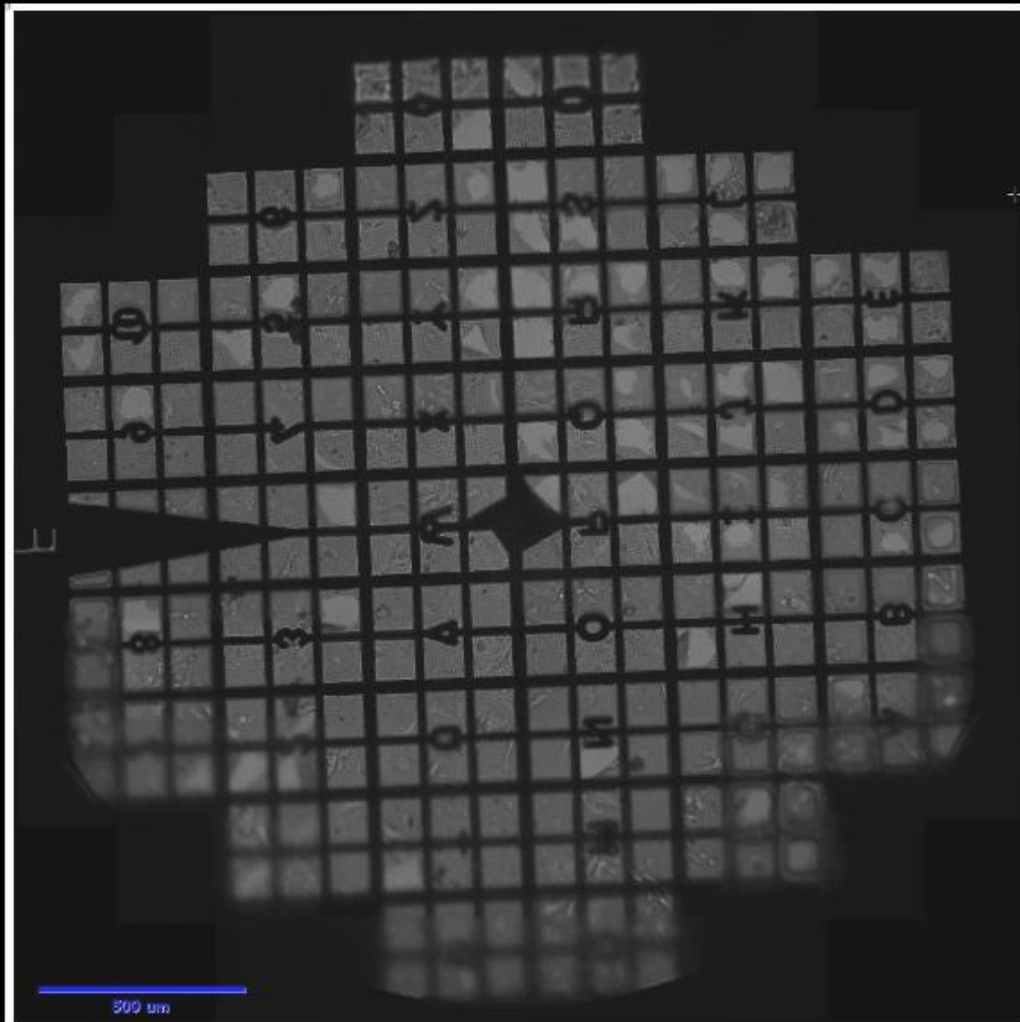
# In situ lamella

Unpublished work



Lea Swistak, Marvin Albert,  
Anna Sartori, Jost Enninga  
Institut Pasteur Paris

## Unpublished work



Acquisition:

Get Fluorescent Stack of area with bacteria :

Target Area on the grid to make multiple lamella: link known

Pick all Bacteria that can be found on the lamellae for

Cryo-TEM:

link lost

-> **Need for automation of Tomograph-Fluo matching**



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Philippe Hulin

Magalie Feyeux

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Anne Gaignerie

*Marianne Guisset*

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## EC-CLEM workflows

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Lea Swistak

Jost Enninga

Anna Sartori

Marvin Albert

Weizmann Institute

Nadav Scher

Katya Rechav

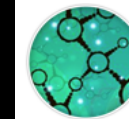
Ori Avinoam

Diamond Light Source

Maria Harkiolaki

Nina Vyas

All team



FRANCE-BIOIMAGING