Smart Farming

End-to-End Deep Learning for Broccoli Head Sizing

Training a deep learning model to estimate the diameters of broccoli heads based on an image and the camera height, using end-to-end methods

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1) Introduction

Smart broccoli farming requires reliable head size estimates

There is an existing pipeline proposed by N. Mateijsen et al.: detect broccoli heads with YOLO from a video feed, estimate the diameters using camera depth and a pinhole formula, then train a growth prediction model based on the collected data.

2) Research question

Can an end-to-end deep learning model provide a reliable alternative to the existing broccoli head estimation technique?

3) Methodology

Design and train a model by using end-to-end methods, with minimal feature engineering.

We evaluated the model architecture by analysing the performance when trained on the original dataset, as well as on a dataset by P. Blok et al.
We looked for trends between error rate and different factors (occlusion ratio, camera height, ...)
We looked at the impact on the accuracy of the prediction model when this alternative method was used to gather the training data.

Model architecture

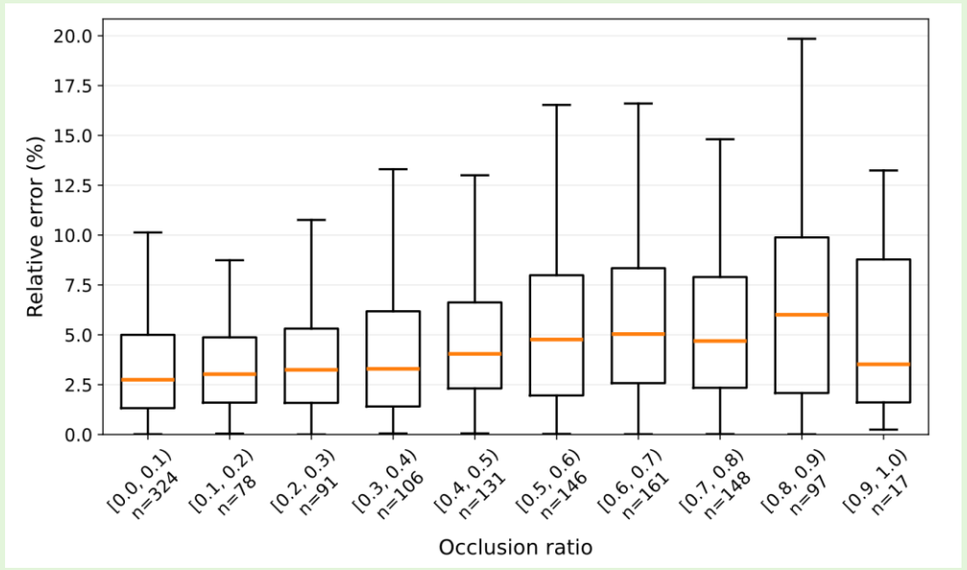
4) Results

0.374 cm
MAE on the dataset collected by Mateijsen et al.
~2 pixels on 224x224 input images

0.668 cm
MAE on the dataset collected by P. Blok et al.
Compared to an MAE of 0.512 cm on the original dataset, randomly sampled to the same size

< 0.02 cm
Average prediction difference when using the new approach

Camera height extrapolation performance is poor
Camera heights expected during usage should be sufficiently present in the training set



5) Conclusion

The end-to-end deep learning approach has an accuracy which is at least comparable to the previous method and could be used as a replacement. It is not yet proven to have better accuracy since a model is only as good as its training data.

Code: github.com/Rijkaron/broccoli-public

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