Summary

This document is dedicated to the study of visual selection using a coarse-to-fine approach. A practical example is studied in the first part : the change detection problem. The aim of this application is to detect changes in an aerial scene by comparing stereo pairs taken at intervals of several years in order to update a database. The result is a set of image locations that have a high likelihood to contain changes. Each location will be submitted to a human operator who will either validate the given change and update the database or reject it. In order to be efficient, the method should require the operator to inspect only a very small set of possible changes rather than perform a complete examination of the entire scene. We are mainly interested in changes occuring for a specific class of objects : buildings. To isolate new construction, we provide an algorithm which has two steps. First, during a focusing phase, we aim to eliminate a large part of the scene without losing any actual changes. This is achieved with a Digital Elevation Model (DEM) comparison between the two different dates. DEM represents depth in a given area. To obtain a DEM, a matching algorithm in epipolar geometry is used. Then, in the second phase, we classify regions of interest (ROI). Each region of interest is described by four images : a stereo pair of the focusing area at the first date and a stereo pair of the focusing area at the second date. To decide whether or not the ROI contains a change, we classify each of the four images as " building" or "non-building" classes. The building vs non-building classifier is a combination of several decision trees induced by learning. Due to the low resolution (50 cm pixel size) and the high noise level (scanned panchromatic photographs, 1/30000 scale), we do not seek an accurate building model during our classification step. Rather, each node of a decision tree is identified with a combination of several features (edges) within a graph of features which is more likely to describe buildings than background. Finally, the classification results at the two different dates are compared. The final result achieves a false negative rate which is less than 10 percent and a false positive rate between 10 and 15 percent.

In the second part of this document, a coarse-to-fine strategy is studied in a theoretical framework. We start with different tests, each of them having a given power and a given cost. We determine the optimal strategy for combining all the statistical tests in order to achieve the lowest error rate possible at the lowest cost. The efficiency of this approach is illustrated on synthetic data. This coarse-to-fine approach has been tested on real scenes in connected studies.

Keywords : *Change Detection, Object Recognition, Decision Trees, Learning, Digital Elevation Model, Coarse-to-fine Strategies.*