SUJET DE STAGE Master 2

“Shape features in partition trees of images”

Context: The new generation of imaging sensors acquires **big volumes of images** with high spatial, spectral and temporal resolution. In order to fully exploit the potential offered by these sensors, there is a need to develop **efficient mathematical models and algorithms** for the spectral-spatial analysis of the recorded high-resolution data.

Method: The representation of an image with a **binary partition tree** (fig.1), or more generally, with a binary forest, has proven to be useful for the multiscale analysis and classification of high-resolution images [1]. Leaf nodes represent small homogeneous regions of the initial partition, while higher nodes represent the merging of two adjacent regions into a bigger one; the root of the tree is then the full image. Regions at different scales are used for image interpretation, based on their spectral, textural and shape features [2].

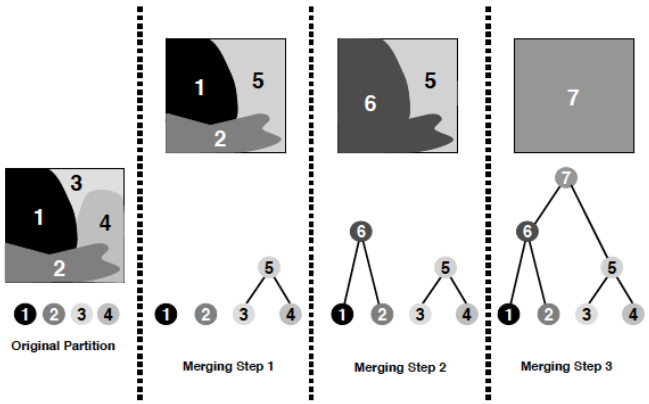

Figure 1. Example of construction of a binary partition tree.

Goal: The aim of the internship is to design and incorporate **shape descriptors in such partition trees, in a computationally efficient way**. More precisely, we are interested in the computation of shape features (such as rectangularity, elongatedness and compactness) to describe each region, in such a way that the shape descriptor of any node could be quickly obtained from the shape descriptors of its children in the tree. The high resolution of the images indeed asks for low complexity algorithms. The work thus consists in **designing both geometrical characteristics** (perimeter, minimum enclosing rectangle and/or ellipse of each region...) **and efficient algorithms** (dynamic programming, integral images or trees...) to compute them.

Validation: The developed model will then be tested for the analysis of hyperspectral images of urban areas with very high spatial resolution.

Requirements for the Master 2 student:
- Knowledge of image processing, geometry and optimization
- Very good C++ coding skills
- Fluency in English

References:
[1] S. Valero, P. Salembier, J. Chanussot, "Hyperspectral Image Representation and Processing With Binary Partition Trees," IEEE Trans. on Image Processing, vol.22, no.4, pp.1430-1443, April 2013.
[2] Y. Tarabalka and J. Tilton, "Improved hierarchical optimization-based classification of hyperspectral images using shape analysis," IGARSS'12, pp.1409-1412, 22-27 July 2012.

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