PS-PLANT TRAINING DATASET DESCRIPTION

Introduction

Automated leaf segmentation is a challenging area in computer vision. Recent advances in machine learning approaches allowed to achieve better results than traditional image processing techniques (Scharr et al., 2016; Mengye and Zemel, 2016); however, training such systems often require large annotated datasets (Giuffrida et al., 2017). To contribute with annotated datasets and help to overcome this bottleneck in plant phenotyping research, here we provide a novel photometric stereo (PS) dataset **with annotated leaf masks**. This dataset forms part of work done in the BBSRC Tools and Resources Development project BB/N02334X/1.

Data description:

Plant material and growth specifications

The dataset comprises of 21 *Arabidopsis thaliana* (L. Heynh. Col-0, wild type) plants grown in a growth cabinet at 22ºC under 150 µmol photons m^{-2} s^{-1} in 12 : 12 hr light : dark cycles. The dataset represents plants at varying time intervals (12 to 48 hours) from 11 and 24 days after germination.

Images description

Raw data:

Depending on the PS-Plant (Fig. 1A) rig used [we had two rigs with either four or eight near-infrared (NIR) light emitting diodes (LEDs)], each capture session consisted of four or eight differently illuminated images of a plant tray (named im0 to im3/im7) and a further image capturing ambient light in the scene (named imAmbient). The raw data can be found in the folder “PS-Plant Data”. Each session was saved with the acquisition day (year, month and day) and time (hour, minute and seconds) stamps and the capture mode as follows:

‘*YYYY-MM-DD_hh-mm-ss_MODE*’;

The capture mode refers to the PS-Plant rig from which the images were obtained. For the four NIR LEDs rig, the mode is NIR, and for the eight NIR LEDs, the mode is VISNIR.

All directories in “PS-Plant Data” have a *PSConfig.properties* file – a copy of the capturing PS system configuration and processing information. The properties file included light source direction vectors (x, y and z), data storage and temporary processing locations, light controller communication port, region of interest (in pixels), camera lens focal length and options for data processing. The obtained raw data was processed using PS calculations written in Python and resulted in the generation of a *SNZShadowImAndAlbedo_adaptiveLS.npz* file for every directory. This file contained integrated height information (Frankot and Chellappa, 1988), surface normal map, albedo and shadow images.

Processed images:

Each Arabidopsis plant from the raw data was individually cropped by specifying the rosette centroid location and the size of the region of interest. All crops have the same resolution (650 x 560 pixels). The cropped images were named as the parent directory with a '_*X*' suffix, where *X* is the plant number in the tray. The images provided are:

- Annotated image layers: Individual leaf labels for each plant that were manually generated using Adobe Photoshop CS6 (Adobe Systems, CA, USA). Every leaf mask was stored in a separate layer in the format of '*Leaf No*'. If the leaf was not visible due to occlusions, an empty layer was included with a title of the missing leaf number. Annotated image layers were stored in a '*psd'* file format.
- Ground truth (leaf labels) images: .png images generated from the .psd files (Fig. 1B).
- Albedo images (Fig. 1C).
- Surface normal map images (Fig. 1D).
- Grayscale images: mean of various illumination directions (Fig. 1E).
- Shadow images (Fig. 1F).
- Composite images: normals in x and y directions, and albedo (Fig. 1G).
- Foreground_Background images: a foreground (white) and background (black) image mask (Fig. 1H).

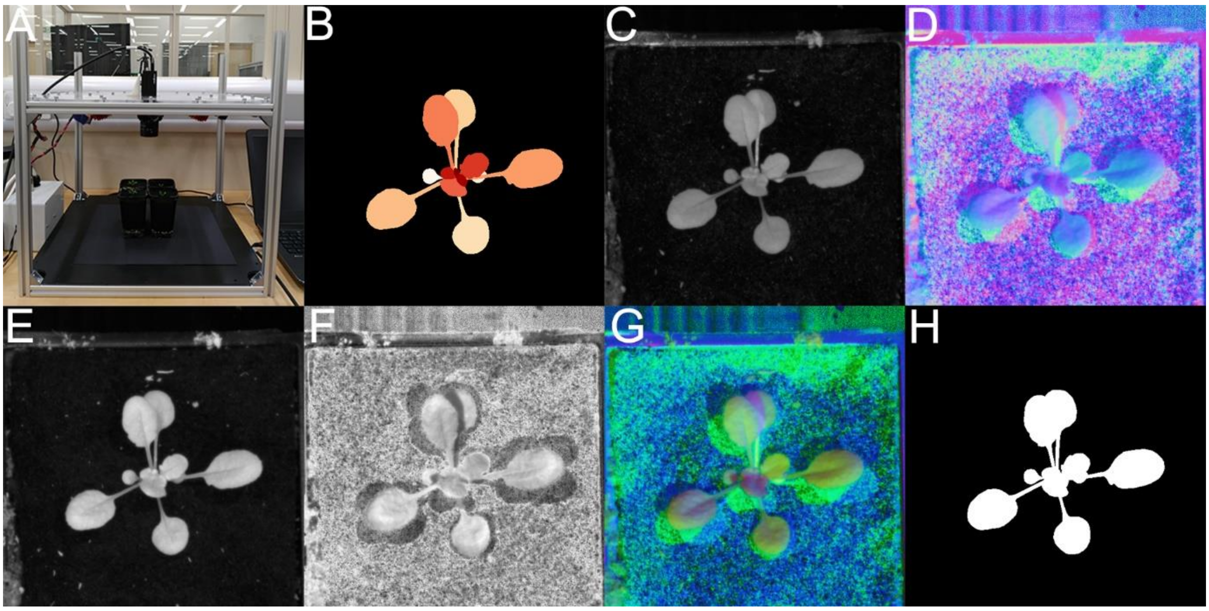

Figure 1. PS-Plant rig (A) and examples of the different types of images provided in the PS-Plant dataset (B-H).

References

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