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ENEA ENTE PER LE NUOVE TECNOLOGIE, L'ENERGIA E L'AMBIENTE

Visualization of 3D laser scanner data from an archaeological site using openscenegraph in ENEA-GRID environment

THREE-DIMENSIONAL SCANNING OF AN ARCHAEOLOGICAL SITE

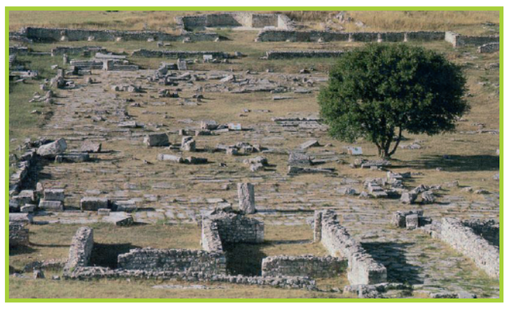
One of the main issues to face in archaeology is the monitoring of a site during a period of time, in order to document the preogress of the activity. This issue can be solved via periodic 3D laser scanning of the site. In this way the whole area interested by archaeological digs can be kept under control.
Each file obtained via 3D scanning contains millions of x,y,z coordinates, each representing one point of the scanned archaeological site. A colour label in the RGB format is associated to each point.
Usually, the final result of the process is a set of points, which may be displayed using the OpenSceneGraph libraries and ENEA GRID environment.
The 3D model obtained by laser scanning is an objective database which allows to extract information about the site morphology, geometric structure and materilas.
If the database contains a sufficiently high number of points, significant degradation phenomena can even be evaluated. Therefore, during post-processing activity on the 3D database, it is possible to retrieve plant, section and 2D elevation views.

Enea Laser Scanner rilief
at Juvanum Site (Montenerodomo, Chieti)

ENEA has a Time Of Flight (TOF) 3D Laser Scanner (Leica Geosystem, HDS 3000).
HDS 3000 is a high speed and high precision laser scanner combining different features suitable for a wide range of applications.

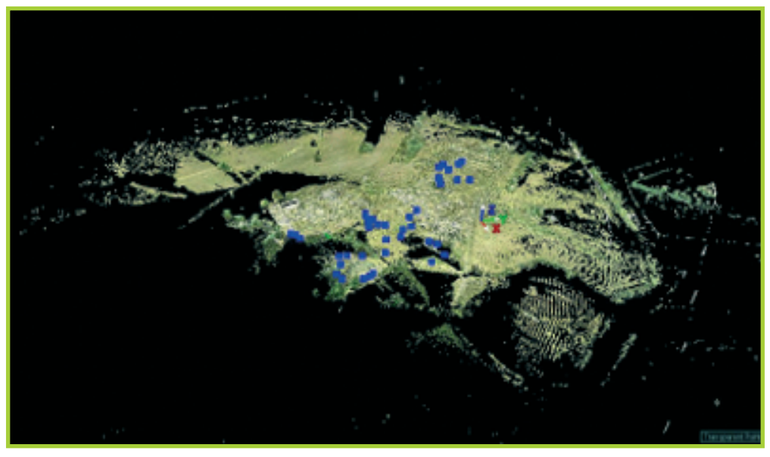
The maximum instrument range is about 300 meters with an accuracy of 3 mm at 50 meters. The distance between each point and the laser source is calculated according to the time between the emission of the green transmitted pluse and the return signal, that is recorded by a detector.

Juvanum *(Montenerodomo, Chieti)*



The instrument was used by Enea technicians, INFO-GER unit of Bologna, to scan the archaeological Juvanum roman site (Montenerodomo, Chieti), in cooperation with the Department of Science of the "G. D'Annunzio" University (Chieti). The obtained database consists of 16.589.664 points, each designated by x,y,z coordinates, reflectance and colour data.
Subsequently, the database has been optimized by removing the noise created by trees, metal structures, people in the area and various undesired objects.
After this post-processing phase, the final set of points was reduced to 5.665.282 points.

Set of points showing the RGB data



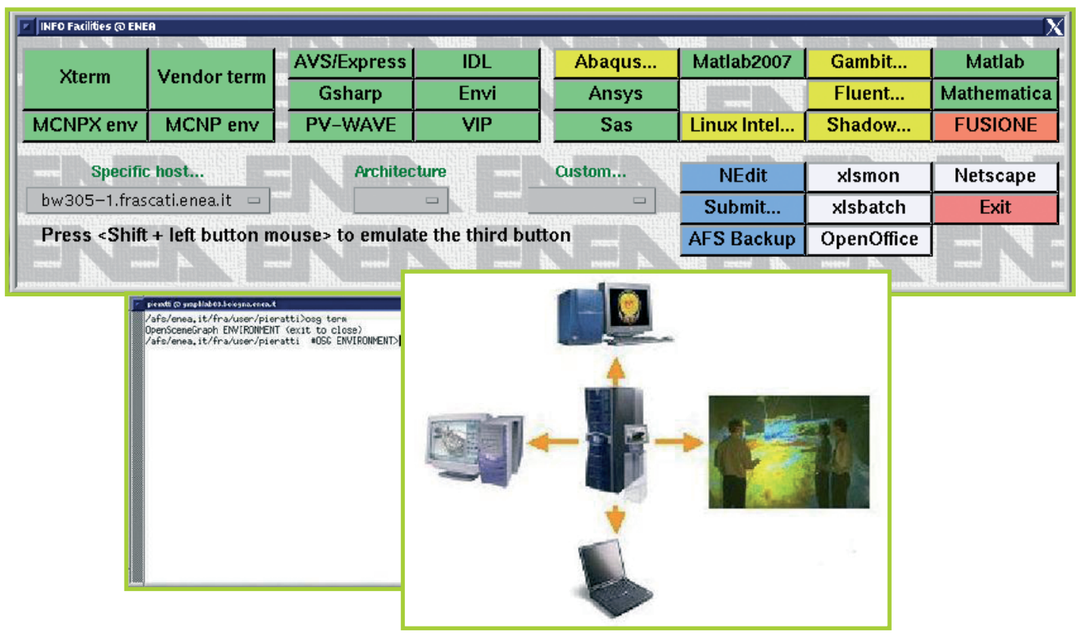
VISUALIZATION OF A SET OF MILLIONS OF POINTS

The final database obtained as described above needed to be processed by an application matching the archaeologist needs, i.e.:

- display of a large amount of data in a relatively short time (so allowing the operator to see the cloud of points in a "near real time" manner while he is scanning the archaeological site);
- operations on the points (e.g. distance between any two points, obtain plant views, sections etc.).

Currently there are commercial software with the above features, but we were oriented to an "open source" solution using our ENEA-GRID and the OpenSceneGraph libraries (OSG), because this is the best for our purposes.

CONFIGURE OPENSCENEGRAPH IN THE ENEA GRID



The OpenSceneGraph main characteristics are:

- Multiplatform (we have compiled OpenSceneGraph for Linux, Irix, Windows);
- Supports OpenGL and 3D stereo viewer;
- High performance;
- Powerful 3D viewer (osgviewer) that lets us to view in a fairly short time sets of several millions of points.

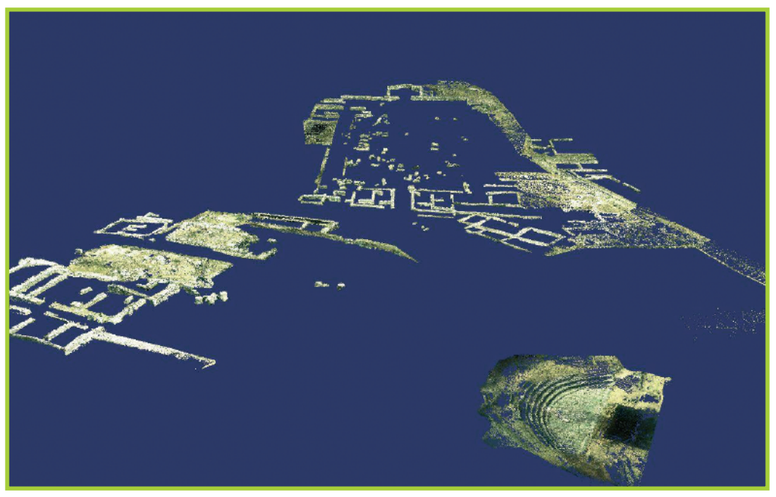
Any ENEA GRID user has a high level graphic library with the ability to create his own viewer with the desired characteristics.
However the OSG does not allow to:

- Measure the distance between two points;
- Extract the plan views;
- Extract the section views.

We have faced first the distance issue: the OSG can not allow to pick a single point and memorise its coordinates, but this limitation has been overcome by integrating into the viewer code the additional ANN library.
In particular:

- we have built up a database containing the coordinates of all the points from the 3D laser scanner;
- we have superimposed to the displayed image an invisible surface;
- when the user clicks on the desired point the matching coordinates on the surface are kept;
- to face the situation when the user clicks on a display point not associated to any database entry, the point from the original 3D database is assumed to be the point closest to the clicked one;
- the coordinates of the selected point are displayed;

ANN is a library written in the C++ programming language to support both exact and approximate nearest neighbor searching in space of various dimensions. It was implemented by David M. Mount of the University of Maryland and Sunil Arya of the Hong Kong University of Science and Technology.



Osg point cloud viewer

Autori: M. C. Baracca, R. Ciavarella, G. Furini, S. Migliori, S. Pierattini
ENEA - Dipartimento Tecnologie Fisiche e nuovi Materiali
e-mail contact: migliori@enea.it, samuele.pierattini@bologna.enea.it, roberto.ciavarella@portici.enea.it ➤ www.cresco.enea.it