# Fusion of MRI and MALDI images for the study of the development of wheat grains

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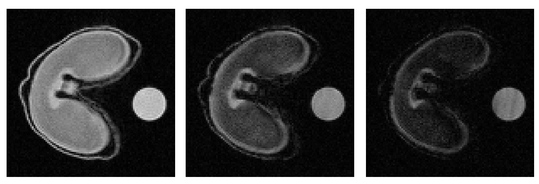
**Water transfers** in the wheat grain: transportation of essential molecules, made possible by the porosity of cell walls

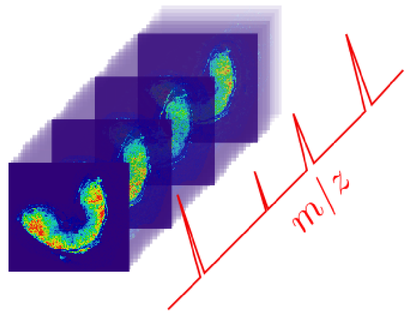
⟶ Search for the cell wall molecules in MALDI which **co-localize** with water in MRI

## New workflow for the fusion of MALDI and MRI images



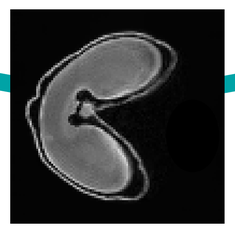
**MRI**
Water distribution
4D images (3D + time)
Rician noise

**MALDI**
Molecule distribution
3D (2D slices + spectra)



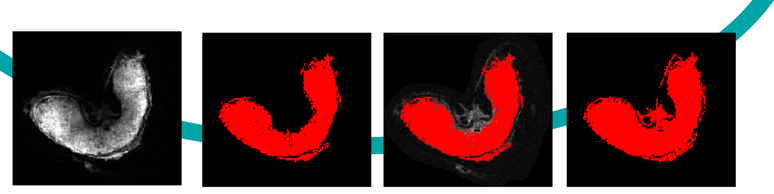

### Filtering
Rician noise removal by a non-local means method [1].

### Processing
Density and T2* image estimation



### Spectrum processing
Peak picking, realignment, deisotoping.

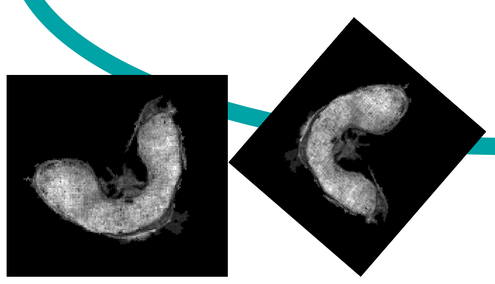
### Segmentation
Region growing on a relevant subset of images



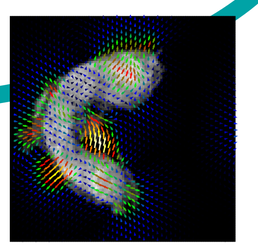
*Refinement of the segmentation in MALDI by considering several images of different molecules*

### Registration

**Rigid**
Rotation, scaling, translation

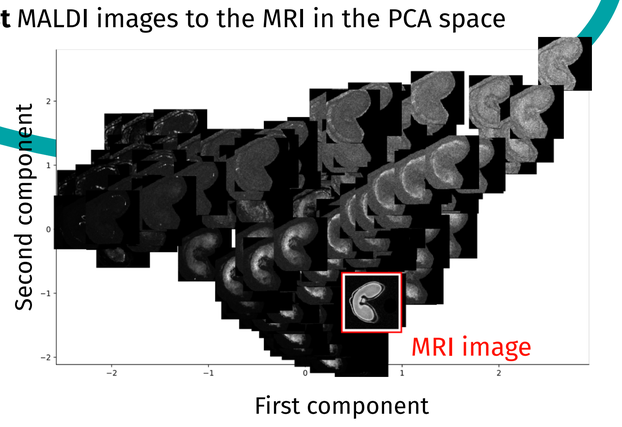


**Non-rigid**
Variational method of [2]: displacements modelled by a vector field



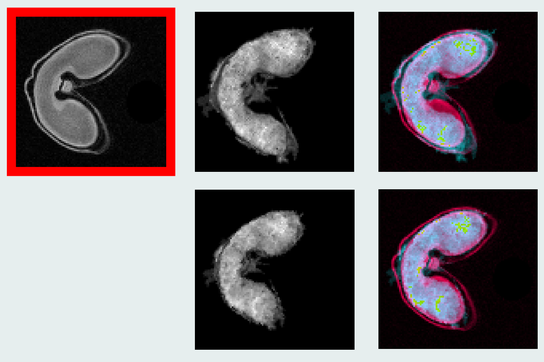
### Statistical analysis

1. **PCA** on MALDI images
2. Projection of the MRI image onto the PCA axes
3. **Closest** MALDI images to the MRI in the PCA space




## Results

Common pixels: rigid: **85.8%**
+ non-rigid: **97.4%**




**Top 3** MALDI molecules which correlate the most with the MRI image

AX6 AX7 AX8

AX N = **arabinoxylan** (polysaccharide) with N chemical group substitution

## Take-home points

- A **new workflow** for the fusion of MRI and MALDI images
- **Variational registration** compensates for deformations in MALDI
- Can be **reused** for any image fusion problem which aims at finding correspondences between images

[1] Wiest-Daesslé N et al. (2008) Rician noise removal by non-Local Means filtering for low signal-to-noise ratio MRI: applications to DT-MRI. In: Med Image Comput Comput Assist Interv. 2008 (MICCAI)

[2] Fischer B., Modersitzki J. (2006) Image fusion and registration: a variational approach. In: Computational Science and High Performance Computing II, vol 91. Springer.