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Modelling of plant growth

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To explain the diversity of plant forms, sizes, and lifetimes, we introduce new models of plant growth based on simplified but realistic biological mechanisms. Growth of plants is described by means of a free boundary problem where the moving boundary corresponds to the meristem, a narrow layer of proliferating cells. All other plant tissues serve to conduct nutrients and metabolites.

In the one-dimensional model without branching, time oscillations, which can be related to endogeneous rhythms, are observed. Periods of growth and rest alternate. The number of growth periods determines the plant size.

Two-dimensional numerical simulations show the emergence of complex structures, and suggest a new mechanism of pattern formation based on the interaction of the moving plant boundary with fluxes inside the plant.

We consider next a one-dimensional model with branching, where the branching condition is determined by concentrations of plant hormones. A wide variety of plant forms is observed. Apical domination, in which growth of one branch suppresses growth of other branches, is studied.

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