Multiscale Mapping of Ecosystem Services by Very High Spatial Resolution Hyperspectral and Lidar Remote Sensing Imagery

12 Months Post-Doctoral Position

Mathieu Fauvel[1] and Nicolas Dobigeon[2]

[1] University of Toulouse, Dynafor/INP-ENSAT, Toulouse, France

http://fauvel.mathieu.free.fr/

[2] University of Toulouse, IRIT/INP-ENSEEIHT, Toulouse, France

http://dobigeon.perso.enseeiht.fr/

1 Context: MUESLI Project

The objective of the MUESLI project is to monitor ecosystem services using high spatial resolution hyperspectral and LiDAR images. Regulating services, such as pollination and biological control, will be considered on a Long Term Ecological Research site. Unlike conventional approaches that use a crisp description of the landscape, i.e., by defining spatial objects from pre-defined classes (forest, agricultural field, river, meadow, . . .), it is proposed to adopt a finer representation that considers the continuous nature of landscape. Indeed, an object for a given spatial resolution is usually not made of only one material. A more realistic representation is to consider that an object can be a mixture of several materials. Using such a representation of the landscape, it is expected to identify new spatial patterns that provide significant regulating services. Furthermore, the object representation will allow to perform a multiscale analysis that better preserves the original landscape configuration.

Hyperspectral images provides a rich spectral information, which is necessary to assess correctly the heterogeneity of the landscape. Conversely, LiDAR data provides topographic information, which is complementary to the spectral information. However, this multi-source data is challenging to process accurately and specific developments will be done during the project. In particular, the definition of a mixture model on objects (rather than on pixels) will be addressed.

Three major steps are planned during the project for a total duration of 36 months. The first step concerns the data acquisition (remote sensing images and field data). The second step concerns the performances assessment of the state-of-art method and the data base construction. The last step concerns the definition and the implementation of the proposed representation of the landscape. The new developments will be compared to conventional approaches.

The scientific contribution of the project will be threefold. First, publications in journals and conferences about the several steps will be done during the three years. Second, maps of regulating services will be produced on the study site. Third, a software will be made available to the scientific community.

2 Objectives

The objectives of the post-doctoral position concern the application and the definition of unmixing models to extract relevant description of landscapes that takes into account its continuous nature. In particular, two points will be addressed in priority during this post-doctoral work:

- First, the high spatial resolution of the images will impose to apply contextual unmixing. If the proportion of each material is important, the spatial configuration of these materials is also an important feature to describe landscapes.

- Second, the physical natures of the hyperspectral and LiDAR data are complementary and this information must be fully exploited during the processing.

The extracted variables will be used in predictive models to link ecosystem services and the landscape descriptors. A field mission is actually conducted from February, 2016 to July, 2016. Several services in forests and agricultural fields are monitored and the data will be available in September 2016.

The implementation will be done using open software such as the Orfeo Toolbox (C++ library from the CNES) and Python with a graphical interface in QIGS.

Obtained results will be disseminate in the scientific community by publications in journals or by communications in conference and national workshops.

3 Requirements

Candidates should have a Ph.D in remote sensing or signal/image processing. Experiences in landscape ecology or environmental topics will be appreciated. A good knowledge in applied statistic or machine learning and image processing is required as well as good level in English.

Candidates should demonstrate their abilities to develop unmixing models, implement the processing chain, supervise master students and disseminate the results of the project through journal papers and communications.

4 Applications

The candidate should send (in English) an extended CV (including formation, experiences, list of publication and scientific responsibilities), a motivation letter and reference's contacts to

<div align="center">

mathieu.fauvel@ensat.fr and nicolas.dobigeon@enseeiht.fr

</div>

Review of applications begins on March, 2016, and will be closed when the position is filled.

5 Additional information

Supervision: Mathieu Fauvel and Nicolas Dobigeon
Location: University of Toulouse, France
Expected starting date: September, 2016
Duration: 12 months
Salary: monthly net salary of about 2200 euros (including mean annual bonus), will be adjusted according to experience and qualification.