

Transfert Learning for predicting biomass from satellite imagery

Supervision:

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Context:

The context of this internship is the proposal of a service to support farmers to better manage their grassland. This can be achieved by an accurately evaluation of the height of grass with a fine spatial precision.

Our approach is to estimate the grass biomass using remote sensing data. With the arrival of new Sentinel-1 (SAR) and 2 (optical) sensors, image time series are now available with a high revisit capacity on the same site (temporal resolution of 5 days) and with high spatial (10m) and spectral resolutions.

In our recent work, we developed a regression model to estimate height of grass with an error lower than 2cm. This validates the remote sensing approach to predict accurately the biomass from satellite images. This model has been developed for specific types of grassland, in different regions and for data collected during a single year.

The questions that this internship will address are mainly:

- is the model learned from our dataset valid for new types of grassland, new years?
- is it possible to transfer the model learn from one type of grassland/years to another one?

The proposed approach that will be developed will make use of a specific machine learning method called “transfer learning” or “domain adaptation”. The “transfer learning” problem consists in automatically learn how to transfer the knowledge acquired from the data acquired in one context in knowledge that would be used in another. More especially, the challenge will be to automatically learn how the model learned from one collection of images with a specific context can be adapted to new images in an another context. Two types of transfer would be studies: the intra-year transfer and the intra-type of grassland transfer. The challenges lie in identifying meaningful features to characterize the context and use machine learning algorithm to learn a transfer function.

The main steps of this work will be:

- the study of the state of the art of transfer learning for regression tasks
- the implementation of a standard machine learning procedure to propose a set of prediction models of the height of grass that are specific to some predefine context (these models would be compare with the current one)
- the proposal of a method to transfer the model from one context to another
- the solid evaluation of the strengths and the limits of the proposed approach

The minimal knowledge in remote sensing images and spatial image processing will be provided by the supervisors during the internship.

The internship will be located in IRISA laboratory, LACODAM Team.

References

- Pan, S. J., & Yang, Q. (2010). A survey on transfer learning. *IEEE Transactions on knowledge and data engineering*, 22(10), 1345-1359.
- Matasci, G., Volpi, M., Kanevski, M., Bruzzone, L., & Tuia, D. (2015). Semisupervised transfer component analysis for domain adaptation in remote sensing image classification. *IEEE Transactions on Geoscience and Remote Sensing*, 53(7), 3550-3564.
- Boyer, S., & Veeramachaneni, K. (2015). Transfer learning for predictive models in massive open online courses. In *International Conference on Artificial Intelligence in Education* (pp. 54-63)
- Simões, R. S., Oliveira, P. R., Honório, K. M., & Lima, C. A. (2018). Applying Transfer Learning to QSAR Regression Models. In *Information Technology-New Generations* (pp. 631-637)

Expected profile and skills

- Programming in Python (sklearn, pandas)
- Programming in R
- Good knowledge of statistics
- Knowledge in machine learning techniques
- Curiosity
- Strong interest for experimental studies
- Interest in remote sensing and environmental sciences
- Scientific English