HR EXCELLENCE IN RESEARCH

2021-04082 - Post-Doctoral Research Visit F/M Post--Doc in computational bio-physics applied to plant development

Type de contrat : CDD
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant
Niveau d'expérience souhaité : De 3 à 5 ans

A propos du centre ou de la direction fonctionnelle

Grenoble Rhône-Alpes Research Center groups together a few less than 650 people in 37 research teams and 8 research support departments.

Staff is localized on 5 campuses in Grenoble and Lyon, in close collaboration with labs, research and higher education institutions in Grenoble and Lyon, but also with the economic players in these areas.

Present in the fields of software, high-performance computing, Internet of things, image and data, but also simulation in oceanography and biology, it participates at the best level of international scientific achievements and collaborations in both Europe and the rest of the world.

Contexte et atouts du poste

Plants continuously develop at the tip of growing axes through the activity of the apical meristems. The genetic regulation of the shoot apical meristems (SAMs), which produce all plant aerial organs, has extensively been studied in the last decades. Various key molecular actors have been identified and their function in patterning the SAM has been mapped in space and time. According to recent works, these molecular actors not only regulate cell identities but also likely induce the physical deformation of tissues by modifying cell wall mechanical properties, in turn inducing leaf or flower primordia outgrowth. From these works progressively emerges a new mechanistic insight on the link between gene regulation, tissue deformation and organ growth in plants. However, despite these recent progresses, the contribution of turgor pressure and water fluxes regulation, that decisively contribute to tissue morphogenesis, is still elusive.

From a mechanical point of view, growth is powered by osmosis that tends to attract water inside the cells. The corresponding increase in volume leads to simultaneous tension in the walls and hydrostatic pressure (so-called turgor pressure) in the cells. Continuous growth occurs thanks to the yielding of the walls to these stretching forces. Plant tissues can be seen as a collection of such cells that all attract water from their environment through plasmodesmata (channels between cells) and aquaporins (proteins on their membranes connected to the extracellular space), respectively referred to as symplasmic and apoplasmic pathways. We have recently developed a 2D model of this system with a simplified description of the apoplasmic pathway, that already showed complex and interesting emerging properties linked to water fluxes, and helped to interpret experimental data.

Mission confiée

This previous work has opened new avenues that we want to explore with new experiments and a more realistic model in the context of the ANR project Hydrofield composed of biologists, biophysicists and modelers. New experiments from our collaborators will provide physical measurements such as local pressure, growth rate, membrane permeabilities; we'll have also access to the spatial and temporal expression of genes implied in the hydraulic properties of the cells; and finally, mutants or drugs will provide a way to alter the mechanical and hydraulic properties and constraint the model.

The goal for the postdoc will be to develop a model in order to be able to take into account experimental measurements and to

Informations générales

- **Thème/Domaine :** Biologie numérique Calcul Scientifique (BAP E)
- **Ville :** Lyon
- **Centre Inria :** CRI Grenoble - Rhône-Alpes
- **Date de prise de fonction souhaitée :** 2021-11-01
- **Durée de contrat :** 2 ans
- **Date limite pour postuler :** 2022-02-15

Contacts

- **Equipe Inria :** MOSAIC
- **Recruteur :**
  Godin Maury Christophe /
  Christophe.Godin@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

The candidate should have a solid background in bio-physics and/or computational biology. She/he should have strong and interdisciplinary communication skills at the interface between biology, biophysics, applied mathematics, and computer science.

Consignes pour postuler

Sécurité défense :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

interpret them: 1) add a more realistic, spatially explicit, apoplasmic compartment, and 2) extend the initial 2D model to 3D in order to have a correct geometrical description of the meristem. In both cases, exploring the properties of the model and comparing it with experimental data will be an important part of the work.

Understanding the contribution of water fluxes may have a profound impact on our vision of morphogenesis. This will open for the first time the possibility to build up a view of plant development unifying the pressure forces that drive development, the material that resist to these forces, and at the center, the biological processes that locally regulate this developmental equilibrium.

References

- I. Cheddadi, M. Génard, N. Bertin, and C. Godin. Coupling water fluxes with cell wall mechanics in a multicellular model of plant development. PLoS Comput. Biol., 15, 2019.
- Y. Long, I. Cheddadi, G. Mosca, V. Mirabet, M. Dumond, A. Kiss, J. Traas, C. Godin, and A. Boudaoud. Cellular heterogeneity in pressure and growth emerges from tissue topology and geometry. Curr. Biol., 30, 2020.

Principales activités

- Review of cell-based models of phyllotaxis and auxin transport
- Participating to meristem imaging and analysis with biologists
- Conception of models of phyllotaxis at cellular resolution
- Implementation of the models (python, C++)
- Paper writing and communication at conferences

Compétences

Scientific skills: a PhD in applied mathematics with applications in computational physics/biophysics is the ideal profile. A PhD in physics/biophysics with experience in numerical modelling would also be adequate. Interest in biological systems and morphogenesis is recommended.

Technical skills: numerical methods (ODE/PDE), scientific programming (python, julia), interdisciplinary environment.

Rémunération

Salary: 2 653€ gross/month (income tax excluded).