Modelling and imaging of growing plants

MSc Project in Applied Mathematics (Numerical Analysis)

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Project start date: March 1, 2020

Project description

The problem of quantifying the growth dynamics of plants from time-lapse images is important for determining variety-specific characteristics and subsequent breeding. Plants have a complex three-dimensional structure consisting of stems and leaves that expand, elongate and bend at individual rates. It is often impossible to achieve a full three-dimensional reconstruction of the plant shape from a limited set of multi-angle images. The goal of this project is to bypass the full shape reconstruction and directly retrieve the growth parameters from the available three-angle images taken at two/three-day intervals over a period of several weeks. First, the plant outline and, if possible, the outlines of its parts must be identified in each image. Second, the mathematical transformation between the plant outlines on consecutive dates will be estimated. In particular, one is interested in the relative motion of specific contour points or parts and in the relation of this motion to the local expansion rate of the leaves.

Suggested literature

[1] M. Kass, A. Witkin, D. Terzopoulos, Snakes: Active Contour Models, *Int. J. Computer Vision*, Vol 1(4), pp. 321-331, 1987.
[2] J.L. Prince and C. Xu, A New External Force Model for Snakes, *Image and Multidimensional Signal Processing Workshop*, pp. 30-31, 1996.
[4] F. Janan and M. Brady, Shape Description and Matching Using Integral Invariants on Eccentricity Transformed Images, *Int. J. Computer Vision*, Vol. 113, pp. 92-112, 2015.
[3] A. El Badia and T. Ha Duong, Some Remarks on the Problem of Source Identification From Boundary Measurements, *Inverse Problems*, Vol. 14, pp. 883, 1998.