Dynamics of a leaf central vein

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Leaves are photosynthetic organs with a diversity of shapes and complex vascular networks, often featuring a central vein with very stable oscillations (Fig. 1(a)). In order to explain the development of this central vein, we propose a numerical model of growth by interface propagation describing the dynamics of the vascular network as a function of the initial shape of the front and the spacing of the veins.

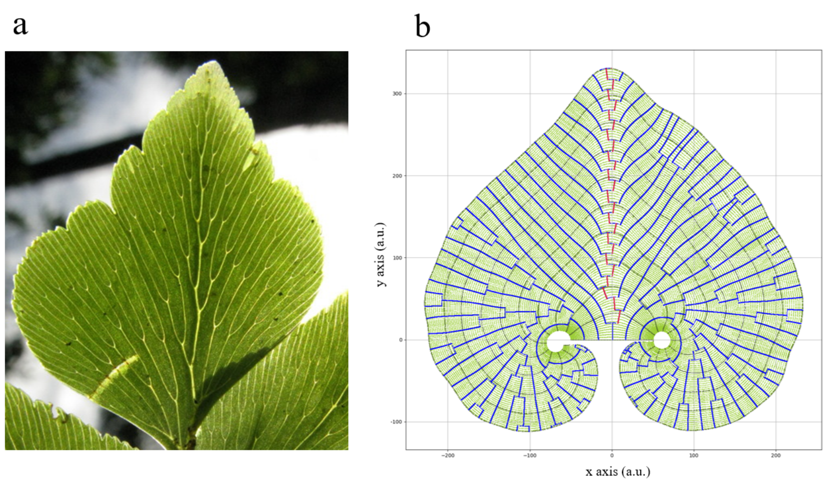

Figure 1. (a) *Adiantum* leaf showing a central vein. b) Proposed numerical model of peripheral growth, with interdependance bewteen front and vein growth. Successive growth fronts are emphasized every 50 time steps. The central vein is highlighted in red.

We make the assumptions that veins can be used as a marker of previous growth zones, as they develop around morphogen auxin flux [1], and include regular vein spacing and symmetrical bifurcations as they correspond to the more primitive leaves [2]. During morphogenesis, two modes of growth are distinguished, peripheral and global [3]. A front propagation model corresponds to a peripheral mode of growth. We find a leaf-like object with a stable central vein, with two lobes by edge effect (Fig. 1(b)). We base our growth function on gaussians centered on the position of veins, and introduce an initial pre-factor on the vein closest to the center, making the central vein stable. In the absence of this pre-factor, the dynamic of the central vein can be modelled by an iterated function whose geometry explains its unstability.

References

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