Modelling Plant Growth from Stereo Images

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Plants can be characterised by a range of complex and variable attributes, and measuring these attributes accurately and reliably is a major challenge for the industry. The measurement of those plant characteristics that are most relevant to a grower has previously been tackled almost exclusively by a combination of manual measurement and visual inspection. This is a highly labour-intensive process, given that tens of thousands of plants have to be assessed, and one which is inevitably limited by the subjective assessments of individual observers. The purpose of this work is to automate the assessment process to reduce labour requirements, and to remove subjective factors from the assessment. Our approach is to use a stereo pair of cameras to capture images of plants and then to model the chief visual characteristics.

The proposed modelling architecture comprises a fast stereo algorithm to estimate depths in the scene and a model of the scene based on visual appearance and 3D geometry measurements. The proposed stereo algorithm employs a coarse-fine strategy for disparity estimation. A weighting method has been developed, together with a Kalman filter, to refine estimations across scales. A self-organising map is applied to reconstruct a surface from these sample points created by the stereo algorithm.

The datasets we used capture one or a few plants growing in a glasshouse over time. We compare and evaluate our results against other popular algorithms, and also demonstrate that the proposed surface model can be used to extract useful plant features that can be of importance in many industry applications.