« Modélisation hybride de la croissance cambiale et application à la gastrulation »

“Hybrid modelling of the cambial growth and application to the gastrulation”

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Abstract: Woody plants produce a secondary tissue (xylem and phloem) from a meristem tissue (i.e., containing undifferentiated meristematic cells, found in zones of the plant where growth can take place) called vascular cambium, responsible for the radial growth of a tree. We will focus on the formation of the secondary xylem, considered in two dimensions in a cross-section framework. A discrete modelling approach is used, based on the cellular scale, in order to attain a more accurate understanding of how the elementary microscopic behaviour of each cell takes part in the macroscopic morphogenesis.

We present a mathematical modelling of the main characteristics of this morphogenesis using an occurrence discrete method to simulate the main features of radial growth using simple geometric rules such as Thom’s division rule (Thom, 1972) as well as a continuous approach to model the spread along the tree of a growth inhibitor, the auxin, whose both local production and diffusion are modelled by a PDE operator. The study applies to concrete instances in which the changes made in the geometrical cellular patterns of the vascular cambium clearly affect the shape of the tree, as in Pinus radiata.

An application of this hybrid technique to the gastrulation in Drosophila melanogaster is eventually proposed.