Postdoc Position in Machine/Deep Learning/Computer Vision

Development and applications of novel Machine and Deep Learning and computer vision algorithms for the analysis of multispectral images for the detection of vine diseases

Context

The activities of the 140 people working at The Research Center in Information and Communication Science and Technologies (CReSTIC) revolve around the extraction and analysis of knowledge, signal and image processing and analysis, machine and deep learning, applied in particular to smart farming. Driving many academic projects, CReSTIC is also a major player in innovation as evidenced by its industrial transfer activities alongside national and international companies. Among them, as part of a collaboration with Comité de Champagne and Segula Technologies company, an ambitious project aims to develop detection strategies and algorithms for detecting the presence of vine diseases based on image processing, machine and deep learning, and information theory concepts. This project focus on the detection of grapevine yellows on Chardonnay, a very challenging task, especially of the Flavescence Dorée, a serious and epidemic disease. It is one of the two grapevines yellow diseases that might cause a rapid decay in Champagne and other wine regions, being considered as the new phylloxera of the vineyard. To date, the detection approach of the yellows is to collectively explore the vineyard on foot every year to identify affected vines and to perform biomolecular tests by approved laboratories. As the survey is not precise nor optimal enough for a large-scale monitoring, the development of integrable detection solutions based on imagery appears necessary.

Subject

We conducted several acquisition campaigns between 2020 and 2023. Spectra were collected on the leaves under controlled conditions as well as multispectral images (5 bands in visible-NearInfraRed and 8 bands in ShortWaveInfraRed). Multispectral images (5 bands in visible-NearInfraRed) were collected in situ at different distances (including by drone), lighting conditions, and periods during the harvest period. The processing of the spectra made it possible to identify discriminating spectral bands, a suitable multispectral camera being built for the 2024 acquisition campaign. The analysis of multispectral images is, however, much more complex, particularly for in situ acquisitions, because of the variability induced by endogenous and exogenous factors (brightness, phytosanitary treatments, vine vigor, other diseases) and especially because of the interannual variability. Existing CNN-models and new hierarchical models developed by our lab have proven effective in detecting grapevine yellows, but the generalization capabilities of these models are not sufficient to compensate for these variabilities.

The objective is to propose new detection strategies and algorithms that are robust to variability induced by endogenous and exogenous factors, and by year. Several tracks could be explored, independently or jointly:

- Extraction of supervised and/or unsupervised features, and identification of the most robust ones using, notably using information theory concepts which have already been developed for the identification of spectral bands from spectra.
- Fusion of multispectral information or identification of an optimal subset at different levels (images - including calculation of an NDVI type index, features, extraction algorithms).
- Integration of reinforcement, continuous learning and/or domain adaptation concepts and adaptation of these concepts to multispectral images

It might also be interesting to design semi-supervised approaches to take advantage of the possibility of acquiring many unlabeled images during new acquisition campaigns.

Requirements

- Self-motivated scientist seeking to pursue a scientific career, holding a Ph.D. or in the process of completing it, in a relevant field of machine/deep learning or other relevant fields.
- Strong knowledge and skills in AI learning, machine learning and data science with hand-on skill and experience.
- Strong foundations in python and pytorch coding. Knowledge and skills in Python environments such as Tensorflow, Pytorch, Keras, Pandas, Scikit-learn, etc.).
- Understand of digital image processing; prior experience in working with image analysis projects (industrial or academic) will be a plus.
- Independent and passionate about data science projects, however good team player, able to undertake research projects together with other team members.
- Excellent communication (oral and written) and public speaking skills.

Information

The PostDoc will be based at the CReSTIC lab of the University of Reims Champagne-Ardenne on the *Moulin de la Housse* campus in Reims. Within the framework of the project, he/she may be required to intervene to the project partners, the Comité de Champagne in Epernay or Segula Technologies in Reims downtown.

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