# A Computational Method for the Analysis of Leaf Growth.

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# Abstract

Although there is a growing understanding of the genetic regulation involved in leaf initiation and development, questions still remain as to how growth, by the processes of cell division and cell expansion, generate the shape and form observed during development. Several different techniques have already been developed to quantify growth. One such approach is tracking of markers to measure the underlying growth of the leaf. Initial implementations of this technique involved manually taking measurements from the leaf surface but now, with the advent of digital imaging and image processing, it is possible to automate the analysis using computer-based approaches.

Programs have been developed to extract information from digital images to generate a three-dimensional tracking system. These computer-based techniques were designed to remove manual input of data and to improve the range and resolution of the description. A statistical description of growth based on multiple leaves can be generated with this technique. The techniques developed were used to study the leaf growth in *Antirrhinum majus* to generate a statistical description of leaf growth, by measurement of regional changes in key growth parameters such as growth rate, anisotropy and direction of growth. Statistical analysis was then used to validate each stage of the processing and to evaluate the approach developed. This evaluation identified where and how the computer-based approach could be further improved.

This approach has been developed as a generalised technique that can be implemented to analyse the growth of any form and shape of leaf. This generality will allow this technique to be used to investigate growth in a variety of leaf forms observed throughout nature.

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