SONY COMPUTER SCIENCE LABORATORIES, PARIS

Domain adaption for agricultural robot operations

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The Sony CSL sustainability team is developing an agricultural robot which is light weight, low-cost, open source and targeted at small farms growing vegetables. The objective is to help market farmers with physically demanding tasks and as such make the profession of organic farming more attractive. The current applications of the robot are the mechanical weeding of culture beds and the monitoring of crops. Both of these tasks rely on computer vision and the segmentation of images into crops, soil and eventually weeds is a crucial step. Various methods have been tested (thresholding of the green excess index, pixel classification using support vector machines or decision trees) but the best performing methods are based on convolutional neural networks. One drawback of using deep learning is that it requires a lot of annotated data. This is even more a problem when working with crops in fields because each soil and each crop are a different domain on which the training has to be performed.

The objective of the internship is to come up with a flexible system that allows the use of small datasets to tackle new segmentation problems. A possible way to get address this problem is to first train the network on a large database and then use domain adaptation techniques requiring only a few annotations of the target domain. The domain adaptation approach can be tested on an existing, large public annotated dataset of sugar beet and then adapt it to our small annotated datasets of lettuce and radish. The student can develop novel approaches, taking inspiration from, for example, ensemble learning, but also by imagining interactive interfaces and collaborative systems that involves the farmer in the evaluation and annotation of data.

The methods developed during the internship will be compared with results obtained by fine tuning the training of a segmentation architecture on the target domain.

The student should have knowledge about neural networks and semantic segmentation, a familiarity with generative adversarial networks would be useful. The student should be familiar with one of the main frameworks for training neural networks (tensorflow, pytorch, keras,...).

*T*ransfer learning between crop types for semantic segmentation of crops versus weeds in precision agriculture Petra Bosilj jErchan Aptoula Tom Duckett Grzegorz Cielniak (2019) Journal of Field Robotics

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