

PhD Position in Computer Science

Multi-scale Modelling of Lignocellulosic Biomass Deconstruction

Keywords: Multi-scale spatio-temporal modelling, 4D (space + time) image processing, lignocellulosic biomass

Hosting laboratory: [FARE Laboratory](#), INRAE / URCA, 2 esplanade Roland-Garros, 51100 Reims, France.

Duration: 3 years

Deadline: 30 September 2021

Objective: The main objective of the PhD project is to develop an image-based computational model of lignocellulosic biomass deconstruction during enzymatic hydrolysis.

Description

Renewable resources from agriculture and forestry such as lignocellulosic biomass (LB) is foreseen as an alternative to fossil carbon to produce biofuel, bio-based chemicals and materials in biorefineries to limit climate change. Nevertheless, due to chemical and structural complexity of LB, it is recalcitrant to biochemical deconstruction by enzymes and requires expensive pretreatment steps. To achieve a cost-effective deconstruction, **it is necessary to understand and overcome the chemical and structural parameters conferring the recalcitrance to LB**. Despite extensive research on identifying such parameters, no universal parameter (not specific to biomass species and pretreatment type) has yet been found.

To identify key structural parameters underlying recalcitrance, **our team has recently investigated the importance of structural parameters at the cellular / tissular scale**. At this end, wood samples are imaged during enzymatic hydrolysis by confocal microscopic time-lapse imaging, providing the observation of the hydrolysis at a cellular level. A first 4D (space + time) image processing including segmentation and tracking has been set up at FARE laboratory, that gives **access to a binary representation of individual cell walls and their evolution over time**.

Starting from this pipeline and the available 4D dataset, the PhD candidate will further **develop the pipeline to extract the dynamics of voxel intensity representing LB deconstruction captured in time series**. The extracted values will be used to estimate parameters of a spatial kinetic model. A correlation analysis between the temporal evolution of voxel intensities and cell wall composition will allow to propose hypotheses of mechanisms underlying LB recalcitrance. The universality of proposed hypotheses and model predictions will be investigated on different biomass species.

FARE lab offers an outstanding scientific and technical infrastructure (such as computing facilities of the [ROMEO HPC centre](#), state of art confocal microscope facility, etc), a highly motivated research team, as well as an international and interdisciplinary working environment offering ideal conditions for successfully completing a doctoral degree. The PhD candidate will have the opportunity to participate in training courses, and international conferences.

Requirements

Candidates should have a MSc in computer science, engineering, applied mathematics, or related fields. Applicants should have good skills in Python/C++ programming languages. Experience in image processing and biophysical modelling would also be advantageous. Excellent communication and reporting skills are essential as the successful candidate will need to work in an interdisciplinary team and write up the conducted research work for presentation and publication.

Application

Applicants should send a letter of motivation and a detailed CV, including the contact details of at least two academic referees to supervisors:

[Dr. Yassin Refahi, yassin.refahi@inrae.fr](mailto:yassin.refahi@inrae.fr), +33 (0)3 26 77 35 86

[Dr. Gabriel Paës, gabriel.paes@inrae.fr](mailto:gabriel.paes@inrae.fr), +33 (0)3 26 77 36 25

Salary: ca. 1400 euros net/month, including health insurance and 25 days paid annual leave, flexible working hours