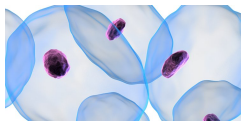
Laboratory of Systems and Synthetic Biology
www.wur.nl\ssb
www.systemsbiology.nl



Systematic analysis of dynamic hormone-sensitive protein interaction networks in plants

Supervisors: Robert Smith (in collaboration with Jan Willem Borst and Dolf Weijers in the Laboratory of Biochemistry)

Contacts: robert1.smith@wur.nl + edoardo.saccenti@wur.nl

Type of thesis: Computational

Required competences: Knowledge of ordinary differential equations (ODEs), their analysis, and ability to simulate systems in MATLAB or Python are desired skills.

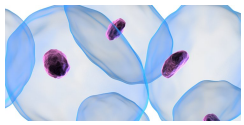
Acquired competences: Constructing, extending, and analysing mathematical models of biological systems. Relating simulations to experimental data and understanding how to derive experimental hypotheses from models.

Date: 28-04-2020

Description

In higher plants, ARF proteins function as integrators in a signalling network induced by the hormone auxin and resulting in transcriptional regulation of developmental pathways. However, even in the classic model plant *Arabidopsis thaliana*, the large size of the involved protein families makes it difficult to understand the key process underlying a plants response to auxin. Recently, experimental work in *Marchantia polymorpha* – that possesses a far simpler auxin network – has shown that stoichiometric balance between different members of the ARF protein family is a key determinant in a plants response to auxin signals (for a schematic description of the system see Figure 4 of Kato et al.).

This project will incorporate three key steps to help explore the auxin signalling pathway in *Marchantia*. First, your task will be to develop a simple mathematical model that can describe the wild-type *Marchantia*'s response to auxin. Second, using this model, are you able to qualitatively match the effects of various system perturbations (e.g. knock-outs, replacement of protein domains, etc.). Third, by extending the model, can you provide insights into the importance of spatial distribution of key ARF proteins in relation



to *Marchantia* development. The hypotheses determined by this mathematical analysis may aid our understanding of auxin signalling in plants and help in the design of future experimental work.

References

Kato H, et al. (2019) Design principles of a minimal auxin response system. *bioRxiv* **doi:** 10.1101/760876.

Middleton AM, et al. (2010) Mathematical modelling of the Aux/IAA negative feedback loop. *Bulletin of Mathematical Biology* **72:** 1383-1407.