POLITECNICO DI TORINO
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Honors theses

Integration of metric survey techniques for architectural multiscale modeling. Applications at the Basilica of San Pietro in Tuscania

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The Basilica of San Pietro is a Romanic architecture located in the municipality of Tuscania (VT) in the Lazio Region. The oldest parts of the church, built with a nave and two aisles, are the crypt and the apse dates back to the XI century. Several transformations were realized during the next centuries and the actual configuration of its interior preserve the renovation realized during the XIII century when the naves were stretched in order to built a new ornamental façade.

Cathedral of Tuscania during the middle-age, the church, located on the top of the Civita hill outside the actual center of Tuscania, is surrounded by the rests of the Episcopal buildings and bastions.

An integrated survey of the Church has been performed using LiDAR techniques integrated with topographic methodologies in order to realize a complete 2D documentation of the Basilica of San Pietro. Moreover thanks to the acquired data a complete multi-scale 3D model of the Church and the surroundings was realized.

Following the traditional approach to a metric survey first of all a principal network has been realized using a total station, moreover a celerimetric campaign was performed to obtain the GCPs necessary for the LiDAR data mounting phase, finally the LiDAR acquisition were projected and realized using a Riegl LMS-Z420 equipped by a Canon Eos 5D digital camera.

The first objective of the work was the realization of traditional 2D drawings (plans, sections and facades) of the Basilica; in order to follow the afore mentioned aim, an integration of the LiDAR data and the celerimetric one has been performed. First of all the celerimetric data was processed using a typical topographic approach, afterwards the LiDAR data were elaborated and finally a first mesh of the entire complex was realized. The first phase of data processing were carry out using Riscan Pro, for the other Geomagic Studio was employed. Using the mesh achieved in Geomagic Studio several horizontal and transversal sections were extracted in order to generate the basis for the 2D drawing production (picture 1).

Geomagic model of the Basilica

The other objective of the work was the creation of a multi-scale 3D model of the Basilica of San Pietro in order to document the entire complex at a small architectural scale and the transept at a very high architectural scale. In this part of the work two different strategies were employed: for the small architectural scale model the 3D modeling has been achieved using the informations derived from the 2D drawings using an approach based the Constructive Solid Geometry. Using this approach the real shape of the object is simplified: this methodology is employed in particular when the form of the structures are simple or when, as in our case, the aim is to give an idea of the complexity of a Cultural Heritage.

In order to follow this objective a small architectural scale model was realized, first of all the area of the Civita hill was modeled using the information derived from the 1:5000 scale map contours using 3D Studio Max, afterwards using the information derived from the 2D drawings all the Basilica was modeled in a CAD software (picture 2).

Small architectural scale model

A different strategy was employed in order to realize the model of the transept, in this case a 3D model using the mesh derived from the point clouds achieved during the LiDAR survey was realized.

Different software were used: first of all in order to better manage the LiDAR data and to create the first surface of the abse Geomagic Studio was employed; moreover using Rhinoceros the gaps were closed and the surfaces not acquired during the survey were modeled. Finally to achieve a realistic model 3D Studio Max was used (picture 3).

High architectural scale model

The intention of the work is to present different strategy in order to realize correct documentations for Cultural Heritage knowledge, using a typical 3D survey methodology (LiDAR survey).

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