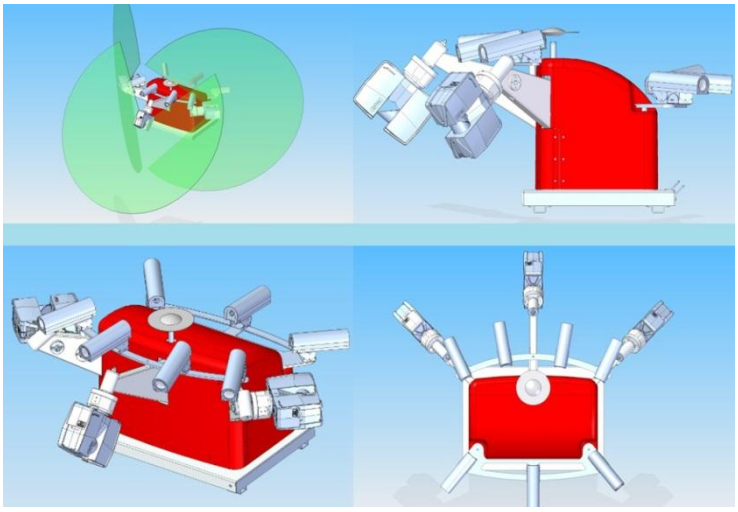
Survey for Mapping and Design

Customer: Toposcan, France



Project Goal: Survey with Road-Scanner3 of 20 km of the town of Riom for testing the use of the Mobile Mapping System for producing 2D and 3D topographic maps in 1:200 scale. The client, a major French topography company, was looking for a high-performance working tool to make topographical surveys and get detailed maps of roads and street furniture. Toposcan launched a benchmark to select the system to be acquired. The final choice has been the MMS Road-Scanner3 of Siteco, equipped with 3 Faro Focus3D laser scanners.

Equipment of the survey: The third generation MMS Road-Scanner3 can be mounted on any vehicle and scaled to meet the particular needs of each survey. It can integrate different types of inertial platforms, 5 to 8 cameras, and 1 to 3 laser scanners.

In this study, the set configuration included:

-6 high resolution cameras (2Mpx)

-3 Focus Faro laser scanners with a 2 mm resolution and a range of 120 m

-Positioning system with IXBLUE LANDIS inertial platform, receiver and GPS/GLONASS dual-phase antennas;

-Odometer

-Acquisition system.

The system was installed on a AUDI A6, equipped with the appropriate THULE bars, and powered with a 12V battery.

Methodology: The survey was carried out in the city of Riom. Toposcan had already conducted out a survey campaign, with conventional methods (GPS and total station), in a 1:200 scale. The existing topographic maps, representing all the roads, and the roadside assets and the street furniture, were very detailed and accurate.

The aim of the benchmark was twofold: on one side checking the correspondence between mobile and traditional survey, and, on the other side, updating, enriching and integrating maps. The survey was carried out on November 29, 2012, in not ideal lighting conditions, nevertheless good enough to produce good videos, also thanks to the characteristics of the cameras used. It must be remembered in fact that the quality of the imagery greatly impact on the overall result of a mobile survey. The video images significantly contribute to the interpretation of the point clouds, and allow the operator to perform additional photogrammetric measurements. The differential correction has been obtained by locating a GPS base station in proximity of the survey.

The mission lasted in total forty minutes, for a global length of 20 km. A survey of the Highway A71, between Clermont-Ferrand and Riom, was also carried out at an average speed of 90 km/h.

Back to the office of Toposcan, Siteco carried out the post-processing activities for the GPS differential correction and the calculation of the trajectories. In this way the vehicle position and attitude were registered at all points of the imagery, and at each start of laser scanning.

The calculation was executed with a standard PC laptop with Core I5 CPU and 4 GB of RAM, and processing took about 2 hours. After a check of the resulting trajectories, the batch processing of the AVI files and of the point clouds were started. This required about 5 hours. The day after the first results obtained were compared with the existing map, making it possible to evaluate the good quality of the results obtained.

It was possible to overlap all the point clouds to the surveyed areas, and analyze them. A strong correspondence of all elements on the maps was found, for perimeters of the buildings, streets and sidewalks, street furniture (signs and other vertical elements, road markings, etc..). The detected gaps were, on average, between 1 and 10 cm, according to the different types of geometrical elements and surveyed areas.

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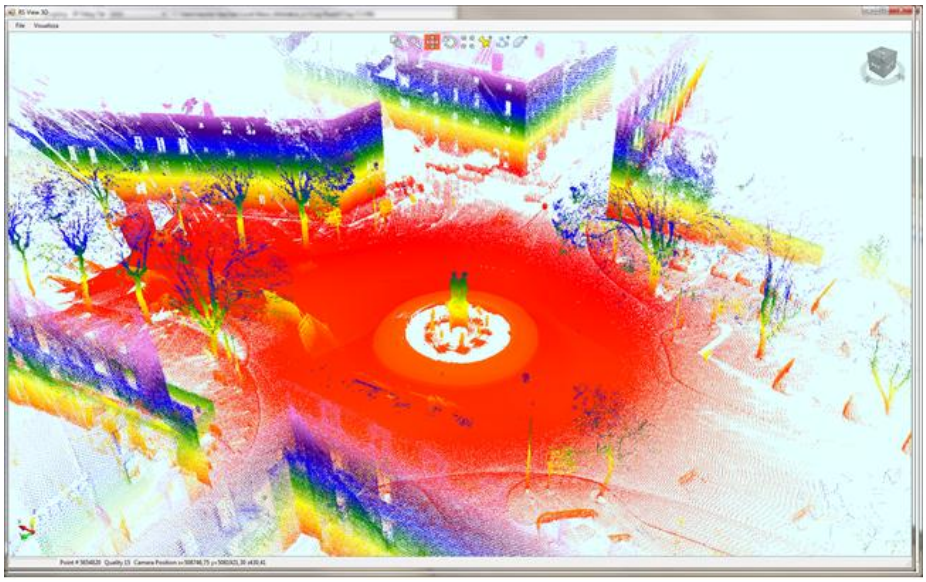
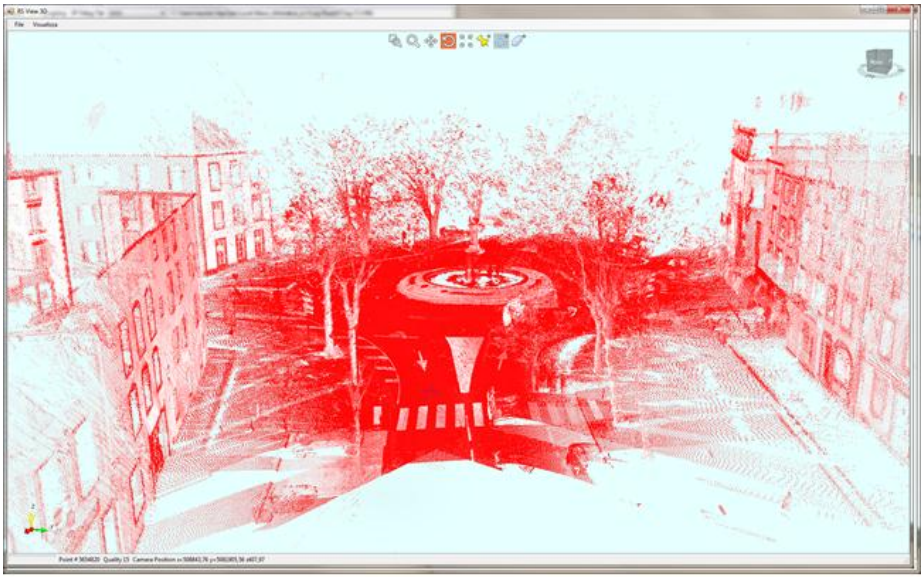
The road stretches with poor GPS quality were fixed using the vertices already present in the existing maps as Ground Control Point. A local adaptation of the trajectories was then carried out,. The gap observed between the two surveys was again lower than 3 cm.

Data Post Processing: The trajectories of the system were calculated with the algorithm of Kalman of the IXBLUE delphins software . Then the software kit supplied with Road Scanner3 geo-referenced the data collected with the cameras and the laser-scanners and produced AVI and point clouds files. At this point, it was possible to produce or integrate topographic maps, with the appropriate applications developed by Siteco.

Photogrammetric Software and Survey: To view this data set and allow measurements, detection and creation of geometries, as well as sections on the point clouds, Siteco used the application Road-SIT Survey. This software can be accessed from within AutoCAD and allows the immediate editing of the DWG drawing, introducing points or polylines digitized on the videos.





The geometries can be digitized using photogrammetric techniques or, more quickly, by snapping to the laser points. To control and manage the large amounts of laser points, Road-SIT Survey offers many sorting functionalities (by subsets, planes and sections).

Test activity for Toposcan: The tests performed with the client was carried out by digitizing the perimeter of some roadside assets, like sidewalks, traffic islands or by inserting points, for example, for the traffic signs. The defined geometries were then easily controlled by overlapping them onto an already existing accurate CAD plan. The precision obtained was of some cm and therefore sufficient to reach the conclusion that the Road-Scanner3 technology allows a topographic survey suitable for mapping and designing.

Figure 2 - 3D point cloud represented with colors in scale, by height or by reflectance.

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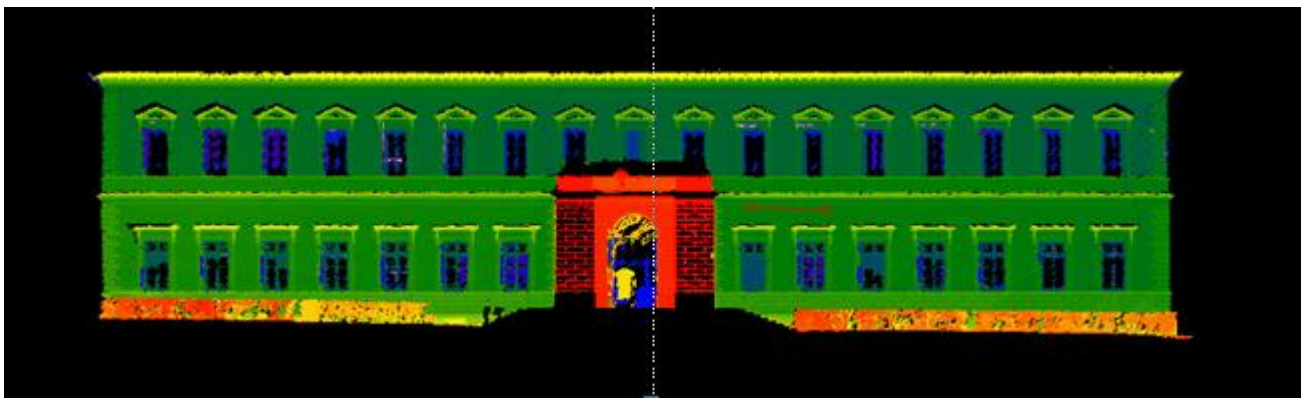

Figure 4 - Longitudinal section of the point cloud along a plane passing through 2 points on the building façade. The different colors define the point distance with respect to the defined plane.

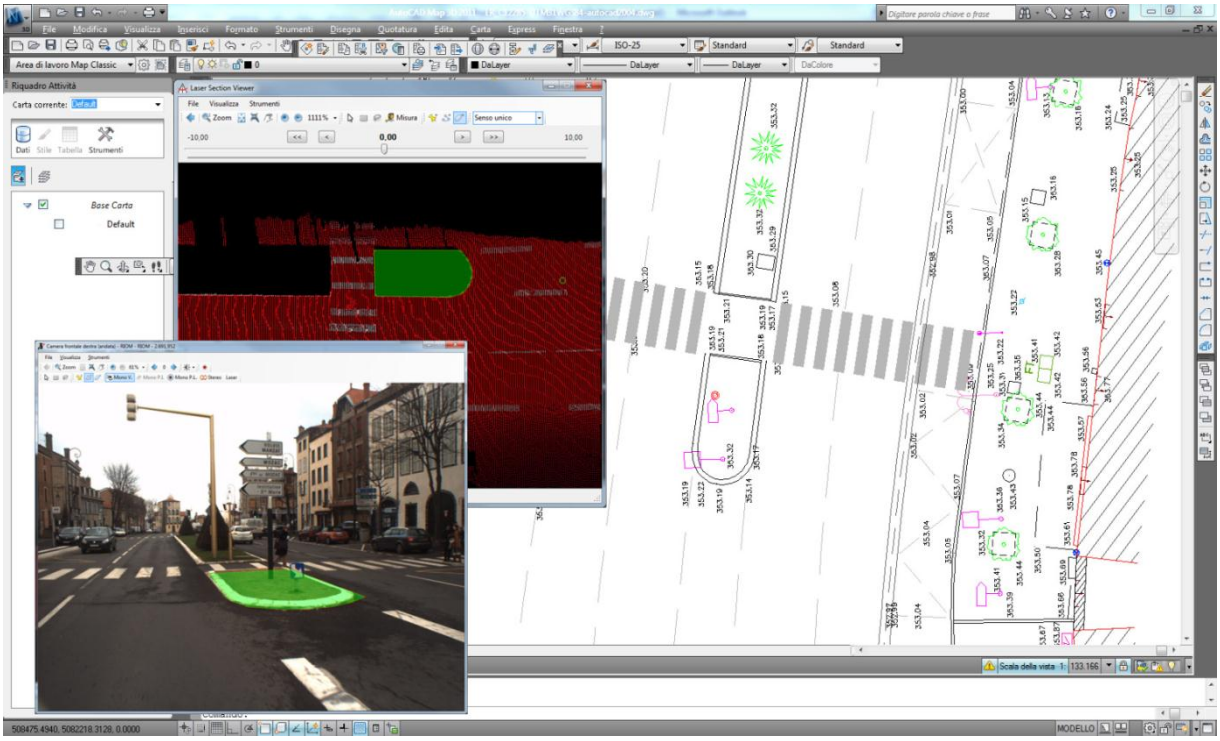

Figure 5 - Road-SIT Survey was activated as a plug from inside AutoCAD. The DWG file represents the plan of the road stretch at the set chainage on the video and on the point cloud. This figure shows the geometry of the traffic island as it results from the point cloud in the plan view and sectioned at road level.

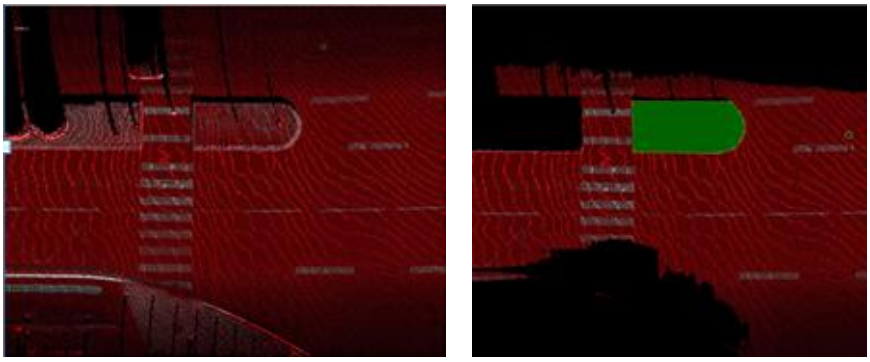

Figure 6 - This image illustrates one of the possible working methods: draw a section of the point cloud on the horizontal plane and decrease progressively (or increase gradually) the display buffer till the geometries of interest clearly appear, then digitize the profile to create the corresponding geometries.

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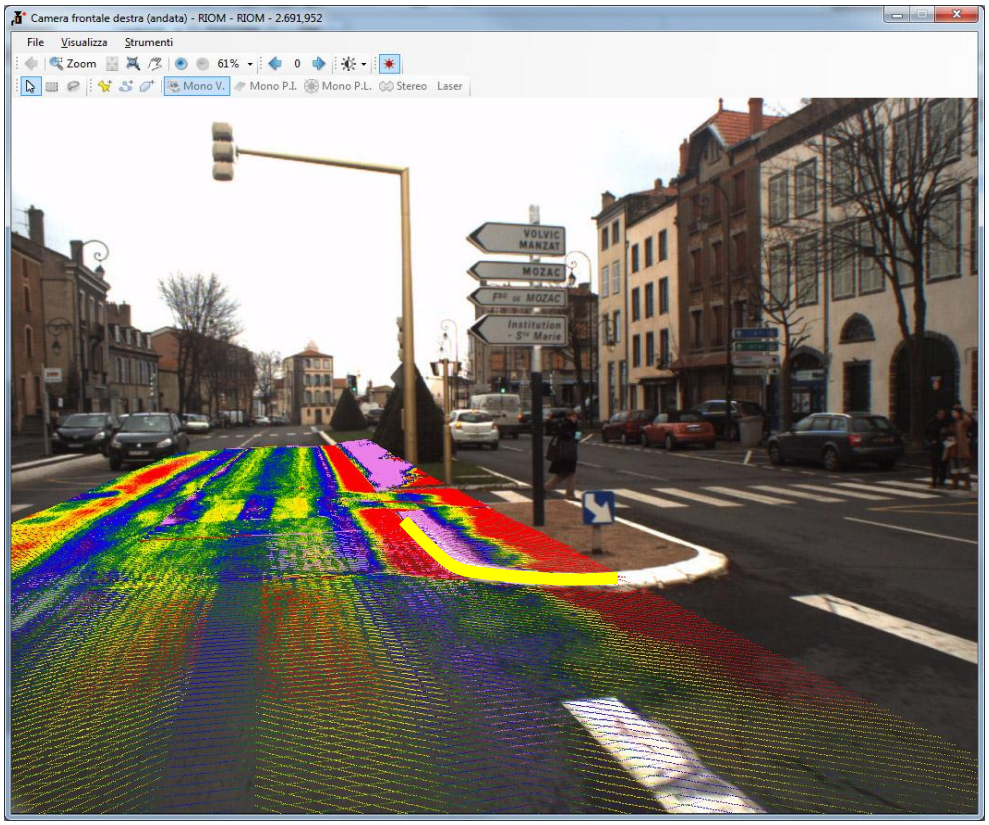

Figure 7 – A different approach for digitizing, for example, polylines consists in representing a portion of point cloud in scale, with different altitude colors, so that the edges representing the gradients, can be easily identified.

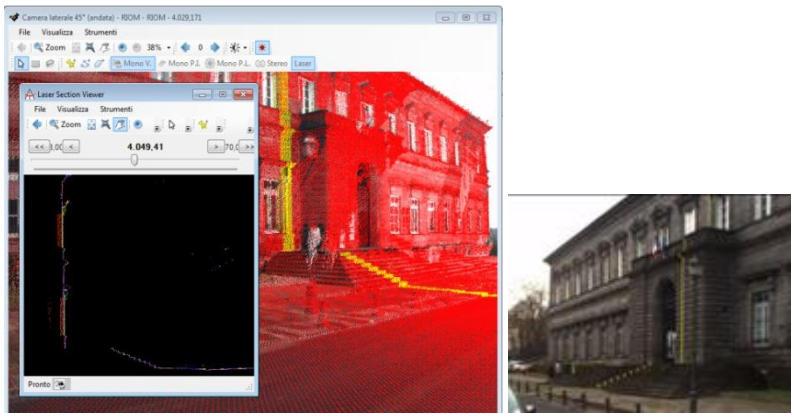

Figure 8 - Finally, a very effective method to draw edges, for instance steps, is to create cross sections of the point clouds, with respect to the Road-Scanner travel direction. By activating the representation of the single section, it is possible to draw the edge of interest, advancing section by section.

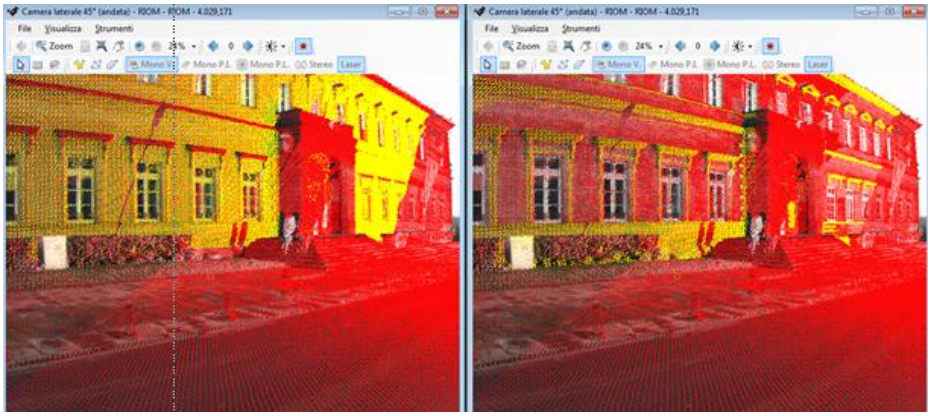

Figure 9 - The longitudinal sections by subsequent planes are normally used to digitize the facades: at each frame of the image there exists a relevant section of points ready for digitizing. For this type of operation it is useful to define the representation of a point buffer, that can be edited according to the quantity of details required.