Instance segmentation method for weed detection using UAV imagery in soybean fields

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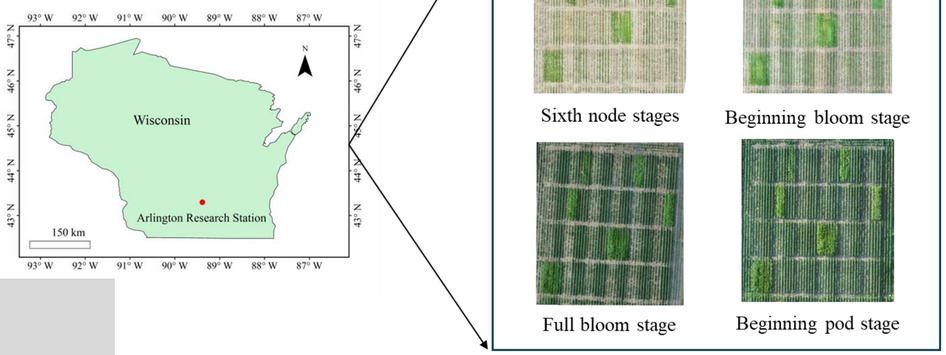
Introduction

Accurate and efficient weed detection and segmentation are fundamental for precision weed management. Previous research has primarily focused on sparsely distributed weeds or individual weed plants, or those under controlled experimental conditions utilizing traditional methods such as thresholding, colour indexing, machine learning, and object detection and classification techniques.

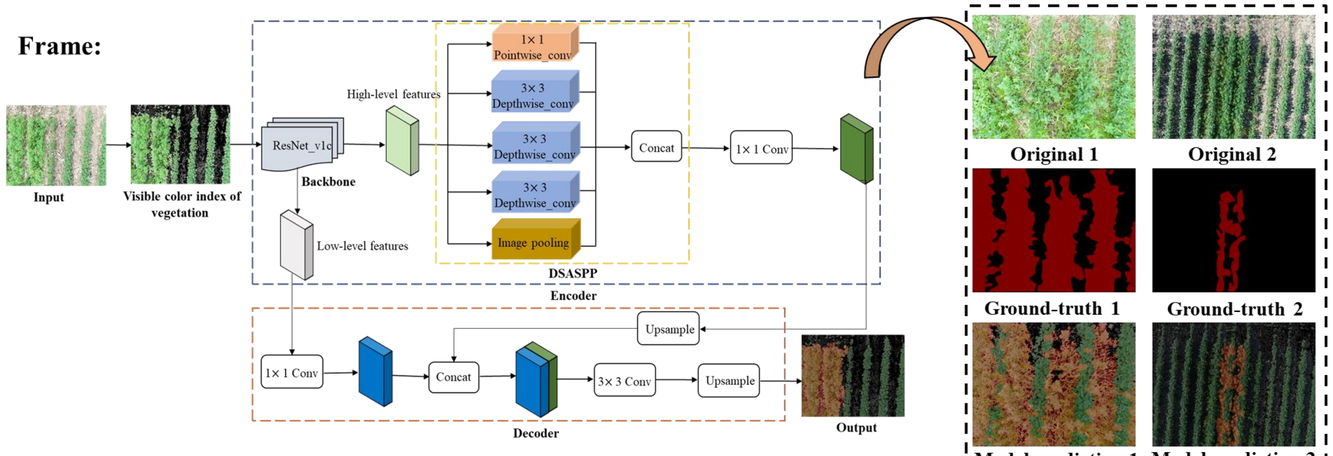
Data

- From June to July 2022
- University of Wisconsin Madison Arlington Research Station, Wisconsin, USA



Methods

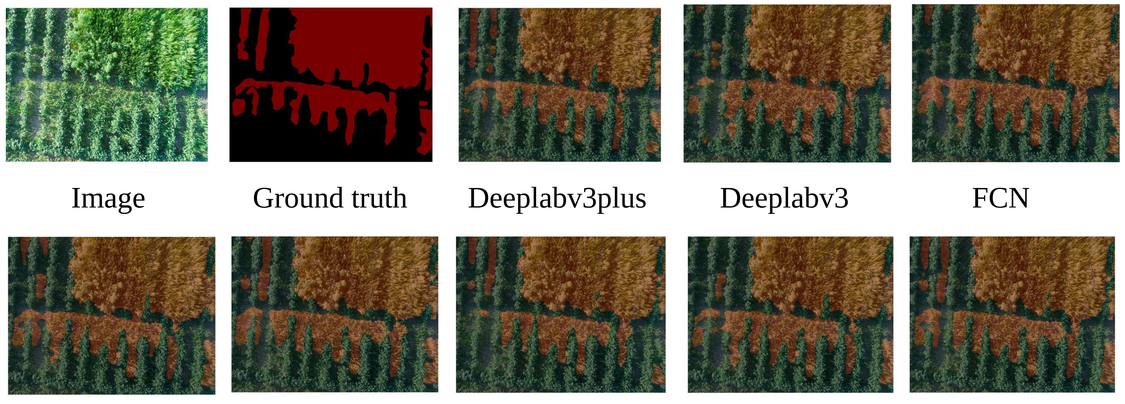
This method improves weed detection and segmentation in dense soybeans fields by using a color index to enhance plant-soil contrast and integrating ResNet101_v and DSASPP into the encoder-decoder architecture to refine multi-scale semantic information for precise weed boundary delineation.



Results

Table 1. Comparisons of segmentation results with different methods

Method	IoU_weed	Acc_weed	aAcc	mIoU	mAcc
Deeplabv3plus	0.887	0.941	0.975	0.928	0.962
Deeplabv3	0.879	0.959	0.972	0.922	0.967
FCN	0.873	0.911	0.972	0.919	0.950
U-net	0.878	0.925	0.973	0.922	0.955
Fast FCN	0.891	0.929	0.976	0.931	0.959
Vision Transformer	0.893	0.940	0.976	0.932	0.963
Swin Transformer	0.890	0.936	0.975	0.930	0.961
Proposed	**0.905**	**0.959**	**0.978**	**0.939**	**0.972**



Visual segmentation results of different methods

Conclusion

- The proposed method is restricted to weed detection in soybean fields, and thus may not be generalizable to other types of crops and agricultural settings.
- The accuracy of the segmentation results is highly dependent on the quality of ground labelling performed by humans.