

Postdoc at LAAS-CNRS (Toulouse, France):

Integration of machine learning and combinatorial optimization techniques for solving Computer Vision large scale problems

Contacts: Frédéric LERASLE (Professor RAP team, lerasle@laas.fr), Cyril BRIAND (Professor ROC team, briand@laas.fr)

1. CONTEXT

This job is part of a collaboration initiated in 2014 between the RAP (<https://www.laas.fr/public/fr/rap>) and ROC (<https://www.laas.fr/public/fr/roc>) research groups at LAAS-CNRS. The motivation is to combine machine learning (ML) and combinatorial optimization techniques, already investigated in these two groups. A first study concerned the classical problem of target detection in images. A first detection method linking a boosting method and mathematical programming has been proposed in [1]. A soft-cascade detector construction method has also been developed; it involves weak classifiers of heterogeneous nature and different temporal performances: SVM, LDA, neural networks. ML techniques are used to train the weak classifiers of the soft-cascade levels, while integer linear programming (ILP) is used to determine the detection thresholds used at each level to classify the targets. Both the processing time of the soft-cascade and its detection performance are considered simultaneously in the method, which makes it original. This detector has been evaluated and compared to the best performing detectors in the literature. These experiments conducted on two public databases clearly showed the interest of the detector in terms of processing time, with a guarantee of detection performance. Dominance properties have also been highlighted. They allow to reformulate the problem in terms of optimal path search in a graph and to develop approximate resolution methods based on the PLNE. This work has been valorized in conference papers of the Computer Vision and OR communities [2,3].

[1] Alhayat Ali Mekonnen, Frédéric Lerasle, Ariane Herbulot, Cyril Briand. People Detection with Heterogeneous Features and Explicit Optimization on Computation Time. 22nd International Conference on Pattern Recognition, Aug 2014, Stockholm, Sweden.

[2] Francisco Rodolfo Barbosa-Anda, Frédéric Lerasle, Cyril Briand, Alhayat Ali Mekonnen. Soft-Cascade Learning with Explicit Computation Time Considerations. 2018 IEEE Winter Conference on Applications of Computer Vision, Mar 2018, Lake Tahoe, United States.

[3] Francisco Rodolfo Barbosa-Anda, Cyril Briand, Frédéric Lerasle, Alhayat Ali Mekonnen. Mean Response-Time Minimization of a Soft-Cascade Detector. International Conference on Operations Research and Enterprise Systems, INSTICC, Feb 2016, Roma, Italy. pp.252-260.

2. MISSIONS

The postdoc recruited on a collaborative project between the RAP (<https://www.laas.fr/public/fr/rap>) and ROC (<https://www.laas.fr/public/fr/roc>) research groups at LAAS-CNRS of Toulouse will study the existing literature combining Operational Research (OR) and machine learning methods in the field of computer vision, in particular those aiming at applications of detection, localization and reidentification of targets in video streams. In a first step, he/she will pursue the work undertaken in the field of person reidentification, which will allow to consolidate these skills and to quickly valorize first results in conferences of Operational Research and Computer Vision. In a second phase, he/she will address the problem of posture estimation by taking inspiration from the methods already proposed in the literature. Finally, he/she will work on integrating all these techniques in order to propose a complete chain of person detection, re-identification and posture tracking in a multi-camera network. The thesis project will be conducted according to an agile approach aiming at producing more and more successful and realistic context experiments by exploiting the camera network already deployed in the ADREAM building

(<https://www.laas.fr/public/fr/le-projet-adream>) of the LAAS-CNRS and thus propose an advanced proof of concept of the approach, dedicated to the visitors of the laboratory.

3. ACTIVITIES

Contributions to 3D vision state-of-the-art techniques

Use of combinatorial optimization solvers

Implementation of algorithms in C/C++/Python

4. REQUIRED SKILLS AND QUALITIES

This offer is specifically dedicated to PhD fellow in Computer Vision with good theoretical background in combinatorial optimization and machine learning.

Other skills:

- Autonomy, teamwork
- Tools for vision and machine learning: OpenCV, neural network libraries and architectures

Duration of the contract: 12 months