Postdoctoral position in Computer Sciences and Image Analysis

Spatio-temporal feature extraction for monitoring environmental changes from heterogeneous high frequency image times series

Type of contract: CDD 12 months (possibility of renewal up to 10 months)

Where? LIPADE (SIP team), University Paris Descartes (France)

When? Early 2018

With who? Camille KURTZ, Nicole VINCENT and Laurent WENDLING (`name.lastname@parisdescartes.fr`)

Keywords: Image analysis, spatio-temporal feature, hierarchical image representation, satellite image times series, change detection

1 Context

This position is to support the scientific effort of the TIMES project ("High-performance processing techniques for mapping and monitoring environmental changes from massive, heterogeneous and high frequency data times series"), recently funded by the French Agency for Research (ANR) for the period 2018–2021. The project aims to support the analysis of satellite image time series in order to monitor the dynamics of our Planet, its land-cover and land-use. The postdoctoral position covers the image processing part of the project, with the main mission of developing and validating novel image analysis methods dedicated to environmental monitoring of landscape objects (e.g. coastal erosion, surface deformation, land cover changes) from the exploitation of the mass of available heterogeneous geospatial data (aerial and satellite images, point cloud data) acquired with very-high temporal frequency.

The ANR TIMES project is a collaboration between recognized teams in Computer Sciences (LIPADE, MIPS, MONASH (Australia) and SERTIT-ICUBE), possessing expertise in image analysis, pattern recognition, machine learning and high performance computing, and in environmental geography (land cover/use change analysis) with LIVE and ICUBE-SERTIT. The enrolled researcher will work in LIPADE laboratory and closely collaborate with the different labs of the consortium with potential travels to visit the other teams.

2 Research project

The recruited post-doc will investigate the extraction of spatio-temporal features for analyzing change detection from various sets of remote sensing data: high spatial resolution satellite image time series, point cloud from LIDAR acquisitions, aerial images, etc. The originality relies on extracting these features based on the multisource variables from the entire data time series, rather than the extraction of features at each individual sample time. We will focus on the development of original object-based approaches, adapted to heterogeneous geospatial data, in order to exploit the spatio-temporal relationships of the data. The research program of the post-doc will focus on two activities:

1. The first activity aims to extract spatio-temporal features from the mass of available heterogeneous geospatial data (aerial and satellite image times series, point cloud data, etc.). To this end, the first step will focus on developing a novel multiscale unified data representation approach, benefiting from the complementarity of multi-source information. We will extend recent works based on hierarchical image representations [4, 8]. From this multiscale representation of the multi-source input variables, the next step will be the extraction of spatio-temporal features that will be the primitives for the change detection step in the next Activity. We will first consider global features from the literature (texture, vegetation indices NDVI, geometry) as well as recently introduced local features (temporal SIFT – [1]). We will also investigate the use of features carrying information on the spatial relations [5, 2]. Once the features will be computed, in order to improve efficiency

as well as robustness and to reduce redundancy, the next substep will be to create a novel common feature space, as discriminative as possible, given a specific change detection task.

2. The second activity targets change detection from data stream by semi-supervised methods. The recruited post-doc will develop effective approaches able to detect generic changes using the features provided by previous Activity, extracted from the multi-source and heterogeneous input data. The developed methods will provide updated information at every new sensed image in order to handle the stream of information describing the data time-series for the observed area. The approach will extend and combine two methods initially developed for optical multiresolution image time series [6, 7]. Another approach based on a semantic strategy to update geographical databases from novel temporal image acquisition will be also investigated [3].

The recruited postdoc will contribute to the success of the project, considering the expected methodological / application needs and performance. He (She) will also be involved in the redaction of scientific publications, project reports and the development of software deliverables provided to the ANR and the other partners during the project.

3 Location

The recruited postdoc will work with the Systèmes Intelligents de Perception (SIP) team. The team is affiliated with the Laboratoire d'Informatique Paris Descartes (LIPADE) of the UFR Mathématiques et Informatique from Université Paris Descartes (Sorbonne Paris Cité). The SIP team develops a priority axis on image analysis and interpretation with a specific focus on visual perception for computer. The lab is located in the center of Paris, 45 Rue des Saints-Pères, 75006 Paris. Visit our web-page: http://w3.mi.parisdescartes.fr/sip-lab/.

4 Application

Highly motivated candidates (PhD) with experience in image processing/analysis, computer vision and feature extraction, as well as strong computer programming (e.g. C++, Java, python) and communication skills are encouraged to apply. We are looking for candidates having a track record of publications in recognized conferences and journals. Experience in remote sensing should be an advantage. As part of this project, the recruited post-doc will have to travel in France for meetings with the project partners or abroad to present the obtained results at international conferences. Applicants should send their CV, letter of motivation and name (+ email addresses) of 2 references to the contacts listed at the beginning of the document.

References

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[4] C. Kurtz, N. Passat, P. Gançarski, and A. Puissant. Extraction of complex patterns from multiresolution remote sensing images: A hierarchical top-down methodology. *Pattern Recognition*, 45(2):685–706, 2012.

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