Master 2 Internship Topic

Using deep learning to pansharpen satellite images

Context: The latest generation of satellite-based imaging sensors (Pleiades, Sentinel, etc.) acquires ***big volumes of Earth's images*** with high spatial, spectral and temporal resolution (up to 50cm/pixel, 50 bands, twice per day, covering the full planet!). These data open the door to a large range of important applications, such as the planning of urban environments and the monitoring of natural disasters, but also present new challenges, related to the ***efficient processing of high volumes of data with large spatial extent***.

Fig. 1: Example of Pleiades satellite images: a very-high-resolution panchromatic image in the left and a multispectral image on the right (©CNES).

Subject: Recent works have shown that deep learning methods succeed in getting detailed classification maps from aerial data [Volpi and Tuia 2016]. However, when applying a deep learning classifier to images acquired by recent satellite sensors (for instance, Pleiades images; see an example of the Pleiades data on Figure 1), the resulting classification maps are not very accurate. This is due to the fact that satellite images are more blurry than the aerial ones due to atmospheric effects. Another reason is that many satellite imaging sensors capture separately a very high-resolution panchromatic (grey-scale image) and a multispectral (color) image with lower spatial resolution; the so-called fusion, or *pansharpening* method, must be further applied to fuse these two sources of information. The errors due to the pansharpening method induce errors in the classification results.

The goal of this project is to propose a new pansharpening method to get a multispectral image with a very-high spatial resolution from two satellite sources: panchromatic and multispectral data. We will explore deep learning frameworks for this purpose. The main idea is to use the very-high-resolution aerial images for synthesizing a training dataset, consisting of the input panchromatic and multispectral images, and the resulting very-high-resolution multispectral image we want to obtain. The work will then consist in designing and training a deep learning architecture to pansharpen images. We will finally evaluate how the new method improves classification accuracies.

Validation: The developed algorithms will then be validated for analysis of Pleiades satellite images with very high spatial resolution.

Location: Inria Sophia-Antipolis Méditerranée, Sophia-Antipolis, France

Duration: 6 months

Research teams: TITANE, Inria Sophia-Antipolis Méditerranée, in collaboration with TAO, Inria Saclay

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