Deep networks for multi-temporal activity analysis of Earth-observation data

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ONERA:

Area branch: Information Processing and Systems  Location: Palaiseau (south of Paris, France)
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Title: Deep networks for multi-temporal activity analysis of Earth-observation data

Keywords: Deep Learning; Remote Sensing; Computer Vision; Multitemporal Activity Analysis; Change detection; Copernicus

Context:

Satellite imagery is of primary importance to solve crisis situations, prevent natural disasters consequences or manage urban activity with precision. With more and more satellites around the Earth, we will soon be able to get everyday images from all around the planet.

Though, changes between two images over a short period are subtle and hard to detect. It is even more difficult to understand how important they are to predict future evolution of a particular place. Analyzing multitemporal, often noisy patterns requires powerful statistical models that still have to be designed.

Last years have seen the massive adoption of deep learning techniques for various tasks in computer vision. In remote sensing and Earth-observation data analysis, our team has developed algorithms for classification and detection which have established new state-of-the-art performances [DFC2015, ACCV 2016]. With this new PhD thesis, we now want to discover how deep networks can help understanding the multitemporal satellite image series.
Research axis will include:

* Semantic classification of aerial and satellite image from various sensors and with various resolutions (from Very High Resolution to Sentinel satellite resolution).

* Deep Learning architectures: design of deep neural networks for change detection (→ including siamese networks [Chopra 2005, Zagoruyko 2015] or adversarial nets [Goodfellow 2014]) and for modelling the temporal evolution of an image (→ recurrent networks);

* Investigating standard tools of image comparison (local descriptors [TGRS 2015], deformable models, 3D structure, etc.) in the context of deep network analysis. Particular attention will be given to invariance properties of the developed tools, in order to allow comparison of images captured by different satellites [EUSIPCO 2016].

* Big data: design of algorithms able to deal with datasets updated on a daily or weekly basis (e.g. Copernicus) and to be linked with open access tools (e.g. Google Search Engine).

Bibliography:

[DFC 2015] Lagrange, Le Saux et al., Benchmarking classification of Earth-observation data: from learning explicit features to convolutional networks, IGARSS 2015


[Chopra 2005] Chopra, Hadsell et LeCun, Learning a similarity metric discriminatively, with application to face verification, CVPR 2005


External collaboration: This thesis will be carried out in close collaboration with the Laboratory for the Treatment and Communication of Information (LTCI) of Télécom ParisTech.

CANDIDATE PROFILE

Education: Excellent degree (M.Sc., M.Eng. or equivalent) in computer science, mathematics or a related field (e.g. electrical engineering).

Specificities: Strong mathematical skills and a background in machine learning, computer vision and programming.

To apply or for further enquiries about the project, please contact Bertrand Le Saux (bertrand.le_saux@onera.fr), Alexandre Boulch (alexandre.boulch@onera.fr) and Yann Gousseau (yann.gousseau@telecom-paristech.fr).

Your application should comprise a letter outlining your academic education and past research, your motivation for this position and your specific experiences (max. 2 pages), CV and transcripts, as well as contact details of 2-3 referees.