PhD position: statistical modelling of wheat grain growth from several imaging modalities

Context

Wheat is the second-most produced cereal crop in the world and the first in Europe. It is mainly targeted to food and animal feed. Grain yield tends to stagnate while the global population increases. One strategy to overcome yield stagnation is to increase the final weight of individual grain. Moreover, the shape of the wheat grain with a deep crease complicates its processing for floor production. A better knowledge of grain shape determinism during its development would help enhance yields and grain processing.

Following fertilization, the grain is mainly composed of the pericarp that grows with a short period of cell proliferation followed by cell expansion. Growth is neither spatially uniform nor steady and lead to a heart-shape grain with lobes and a crease. A mechanical role of the outer cell layers in the size determination of the wheat grain has been suggested, but the underlying mechanisms remain unknown. The understanding of these mechanisms requires the kinematic and quantitative characterisation of the grain shape and volume and of the organisation of tissues including outer layers. This relies on the use of imaging methods at the different characteristic scales: cell wall, cell, tissue. In particular, confocal microscopy allows local characterisation of cell wall (morphology, composition), whereas 3D computerized tomography makes it possible to apprehend the shape and the size of the whole grain and its compartments (see figure). At an intermediate scale, fluorescence macroscopy combines a large field of view with multispectral information.

The comprehension of the **morphogenetic mechanisms** of the grain outer layers requires the development and the implementation of **quantitative characterisation of images** obtained from these modalities, as well as the **fusion of the information** obtained at the various acquisition scales.

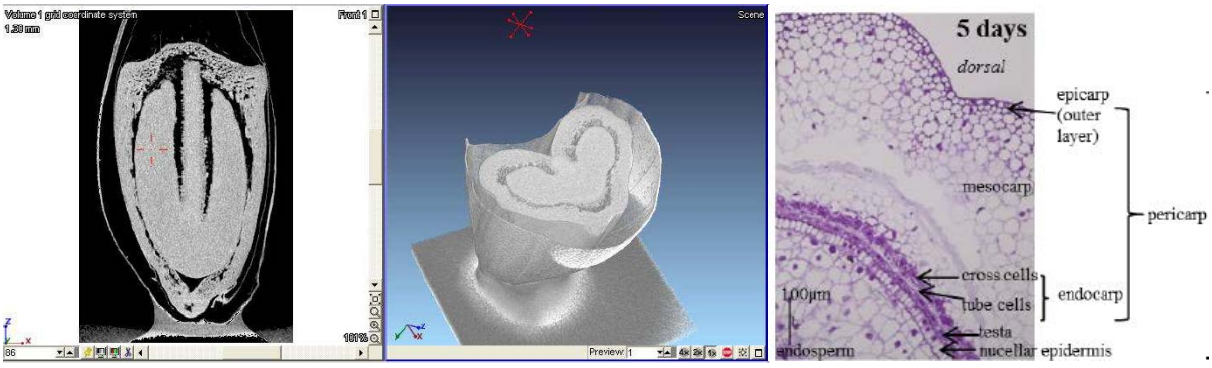

Figure: Acquisition and reconstruction of 3D images obtained by X-Ray tomography of a wheat grain, and bright filed microscopy image of a slice after histological staining

Objective

The aim of this project is to develop a kinematic 4D (3D+t) atlas of cell and tissue morphology within the grain from different imaging modalities. The work will consist in identifying and implementing efficient image processing and analysis algorithms adapted to the different imaging modalities, to develop group-wise image registration tools to address the biological variability, and to merge the

information obtained from each modality into a common reference model. The expected result is an atlas of the cell and tissue morphology of the grain during its development. In the end, the results could be integrated into mechanistic models of morphogenesis to elucidate the role of the grain outer layers on the determinisms of its growth.

Prerequisite

The candidate should be trained in applied mathematics, in modelling or in computer sciences. A specialisation in image processing and analysis would be of interest. A motivation for inter-disciplinary work and for biological questions in particular will be highly appreciated.

Required documents: resume, motivation letter showing the interest for the proposed work, two reference letters, examination notes, ranking.

Position open until April 5, 2017

Working conditions

The PhD will be located in Nantes (west of France), within the BIA research unit (INRA), in collaboration with the GDEC research unit (INRA-University) located in Clermont-Ferrand. Data acquisition periods are envisioned at the SOLEIL Synchrotron.

Salary: 1473 euros/month, during 36 months.

Recruitment: from septembre 2017.

Contacts

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Références

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