PhD thesis project
Blind restoration of hyperspectral aerial images. Application to coastal environment

The new generation of airborne hyperspectral imaging sensors, embedded on light aircraft or UAVs, is of great economic, technical and scientific interest. Nowadays, these sensors deliver huge datasets with very fine spectral and spatial resolutions. These datasets allow retrieving valuable information on the nature (content) and the spatiotemporal evolution of over flown areas. However, their analysis and interpretation remain difficult in practice, especially for the data acquired in coastal areas because they are distorted by several sources of degradation (at the sensor level or due to the atmosphere and/or the water column). Some reflectance models and inversion techniques have already been developed in the literature to estimate the specific parameters of the water column. However, the accuracy of the corresponding results is highly dependent both on the studied areas (due to inherent spatial and temporal variability) and on the availability of auxiliary data coupled with the aerial acquisition. This limits the use of these models in terms of accuracy, robustness, and automatic operation.

To interpret the content of such data in an optimal way (so as to reveal, for instance, the accurate spectral signature of in-situ minerals and vegetable species imaged on the whole available spectrum), a preliminary stage of restoration (including denoising and deconvolution) must be introduced to compensate for the different sources of degradation, either depending on the sensor and/or the acquired scene.
To solve this complex problem the development of a restoration approach introducing a minimum of *a priori* knowledge and a joint exploitation of local spatial and spectral information is necessary
To achieve this goal, we propose in this thesis to develop an original multi-criteria restoration approach both taking into account the heterogeneity of involved environments and being adaptive to the acquisition conditions and the content of over flown areas. Three components will therefore be considered together:

• The first component focuses on the analysis and the estimation of the characteristics of a signal dependent observation noise, especially for images acquired with the last generation of hyperspectral sensors.

• The second component relates to the deconvolution problem of hyperspectral data. It requires first an advanced modelling of the point spread function (PSF) of the whole imaging system and then its accurate