Recovering 3D architectural information from dense digital models of building

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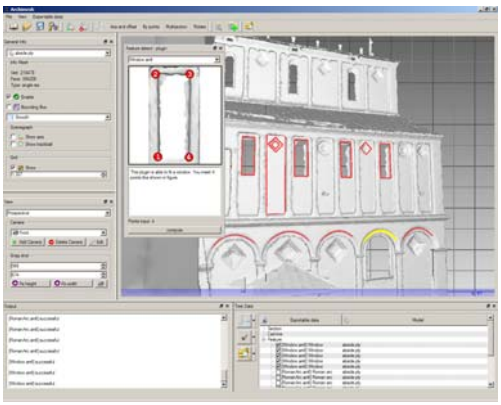
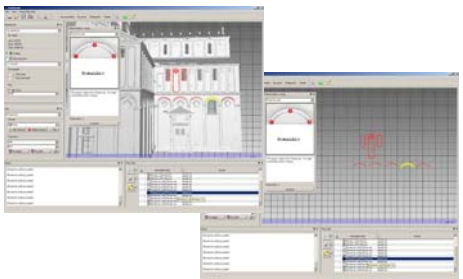
Snapshots

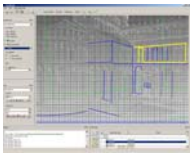
A common and diffuse need in architecture is the generation of snapshots of the scene (prospects, views) to be printed on large format output devices (plotters). Such images must be big enough to provide the required dots per inch for all the printing area. For example to print an A1 poster at 300 dots per inch, the image size must be 9921*6984. This can be a problem, since the stabdard graphics hardware support a limited size for a snapshot.
Our system supplies a tool for generating of high resolution snapshots.
The resolution is not limited to the screen resolution because the image plane defined by the user is automatically subdivided into parts by means of a regular grid. For each grid element, the scene is rendered at the maximum resolution available for the frame buffer currently in use. The final image is built by simply collocating the partial views in the right position.
Moreover, the user can easily select the appropriate projection type: one point, perspective, orthographic, isomertric, cavalieri.

Fitting of high level primitives

Another important aspect of the reverse engineering process in our application is the automatic fitting of high level primitives to the 3D data. The least squares fitting of primitives is not a new approach. The relevant aspect of our solution is the ease for the user to extend the capability of the application and to implement new primitives fitting tools.
At present, the system is able to detect roman arches (of the largest class of the arches) and generic windows however, the basic organization in plugins makes it easy to write the new simple rules for the identification of other primitives belonging to existing classes or other classes and to expand the availability of fitting tools.

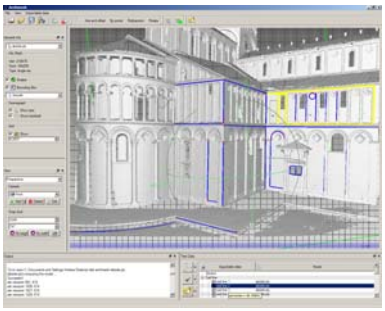


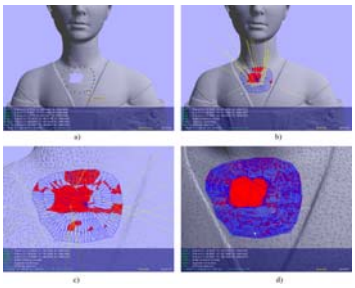


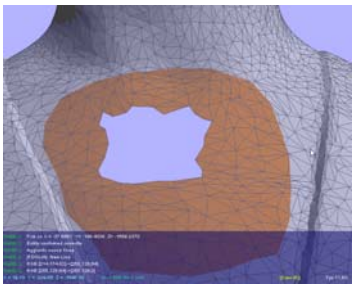


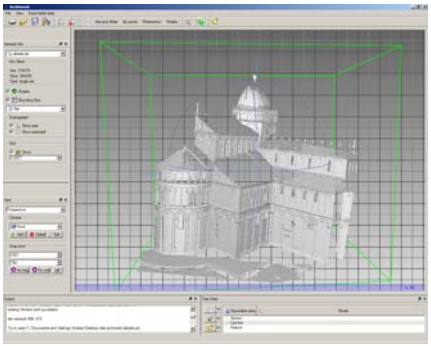
3D Selection

An important aspect in the process of recovering 3D information out of a huge 3D digital model of a building is represented by the possibility to design geometric primitives by exploiting the underlying 3D model.
In our system we support the design of polygonal lines and close surfaces. The importance of this tool is really high. The simple drawing of lines on the model permits the user to design directly in 3D starting from the acquired state of the structure. Locating regions in 3D allows the measurement of particular regions of the building which are not necessarily delimited by edges of the model; a typical example are the parts of the external surface to be cleaned or restored.



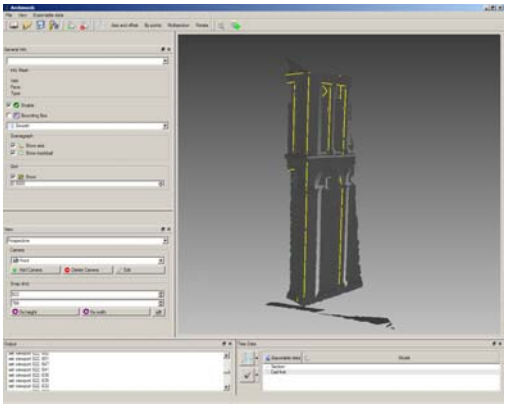






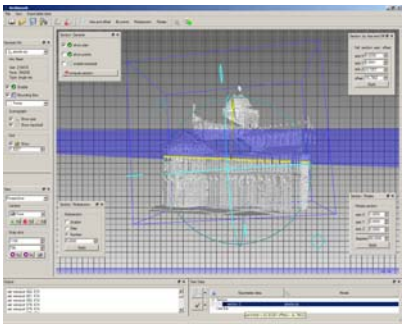
Reverse engineering

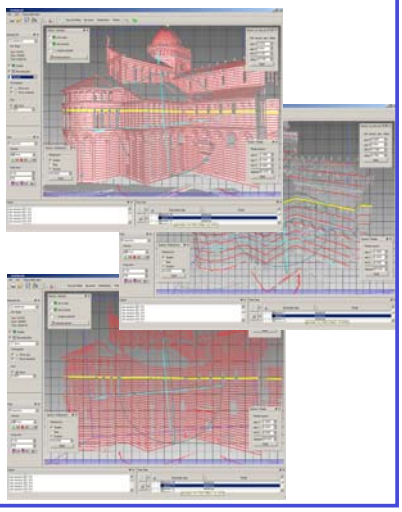
The automatic recovering of edges is an important component in the reverse engineering process. The recognized features can be directly exported in a CAD application software.
The method we implemented in our system adopts a region growing approach and consists of two main modules:
region growing which identifies uniform regions of the model;
and edge detection which attends to the location of edges as the result of the intersection between the interpolating planes of two adjacent regions.
The feature extraction algorithm with a simple query management system, is able to define the edges she/he is interested in by simply expressing angles between adjacent regions or tolerances.



Sections

Among the facilities the program puts at user's disposal sections and high resolution rendering have to be pointed out.
In order to compute the sections between a plane and the 3D model the user can directly use the analytic expression of the plane normal and a distance from the origin of the coordinate axes or she/he can, more simply, select three points on the model: the sections can be obtained for equidistant parallel planes as well.
The vectorial edgemesh data structures, corresponding to the sections, can be exported in multiple common formats. Some examples of multiple parallel sections are shown in Figure.





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