Satellite Image Sequences Analysis using 3D Clustering

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Résumé du projet de recherche (Langue 1)
With the booming number of available satellite images and data, the automatic interpretation of remotely sensed images has become an increasingly active domain [1]. With sensors now capable of getting images at very high resolution (VHR), it is more and more difficult to design algorithms and methods able to efficiently process such data in a reasonable amount of time. Such process usually contains two steps: (1) a segmentation step that consists in grouping together connected groups of pixels with the goal of finding homogeneous segments; (2) a spatial-temporal clustering step, wherein the segmented objects are analyzed in order to create groups of 3D similar elements. With the recent progress in satellite imaging, there are several possible levels of interest in a very high resolution satellite image [2]: firstly, we can usually distinguish three main types of objects, namely water bodies, vegetation areas and urban areas. At a second level we can separate different types of urban blocks, different types of vegetation areas, and start to distinguish elements such as roads. Following the evolution of such objects in time is an emerging problem with a wide range of applications, such as predicting the evolution of urban areas, monitoring the evolution of crops culture. Furthermore, more global issues can be analyzed, such as assessing deforestation phenomenon through time or predicting the long-term effects of natural disasters (for example, hurricanes, flash flood or droughts).

Résumé du projet de recherche (Langue 2)
As previously mentioned, analyzing sequences of satellite images is challenging for several reasons: unlike in classical videos, the detected objects can evolve and have a completely different shape in time, either due to seasonal differences or urban changes (e.g., house demolished and replaced with a new one, on same area). Furthermore, alignment issues, or partial/total clouds-related object occlusion add a second layer of difficulty. The goal of this thesis is to propose a generic unsupervised model in which machine learning algorithms would firstly spatially analyze series of images before reinforcing their segmentation by building time structures to predict the evolution of the objects. These 3D, spatio-temporal, structures can be constructed using Markov random fields [3], graph-based [4][5][6] or hidden Markov models, etc. Clustering or classification techniques could be further applied to the 3D objects for semantic identification in order to enforce the pertinence of their evolution and prediction. This subject is of great environmental and social interest if we consider that the evolution of our planet earth can highly influence the next generations’ quality of life and behaviors.

Informations complémentaires (Langue 2)