Post-doc subject

Deep learning for the detection of green spaces and their impact on cancer

Context

The Imagine team of the LIRIS (Image and Information System Laboratory) aims to develop new computer vision methods to automatically analyze the content of images and videos. These methods are applied in various contexts, like aerial images.
Within the framework of the EVERCAN project, we propose to study the impact of green spaces in urban environments on the most common cancers. For this, it is necessary to build a spatialized data to identify and characterize urban green spaces (UGS) in France that will allow a precise spatio-temporal analysis. The work of LIRIS, in this context, aims to develop automatic methods, possibly interactive, based on deep networks to identify UGS that will serve as a basis for calculating geographic scores usable at the national level. More precisely, starting from multimodal data (ortho-photo or aerial images, NDVI images, land use in particular), the objective is to design a neural architecture allowing to automatically combine this information to identify vegetation areas and their surroundings (square, park, wood, cemetery, building, house, etc.) present in an aerial or satellite image

Topic

Within the framework of the EVER-CAN project, the input of the network will thus be composed of several images. In other words, one of the first objectives of the network will be the fusion of the different information given in input. In the field of computer vision, applications concerning information fusion are numerous [1-5]. Although the field of fusion largely predates that of deep learning, deep neural networks have been used for a decade [6] to perform this task, which is nonetheless difficult when the images are not completely aligned. Note that the LIRIS team has already worked on this type of problem in the context of Remi Ratajczak's and Clément Douarre's theses [7] but on a different scale.

These theses have enabled us to acquire know-how on the neural architectures envisaged in frameworks such as the one proposed by the EVER-CAN project, and the types of fusion (early, intermediate, or late) to be consider in such kind of situation. Regarding the learning of the network model, a semi-supervised learning will be studied. More precisely, as data annotation is essential for the learning phase, but very time consuming, we propose to limit the annotation phase conducted by experts to a small portion of data and follow a "weakly labeled" data approach [8], i.e., data will be partially labeled by algorithms.
Finally, we seek to develop an automatic processing pipeline that can be further corrected by the user. More precisely, we would like to develop an active and interactive learning process so that the user can indicate via an interface the wrong classifications, and then allow the classification model to evolve in consequence. We have already initiated this type of approach with the GOURAMIC software [10,11]. The objective of this software was to classify agricultural parcels from old aerial images. In this framework, the user draws a few strokes on the image to indicate the classes of the underlying pixels, and the developed algorithm infers

the classification over the rest of the image using these strokes. The next step could have been an automatic classification done beforehand and a relabeling of some automatically misclassified parcels; this would save the user time. This is what we seek to realize in the EVER-CAN project.
In summary, we plan to develop an automatic EV detection method based on deep learning with the possibility to consider the feedback of the user. This method will be generic enough to be used in other contexts. The developed software will be made available to the scientific community. Note that the research topics considered to solve the problem of EV detection are expected to push forward the state of the art of computer vision as following:

- Multimodal learning
- Semi-supervised learning
- Active learning

The final objective of these propositions is to contribute to the development of a data layer that can be integrated into a GIS system but also help to develop new GIS scores. The recruited person will be expected to valorize his/her contributions with publications in international conferences and journals.

Terms of the Post-Doc

The post-doc will take place at the LIRIS laboratory (Bron, 69) in a dynamic team and a flexible working environment.
Net monthly salary: about 2100 € (depending on the experience of the candidate).
It will start in September 2023, for a duration of 18 months (the dates can be adapted).

Required profile

The candidate must hold a PhD in the field of computer vision. He/she should have expertise in image or video analysis and deep learning.
The candidate will be required to collaborate with researchers from other disciplines. This requires the candidate to be self-motivated, and rigorous.

Expected skills:

- Python language
- OpenCV library
- Versioning tools (GIT)
- PyTorch framework.

Contact:

Laure Tougne Rodet : laure.tougne@univ-lyon2.fr
Carlos Crispim-Junior : carlos.crispimjunior@univ-lyon2.fr

Bibliography

1. Kim, Y. M.; Theobalt, C.; Diebel, J.; Kosecka, J.; Miscusik, B.; Thrun, S. Multi-View Image and Tof Sensor Fusion for Dense 3d Reconstruction. In 2009 IEEE 12th International Conference on Computer Vision Workshops. ICCV workshops 2009, 1542–1549.
2. Busemeyer, L.; Mentrup, D.; Möller, K.; Wunder, E.; Alheit, K.; Hahn, V.; Maurer, H. P.; Reif, J. C.; Würschum, T.; Müller, J. Breedvision—a Multi-Sensor Platform for Non-Destructive Field-Based Phenotyping in Plant Breeding. Sensors 2013, 13, 2830–2847.

3. Hwang, S.; Park, J.; Kim, N.; Choi, Y.; So Kweon, I. Multispectral Pedestrian Detection : Benchmark Dataset and Baseline. In Proceedings of the IEEE conference on computer vision and pattern recognition pages 1037-1045.
4. Wagner, J.; Fischer, V.; Herman, M.; Behnke, S. Multispectral Pedestrian Detection Using Deep Fusion Convolutional Neural Networks; 2016;
5. Ma, J.; Ma, Y.; Li, C. Infrared and Visible Image Fusion Methods and Applications: A Survey. Information Fusion 2019, 45, 153–178, doi:10.1016/j.inffus.2018.02.004.
6. Li, S.; Kang, X.; Fang, L.; Hu, J.; Yin, H. Pixel-Level Image Fusion: A Survey of the State of the Art. Information Fusion 2016, 33, doi:10.1016/j.inffus.2016.05.004.
7. Douarre, C. Spectro-Imagerie et Apprentissage Profond : Application à La Détection de Maladies de Plantes, Université Lumière Lyon 2, 2021.
8. Zhou, Z.-H. A Brief Introduction to Weakly Supervised Learning. National Science Review 2017, 5, doi:10.1093/nsr/nwx106.
9. Vayssade, J.-A.; Paoli, J.-N.; Gée, C.; Jones, G. DeepIndices: Remote Sensing Indices Based on Approximation of Functions through Deep-Learning, Application to Uncalibrated Vegetation Images. Remote Sensing 2021, 13, doi:10.3390/rs13122261.
10. Ratajczak, R.; Crispim-Junior, C.; Faure, E.; Fervers, B.; Tougne, L. Automatic Land Cover Reconstruction From Historical Aerial Images: An Evaluation of Features Extraction and Classification Algorithms. IEEE Transactions on Image Processing 2019, doi:10.1109/TIP.2019.2896492.
11. Elodie, F.; Ratajczak, R.; Crispim-Junior, C.; Danjou, A.; Perol, O.; Tougne, L.; Fervers, B. GOURAMIC: A Software to Estimate Historical Land Use in Epidemiological Studies. Environmental Epidemiology 2019, 3, 118, doi:10.1097/01.EE9.0000607020.37456.35.