

# Precision Optical Weed Removal Evaluation with Laser



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## Abstract

Weed control represents one of the most significant challenges of modern agriculture. Crop yield loss due to poor weed control is as high as 32%, globally.

Weed removal with optical source such as UVC lamps and high-power LEDs is promising. It removes the need of conventional mechanical weed removal.

We propose a novel weed recognition method with laser. The method shows its early promising effects. It is able to detect weed with a high accuracy.

## Introduction

Directed energy weed management is successful in weed management. It includes

- Flame weeders
- Infrared weeders
- Steaming weeders
- Microwave
- Solarization

Study showed that flaming weed control can be effective for young orchard weed control but failed in established orchard perennial weeds.

The dose and the time interval required for the flame weed control is also important and varied depending on different crop species, size, and density.

## The Challenges

Autonomous weed detection remains as a challenge. It is due to the complexity nature of the weed in the wild environment.



Occlusion



Unorganized



Very Small



Under the Shade



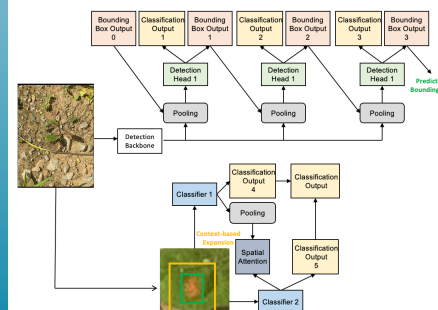
Complexity Failure of Modern Methods

## Methodology

The LED consists of visible and near infrared light in the range of 500 nm to 1500nm. The distance between LED and weed is 3cm. The LED was applied for 10 seconds on the dandelion weed. The data collection lasts 4 days after LED based weed treatment. Following the 4 days of data collection, data processing is followed.

Fine grained cascade network is used for detection. The network backbone uses a ResNet-50. Overall, it is implemented with four stages. The first stage is Region Proposal Network (RPN) followed by three stages of detection heads. The three detection heads progressively increase IOU thresholds of 0.5, 0.6, 0.7.

The progressively increasing IOU ensures the rejection of the false positives of the laser projection. The network output both localization of the laser projection using its regressor and classification heads.



## Results

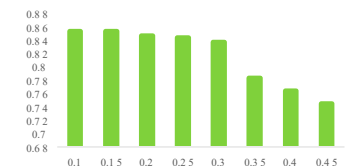
The following shows the raw data and weed recognition results.



Raw Data



Recognition Results



Detection Accuracy vs Bounding Box IOU

## Acknowledgements

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