

# COMPUTATIONAL BIOMEDICAL IMAGING

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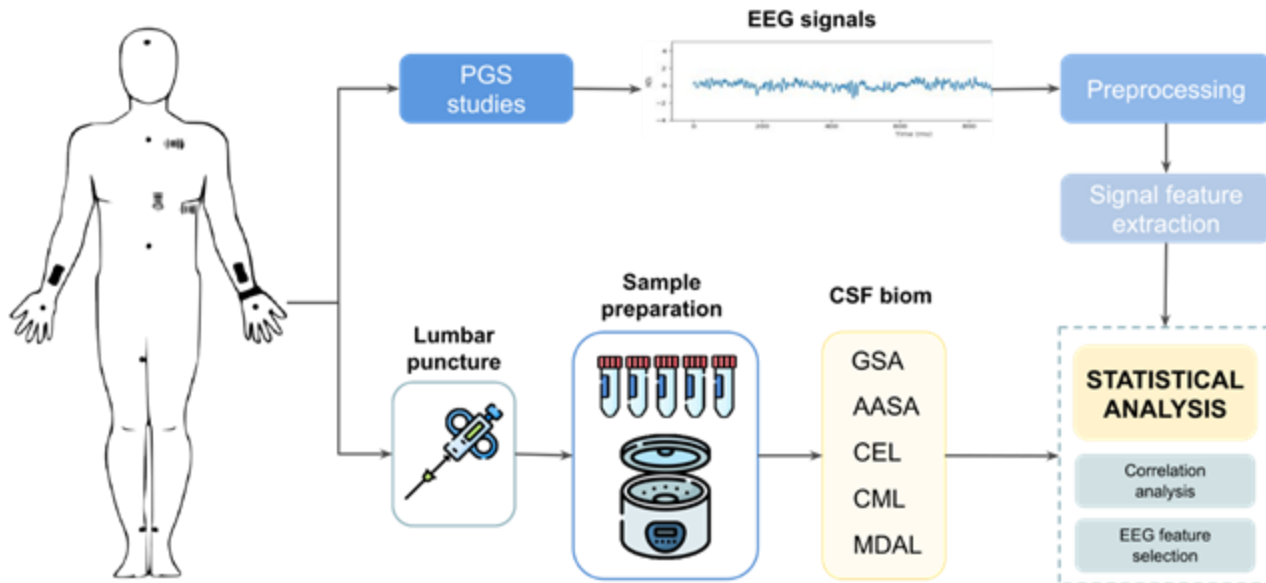


Cutting-edge research, knowledge for society and open science

<https://www.youtube.com/watch?v=I72QSPTzsBQ>

## PREDICTION OF STRESS OXIDATIVE MARKERS

### Workflow



### Cerebrospinal Fluid Biomarkers

**GSA** (glutamic semialdehyde)

**AASA** (amino adipic semialdehyde)

**CEL** (N- $\epsilon$ -(carboxyethyl)lysine)

**CML** (N- $\epsilon$ -(malondialdehyde)lysine)

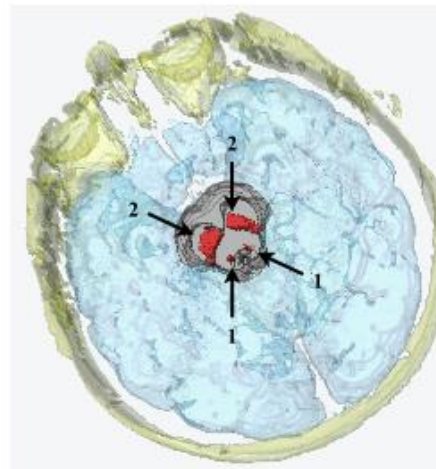
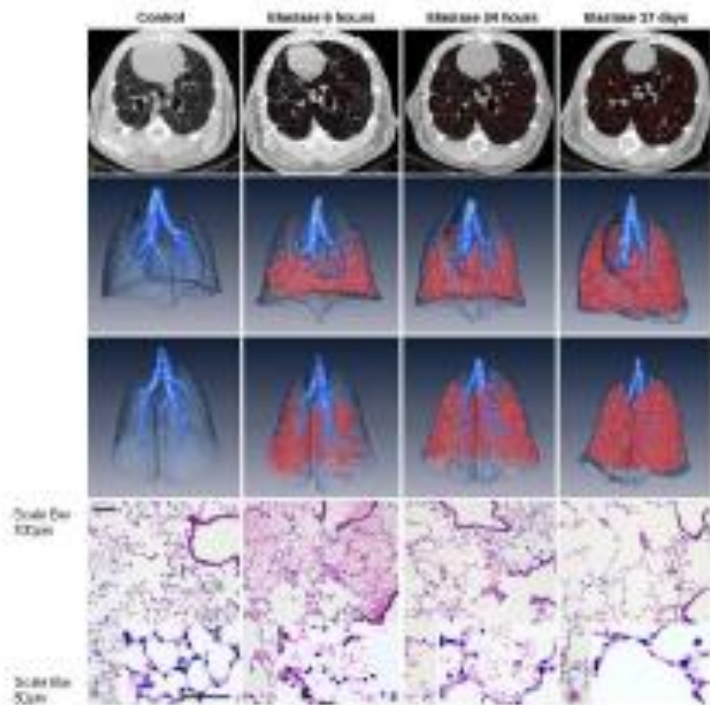
**MDAL** (N- $\epsilon$ -(Carboxymethyl)lysine)

A. M. Gaeta et al. bioRxiv (2025)

L. Gallego et al., IEEE J Biomed & Health Inf (2025)

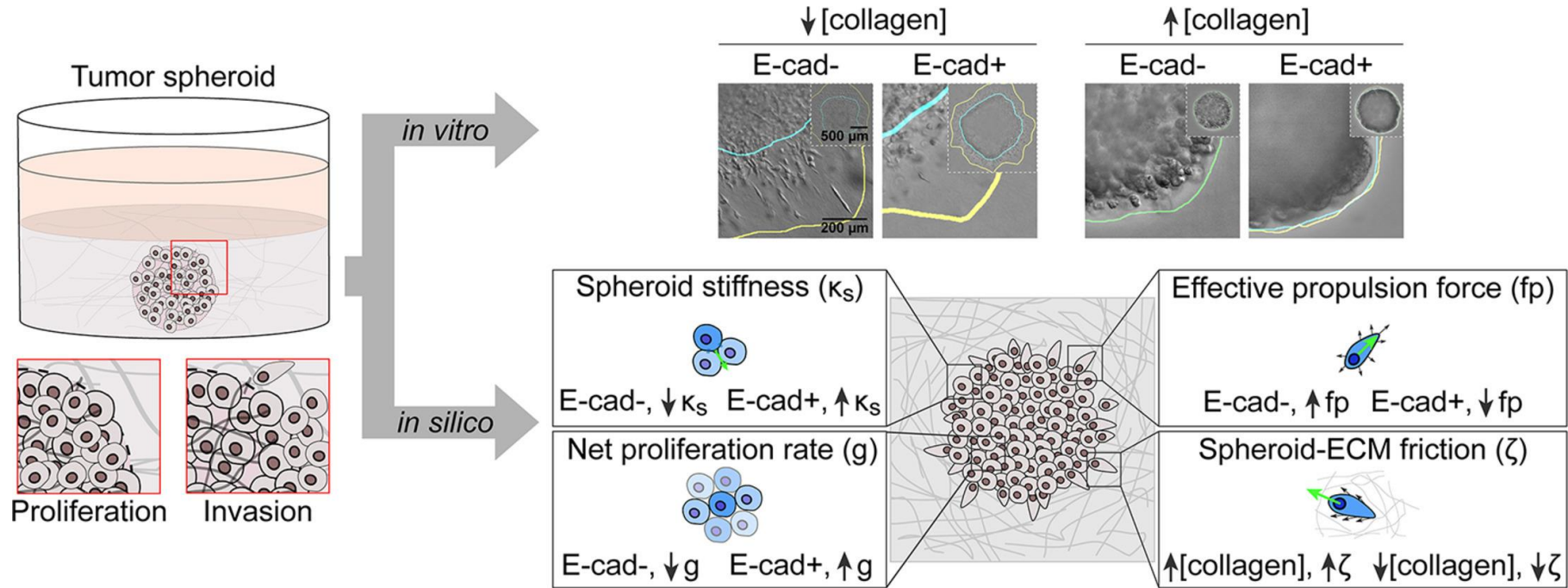
A. M. Gaeta et al. Front Aging Neuroscience (2024)

## QUANTITATIVE RADIOLOGY



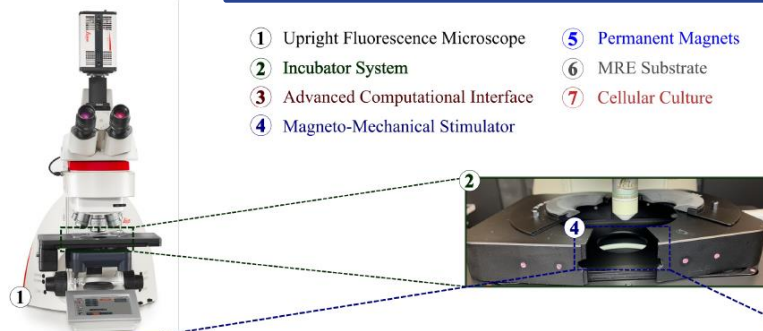
- X. Artaechevarria et al., IEEE TMI, 2009  
A. Muñoz-Barrutia et al., J Biomed Imaging, 2012  
M. Ariz et al., IEEE TMI, 2019  
X. Artaechevarria et al., Eur Rad, 2009  
P. M. Gordaliza et al., Scientific Reports, 2018  
R. D. Rudyanto et al., Med Imag Analysis, 2013

## MODELING OF BIOLOGICAL SYSTEMS



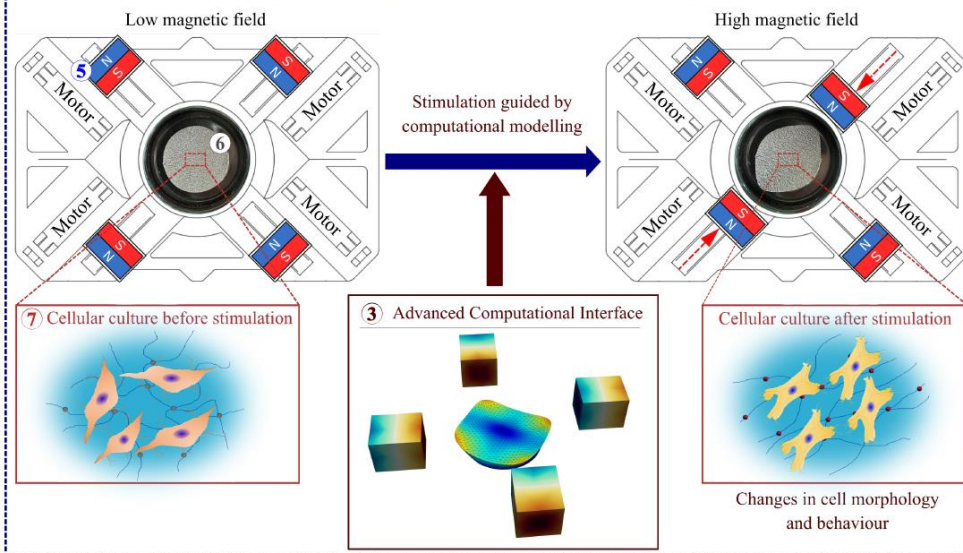
A. J. Crawford et al., Acta Biomaterialia (2024)

D. Garcia-Gonzalez & A. Muñoz-Barrutia, Extreme Mechanics Letters (2020)



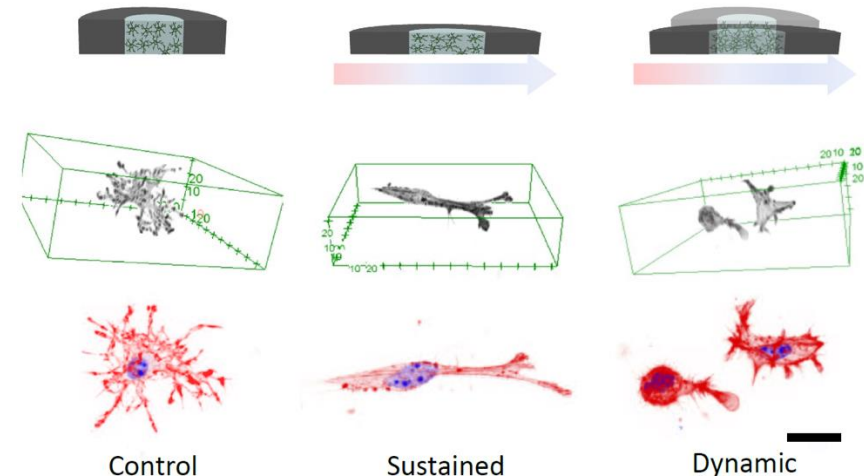
- ① Upright Fluorescence Microscope
- ② Incubator System
- ③ Advanced Computational Interface
- ④ Magneto-Mechanical Stimulator
- ⑤ Permanent Magnets
- ⑥ MRE Substrate
- ⑦ Cellular Culture

④ Scheme of Magneto-Mechanical Stimulator Functioning

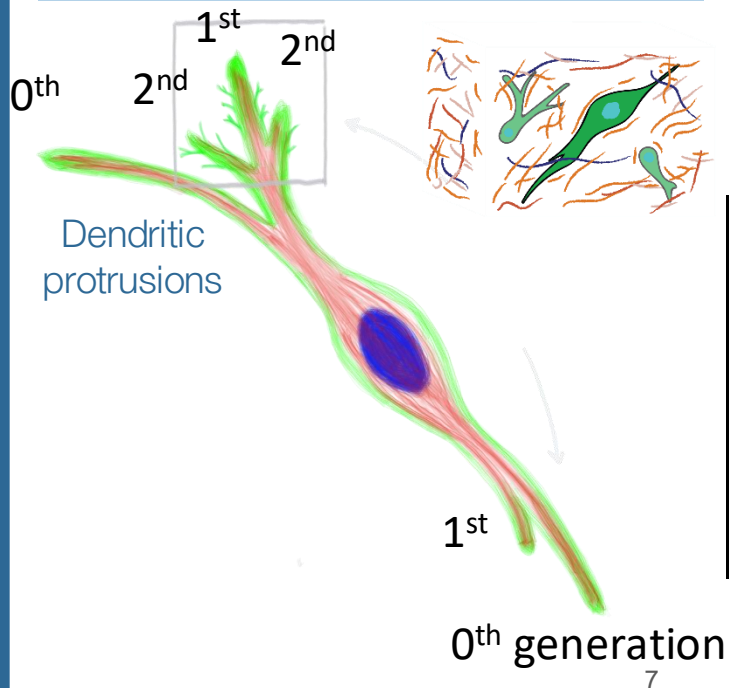


## CHARACTERIZATION OF THE RESPONSE TO MECHANICAL PERTURBATIONS

**a** Mag. field OFF    **b** Mag. field ON    **c** Mag. field ALTERNATING



Astrocytes cultured in 3D

CHARACTERIZATION OF  
3D MIGRATION

What is the role of cellular protrusions in 3D  
mesenchymal cell migration?

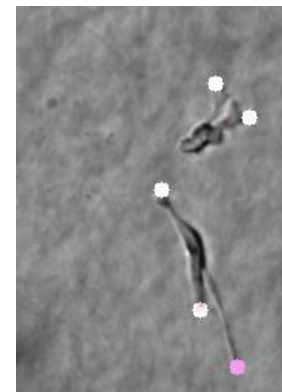
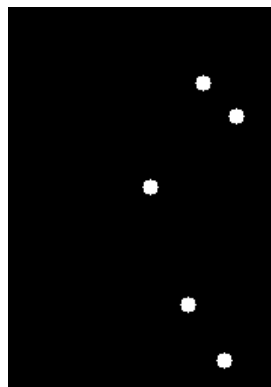
**BioImage analysis**

Cell  
segmentation

Protrusion  
detection

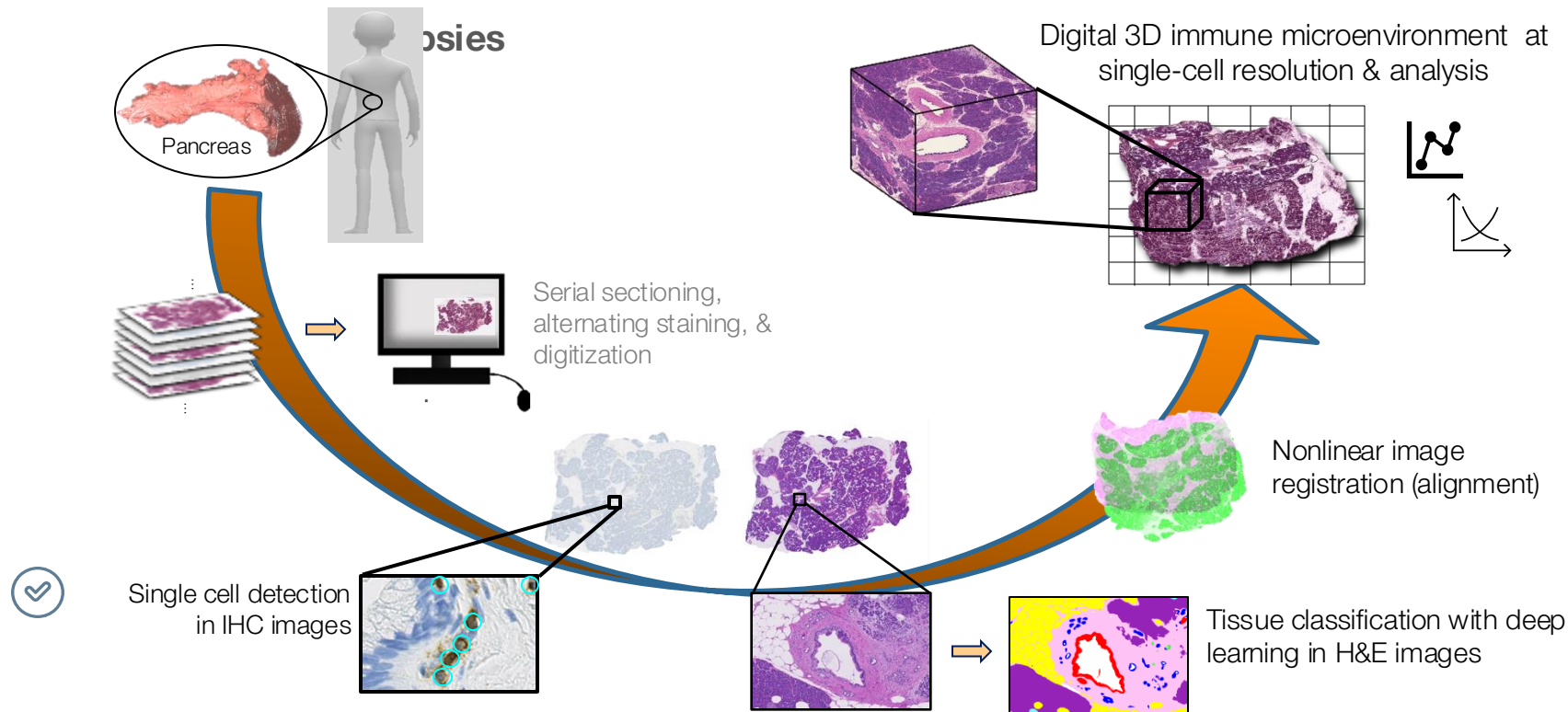
Cell tracking

Protrusion  
tracking



M. Maska et al., Nat Methods (2023)  
P. R. Nair et al., Science Advances (2024)  
E. Gomez-de-Mariscal et al., arXiv (2021)

## DL enabling cellular and tissular quantification on whole

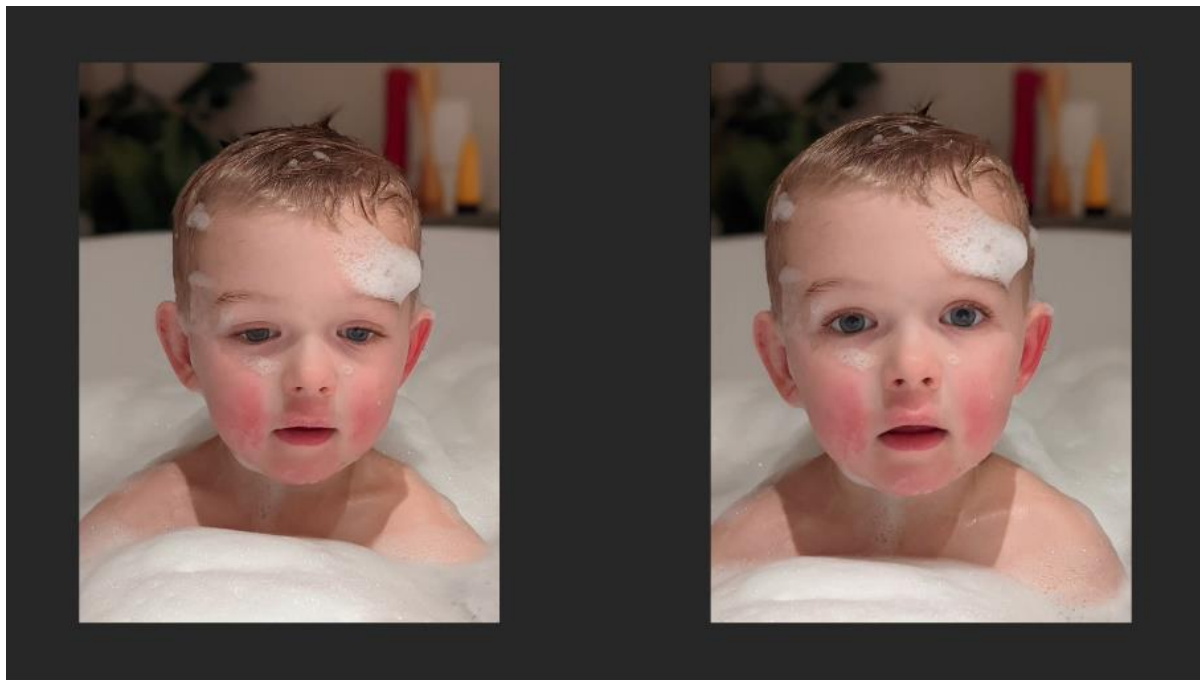


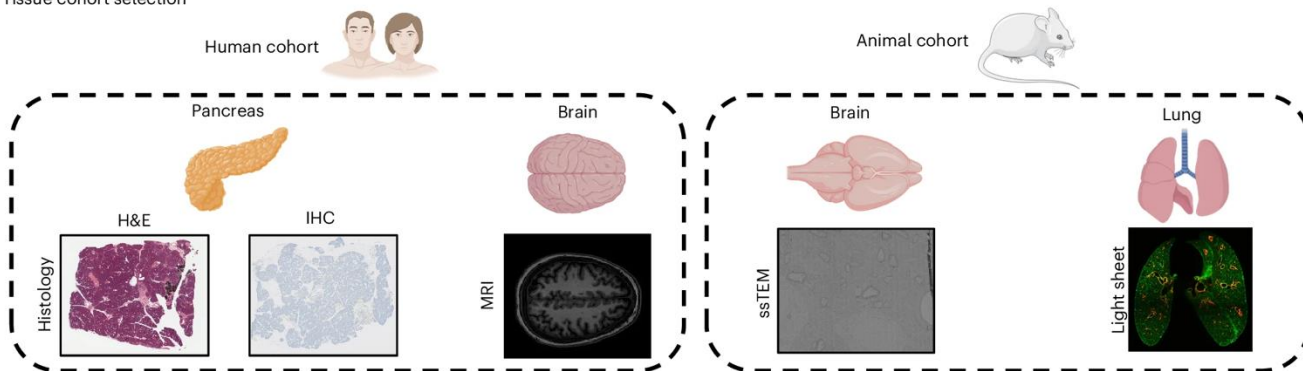
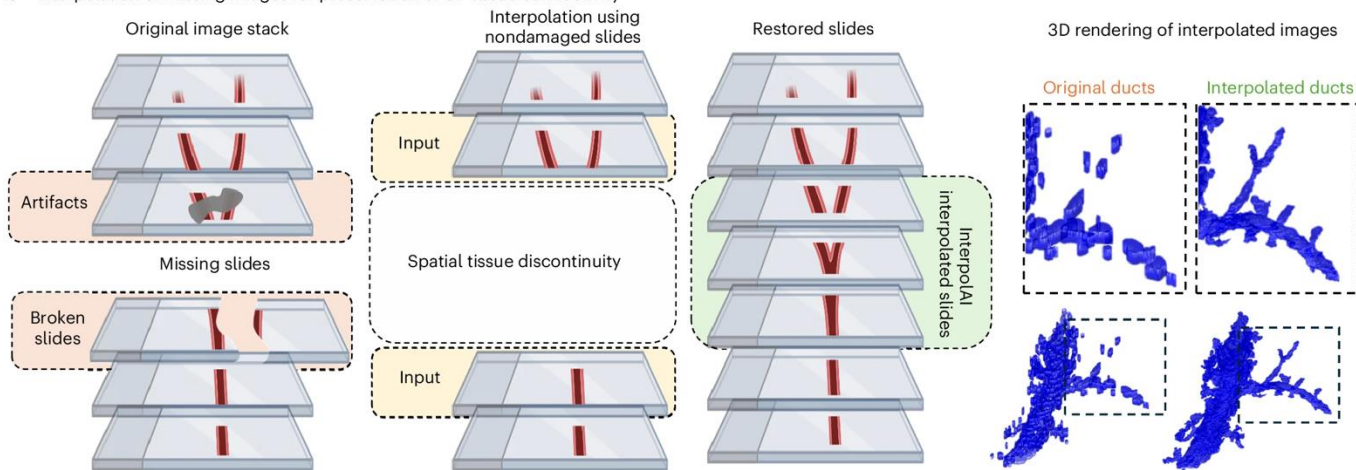
V. Matos-Romero et al., bioRxiv (2025)

A. L. Kiemen et al., bioRxiv (2024)

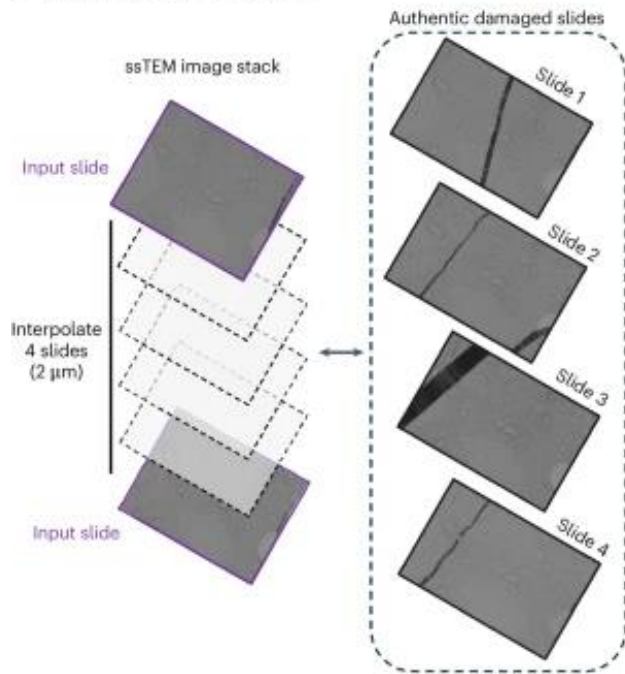
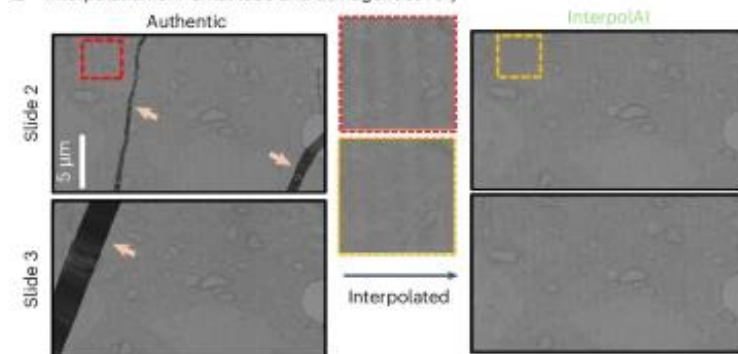
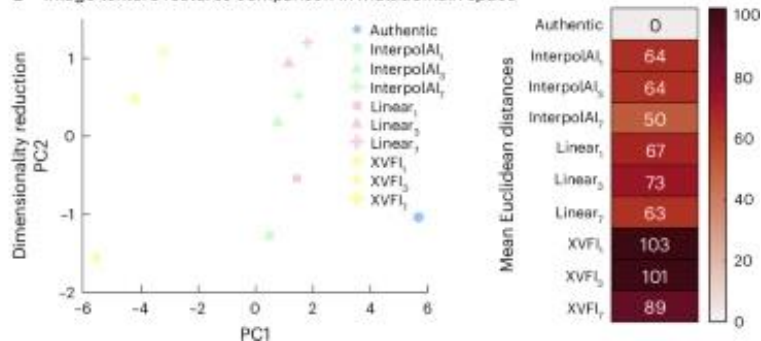
## Frame Interpolation for Large Image Motion (FILM)

<https://film-net.github.io/>



**a** Tissue cohort selection**b** Interpolation of missing images for preservation of 3D tissue connectivity

## The FILM

**a** Interpolation of 4 ssTEM images**b** Interpolation of frontal lobe and damage recovery**c** Image texture features comparison in multidomain space

# FAIR DEEP LEARNING FOR BIOIMAGE ANALYSIS

The AI4Life approach

<https://ai4life.eurobioimaging.eu>



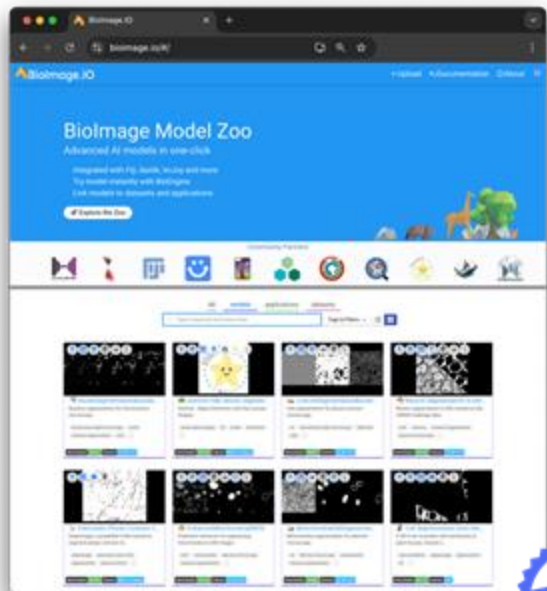
<https://doi.org/10.1101/2022.06.07.495102>

# BioImage Model Zoo

An open-source repository for FAIR AI models



<https://doi.org/10.1101/2022.06.07.495102>



segmentation

denoising

image-reconstruction

object-detection

image-classification

semantic-segmentation

image-restoration

2d

3d

pytorch

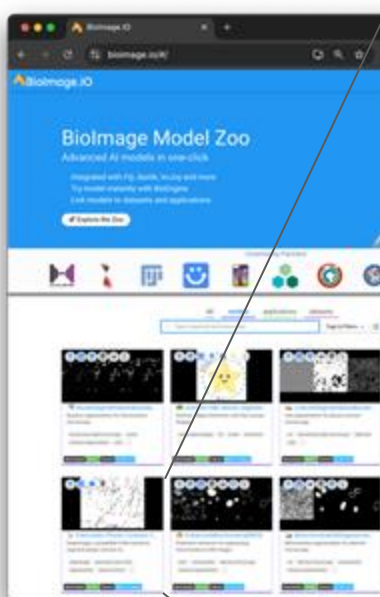
tensorflow

whole-slide-imaging

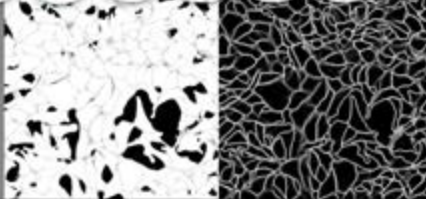


# BioImage Model Zoo

An open-source repository for FAIR AI models







 **LiveCellSegmentationBoun...**

Cell segmentation for phase-contrast microscopy.

2d transmission-light-microscopy

label-free cells ...

10.5281/zenodo.5869899 downloads **45822**

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  LiveCellSegmentationBoundaryModel

## U-Net for Livecell Segmentation

This model segments cells in phase-contrast microscopy images, which are often used in live-cell imaging. It predicts boundary maps and foreground probabilities. The boundaries can be processed e.g. with Multicut or Watershed to obtain an instance segmentation.

### Training

The network was trained on data from the [LiveCell](#) publication. The training script can be found [here](#). This folder also includes example usages of this model.

### Training Data

- Imaging modality: phase-contrast microscopy
- Dimensionality: 2D
- Source: <https://doi.org/10.1038/s41592-021-01249-6>

### Recommended Validation

It is recommended to validate the instance segmentation obtained from this model using intersection-over-union. See [the validation script](#). This model can also be used in ilastik, deepimageJ or other software that supports the bioimage.io model format.

### Training Schedule

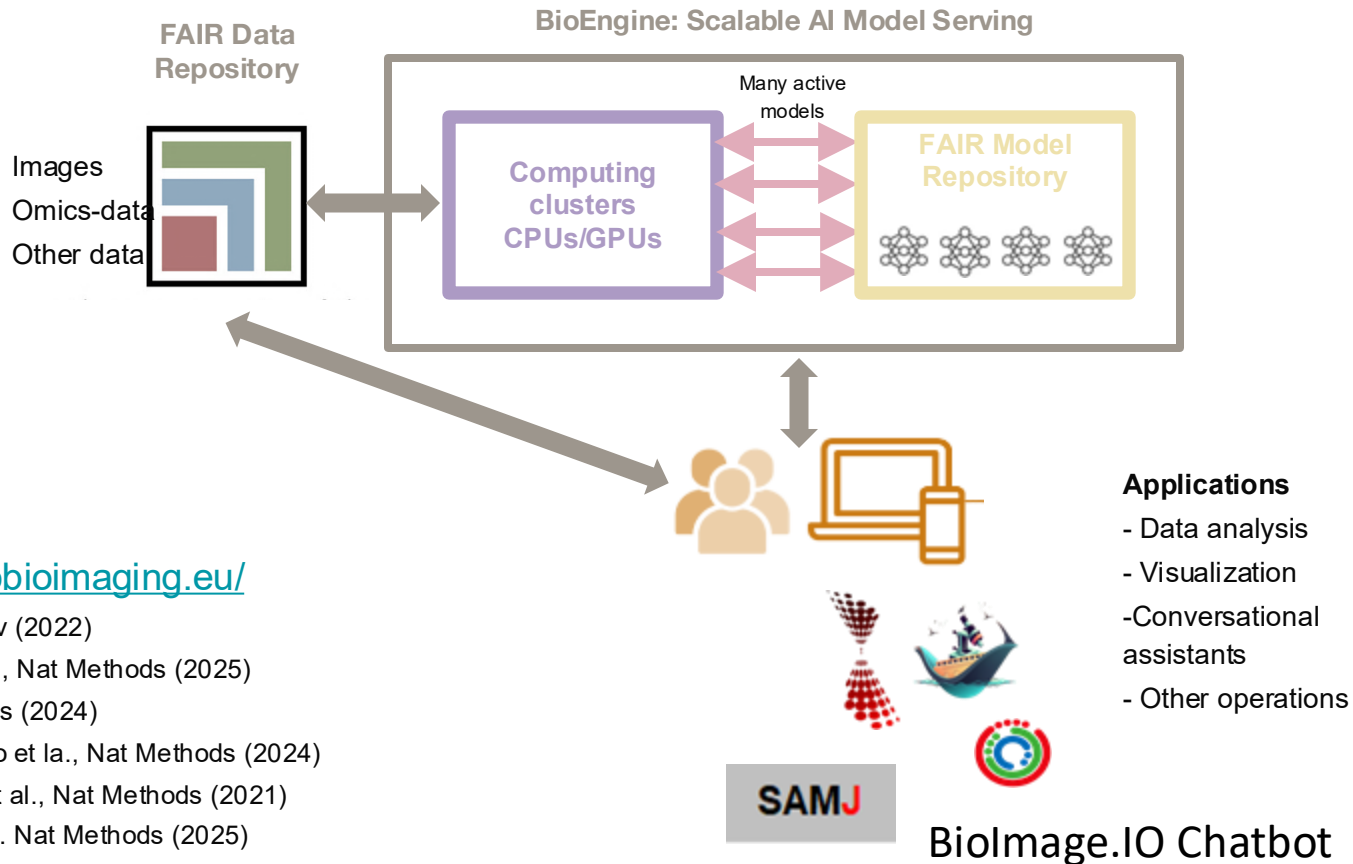
n\_epochs: 133 batches\_per\_epoch: 407 batch\_size: 8 loss\_function: DiceLoss optimizer: Adam learning\_rate: 0.0001 n\_train\_images: 3253 n\_validation\_images: 570

### Contact

For questions or issues with this models, please reach out by:

- opening a topic with tags `bioimageio` and `livecellsegmentationboundarymodel` on [image.sc](#)

# The AI4Life Ecosystem Overview



<https://ai4life.eurobioimaging.eu/>

W. Ouyang et al., bioRxiv (2022)

T. Zulueta-Coarasa et al., Nat Methods (2025)

W. Lei et al., Nat Methods (2024)

C. Garcia-Lopez-de-Haro et al., Nat Methods (2024)

E. Gomez-de-Mariscal et al., Nat Methods (2021)

D. Franco-Barranco et al. Nat Methods (2025)

- **AI-powered bioimage analysis** for biomarker discovery, supporting predictive and personalized medicine ([HORIZON-HLTH-2026-01-TOOL-01](#)).
- **Digital pathology workflows** and **spatial omics integration** for cancer and neurodegenerative diseases.
- Co-development of **FAIR and reusable AI workflows**, building on open-source tools (e.g., deepImageJ, BiaPy, BioImage.IO).
- Joint initiatives in **generative AI for biomedical imaging** (e.g., HORIZON-HLTH-2025-01-TOOL-03).
- Synergies in **mental and neurodevelopmental disorders**, combining multimodal data and interpretable ML.
- Collaborative projects on **resilient and sustainable health systems** using federated learning and high-performance computing.