

WASP Project Course 2021

Semantic Weed Detection for Automated Agriculture

Background

RISE has collected a dataset of images with crops growing on a field. Occasionally there are also weeds growing among the crops, and if these are accurately indicated, they can be mechanically removed, or pesticide could be applied at the location. An accurate weed detector can thus help making farming more environmentally friendly.

The dataset is very large, so for convenience a selected subset will be provided to you. The subset has been annotated in WARA-media, with polygons that indicate weeds, crops, and soil (see figure below). In contrast to annotations such as in the Cityscapes dataset [1], the annotations are only partially covering the image. Your task is to make best use of these partial annotations to select and train a semantic segmentation network (e.g. a U-Net can be used). In particular note that the unlabelled regions also contain weeds, crops and soil, and can thus NOT simply be treated as a separate "unknown" label, as is popular elsewhere.



Top row: Cameras mounted on a tractor, and example weeding robot.
Bottom row: example details from annotated frames.

Depending on interests of the project participants, this problem can either be posed as a class incremental learning problem [1], or as a regular semantic segmentation problem with contrastive representation learning [3].

For benchmarking, the Cityscapes dataset [1] can be used, by generating similar annotations to those provided, and then testing the performance on fully annotated frames.

Constraints: There are no constraints on location. The dataset is remotely available.

Participants

Industrial partner: RISE SICS East

Industrial supervisor: Daniel Larsson, daniel.larsson@ri.se

Academic supervisor: Per-Erik Forssén, per-erik.forssen@liu.se, Linköping University

Coordinating WARA representative: Johanna Björklund, WARA Media

Challenges to investigate

- Design and evaluate a method that makes the best possible use of the available annotated data.
- Unlabeled regions should be treated as unknown, not as a separate category.

Resources

RISE-CVL Dataset with detailed annotations of weeds, soil patches and crops.

Access to WASP compute resources for the participants may be needed, as RISE compute clusters are constrained.

Deliverables

- A report, or a scientific publication that describes experiments and the proposed method.

References

1. M. Cordts et al. *The cityscapes dataset for semantic urban scene understanding*, **CVPR16**, <https://arxiv.org/abs/1604.01685>
2. E. Belouadah et al. *A comprehensive study of class incremental learning algorithms for visual tasks*, **Neural Networks 2021**, <https://arxiv.org/abs/2011.01844>
3. W. Wang et al. *Exploring Cross-Image Pixel Contrast for Semantic Segmentation*, **ArXiv 2021**, <https://arxiv.org/abs/2101.11939>

Keywords

semantic segmentation, partial annotations, class incremental learning, contrastive representation learning