Environmental Computational Science
and Earth Observation Laboratory

Master thesis subject

Efficient coconut tree mapping exploiting human-machine interaction

Context

In several developing countries coconut trees are a very important source of income. Therefore, mapping them is essential for monitoring, and sometimes for post-disaster assessment. Recently machine/deep learning methods have achieved high accuracies in image detection/recognition tasks. However, they usually need a considerable amount of annotated data (e.g., the image and a bounding box defining where the object is located in the image) for training a model. The construction of this annotated set of images often is time-consuming and with a limited budget for manual annotation.

Active learning methods can help the users to focus their time in manually annotating a smaller set of effective training samples that can be used to train a model with considerable accuracy. These methods use a previous version of the model to select the next samples (e.g., most uncertain or the ones that could increase the diversity in the set of annotated data) to be annotated by the user. After several iterations of this process the trained model becomes more accurate.

Recently, some works have proposed to use feature projection methods to make the annotation of large numbers of objects in images more efficient. The idea is to project image features in a 2D coordinate space where objects that are visually similar are projected to points that are close to each other in the 2D projection. In this way several similar images can be selected in the 2D projection and the task for the annotator becomes to detect visually which of the selected samples are not from the same class as the majority. Therefore, the user performs very few actions (e.g., clicks in a GUI) to annotate several objects. This annotation process is depicted in the next figure. The figure shows the 2D projections in the left part (showing classification probabilities in the background), where each point corresponds to one sample in our dataset. When the user selects a group of samples (highlighted in orange in the figure) the images corresponding to those selected samples are shown in the middle panel. There, the annotator needs to detect which objects are not of the same class as the majority. Using this approach usually leads to annotating more objects faster. The work that proposed this approach for coconut tree annotation did not specify which regions in the 2D projections should be explicitly suggested for annotation. Basically, the user can focus in any region of the 2D projection, which is not necessarily the best approach.

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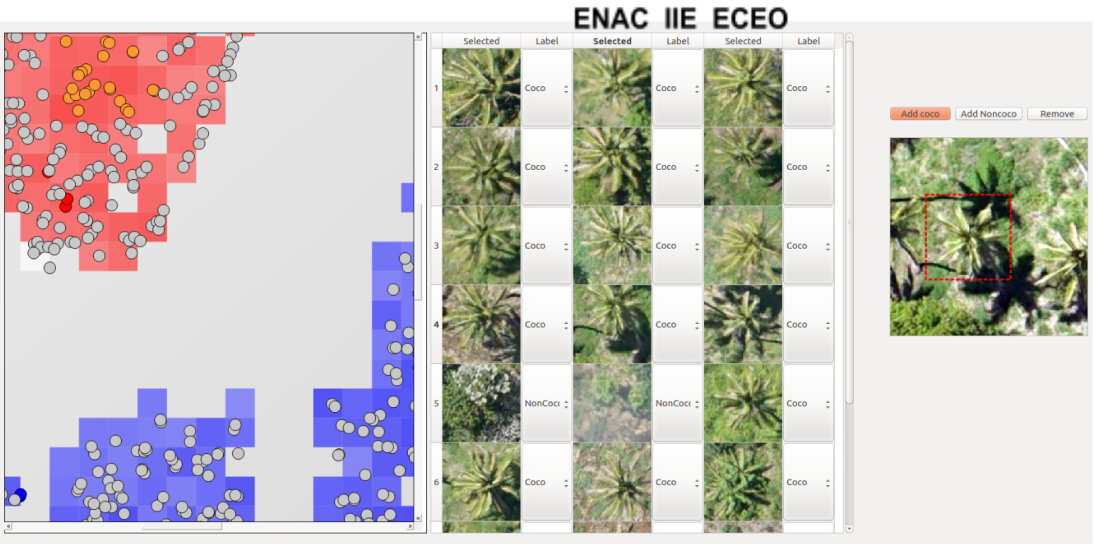
EPFL ENAC IIE
Devis Tuia, Prof.
Rue de l'Industrie 17
Case Postale 440
CH – 1951 Sion

Téléphone : +41 21 69 382 83 (secr).
E-mail : devis.tuia@epfl.ch



In this work, we want to explore how to give explicit suggestions to the annotator, about which group of samples should be annotated, using the aforementioned approach of image annotation in 2D projections. Using these explicit suggestions we could not only annotate a large number of objects efficiently, but also to annotate more effective samples that could decrease the number of annotation iterations to train an accurate model that can correctly detect the objects of interest in other images.

Objectives

- Familiarise with methods for object detection/recognition and feature space projections
- Investigate different forms of guiding human users to annotate more efficiently trees in aerial imagery

Requirements and practical info

- Background in machine/deep learning is welcome.
- Programming skills in Python.
- The thesis will be supervised from the Sion campus.
- Access to parallel computing resources is provided.

Literature

- Vargas-Muñoz, J. E., Zhou, P., Falcão, A. X., & Tuia, D. (2019, July). Interactive coconut tree annotation using feature space projections. In IGARSS 2019-2019 IEEE International Geoscience and Remote Sensing Symposium, 5718-5721
- Tuia, D., Volpi, M., Copa, L., Kanevski, M., & Munoz-Mari, J. (2011). A survey of active learning algorithms for supervised remote sensing image classification. IEEE Journal of Selected Topics in Signal Processing, 5(3), 606-617.

Contact

Prof. Devis Tuia, devis.tuia@epfl.ch