Summary

Despite advances in Photogrametry and Computer Vision, automatic scene reconstruction from photographs seems a formidable task, far from being reached. In this thesis, we focus on building reconstruction from multiple aerial images. A new approach is presented, that uses a very generic modelling of buildings as polyhedral shapes with no overhang, in which external knowledge is introduced through a priori constraints on base primitives.

The general strategy is subdivided in four main steps. In the first step, three types of 3D primitives are extracted from images : 3D segments, planar patches and oriented portions of facades. They will be of primary importance to infere buildings hypotheses and to select the best one. In this step, multiscopy context will help as far as exhaustivity and precision are concerned. In a second step, from the arrangement of planes deduced from plane primitives the system builds up a 3D graph of facets and then a so-called "compatibility graph" where the nodes are the initial facets of the 3D graph and edges between two nodes state that both facets belong to at least one common hypothese of building and thus are "compatible". In our scheme, buildings are modelled, in a very generic way, as polyhedral volumes with no overhang and it is shown that maximal cliques in the compatibility graph supply all the hypotheses of buildings that can be deduced from the arrangement of planes. Before effectively computing all the solutions by brute force search, some simplifications in the initial 3D and compatibility graphs are made, based on DEM and focalisation masque, in order to reduce the crippling combinatory that arise from the maximal cliques problem. In the set of all the hypotheses finally extracted from the compatibility graph, the choice of the final model is done, in a third step, through a bayesian formulation that enables different kinds of observations to be taken into account. Model complexity and a priori constraints on base primitives such as orthogonalities, parallelisms, symetries, horizontalities are also naturally introduced to balance caricature needs and data adequacy. The last step consists of effectively enforcing constraints in the building reconstruction. An implicit parametrization of the building enables to ensure that constraints are exactly verified.

Results are provided and show the validity of the approach that stays very generic on the contrary to model-based methods while bringing external architectural information through geometric constraints, which generally lacks in data-driven algorithms. The system can handle arbitrary complex buildings, even with internal altimetric discontinuities and overcome focussing errors. Despite its generality, the algorithm remains very tolerant to errors in primitive detections and shows promising results for the modelling of periurban scenes.

Keywords : *Buildings Reconstruction, Aerial Images, Multi-view Context, Bayesian Formulation, Digital Elevation Model, Hypothesize-and-verify Strategies.*