OBELIQUE PHOTOGRAMMETRY SUPPORTING 3D URBAN RECONSTRUCTION OF COMPLEX SCENARIOS

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Objectives
Although remarkable progress has been made in recent years, there are still many open issues when it comes to the 3D modelling of complex urban scenarios like historical and densely-built city centres.
This research aims to:
• investigate state-of-the-art methods for 3D building modelling;
• test their performance when dealing with a complex urban scenario;
• exploit the use of oblique airborne imagery and terrestrial mobile mapping data in order to support the 3D reconstruction task.

Area of interest
The project area is the oldest part of the Italian city of Bergamo, called “Città Alta” (1.2 x 0.8 km).
It poses significant challenges:
• presence of medieval buildings with complex and varying roof shapes;
• visibility constraints, that limit data acquisition from airborne platform.

Input data
AIRBORNE DATA
The airborne dataset comprises 1073 nadir and 4292 oblique images. They were acquired by AVT with Vexcel Ultracam Osprey Multi-camera system - a large frame nadir camera and four oblique looking cameras (nadir GSD of 12 cm).
Photogrammetric processing tools:
• in-house developed (block generation);
• Pix4D [AT – RMSE, 4.7 cm, RMSE, 5.8 cm, RMSE, 4.9 cm];
• SURE (DIM).

TERRESTRIAL DATA
Terrestrial Mobile Mapping System (MMS) data were acquired by SINECO with their Laser Mobile Mapper. As mapping sensors, the platform integrates two synchronously operated RIEGL VMX 450 lasers canners.

Methodology and results
BUILDING MODELLING WITH PARAMETRIC SHAPES
The tridicon/Hexagon suite of tools is adopted to test a reconstruction method based on parametric shapes fitting, starting from the DIM results.
Oblique imagery is then exploited to support the editing of the building models.

DATA INTEGRATION
MMS data are integrated with the photogrammetric point clouds to provide for a complete 3D reconstruction of the urban scene and detect architectural details on facades (at scale 1:100-1:200).
Visualization and management tools:
• BIM3DSG (in-house developed);
• Potree;
• Geoverse.

Conclusions and future works
The 3D reconstruction of complex urban scenarios is still a challenging task:
• the use of parametrized roof shapes to best fit the input airborne data can provide for efficient modelling results in case of standard roof shapes;
• when dealing with a medieval city centre, a significant manual editing of the results is required and the use of oblique imagery is essential in supporting it;
• the use of MMS data to complement airborne point clouds is proved to be a promising and efficient solution to retrieve a complete 3D urban reconstruction;
• the management of such massive datasets is still problematic.
Different reconstruction approaches are under development and investigation:
• a method based on point cloud segmentation and polyhedral reconstruction;
• methods for generating a 3D mesh optimized for efficient handling.