# TcpScancyr for Tunnels

## Tunnels Cross-Section Generation From 3D Scanner

This software computes cross sections of tunnels for roads and railroads, from laser scanner data.

### Project Data

First the program requests the main project information, such as horizontal and vertical alignment and superelevations through numerical entry or by means of the conversion of other commercial formats (LandXML, Inroads, etc.).

Optionally the station´s coordinates can be inserted, that is, the locations where the scanner has been placed.

The data entry is interactive and it is supervised, controlling overlaps and other possible mistakes. The presentation is dynamic, being able to view simultaneously the analytical and graphical information, including dimensioning.
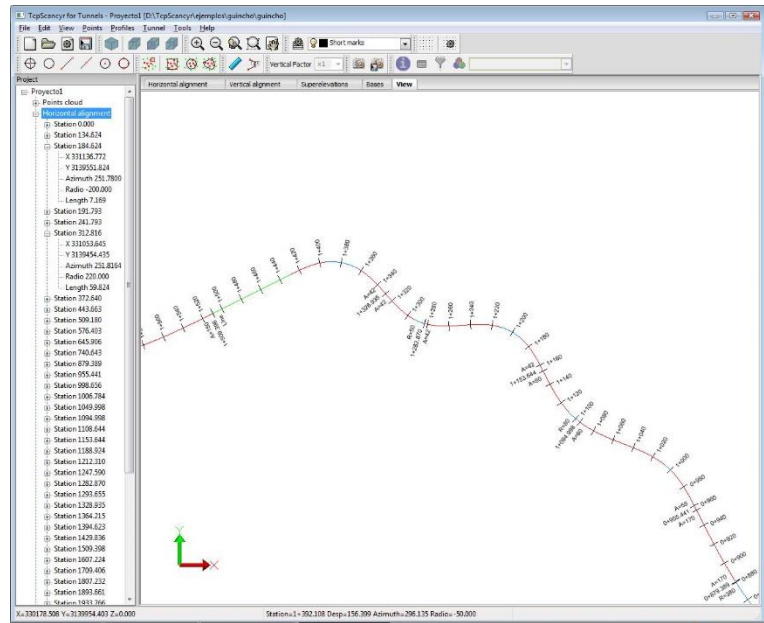
### Templates Definition
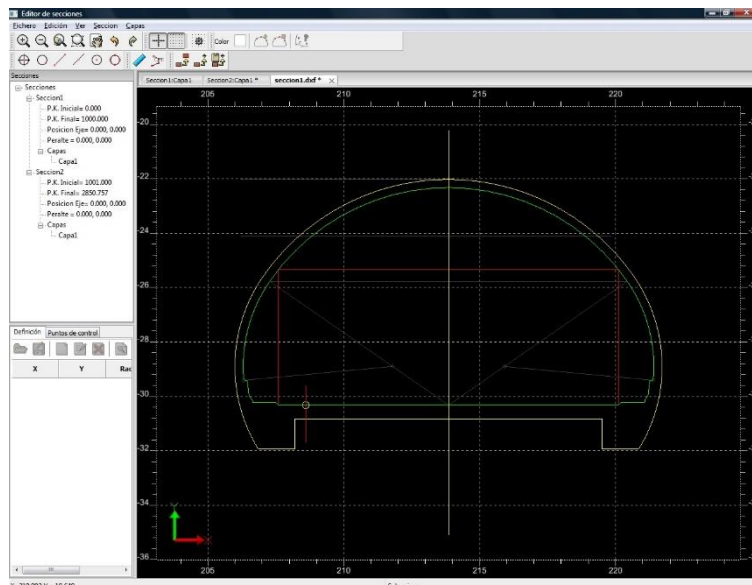
It is possible to define the theoretical template of the tunnel, which can consist of several layers, by means of numerical entry or importing a DXF file with the polylines that define the geometry. The template vectors can be fixed, variable or camberable.

Also it is necessary to indicate the relative position of the template with regard to the horizontal alignment and the elevation, the thickness of roadbed, the criteria of application of the superelevation, the destroy height, etc.

The templates can be applied to the station´s different ranges. Control points can be defined for every layer. These points will be used to calculate the deviation from the horizontal alignment.

## Management of Scanned Points

Once the data is defined, information of the scanned points is added by means of a set of ASCII files of coordinates, also the intensity and RGB color of every point can be incorporated.

Also it can import files from Topcon (*.clr, *.cl3), Cyclone (*.pts, *.ptx), Leica HDS 4500/6000 (*.fzs), Leica Nova MS-50 (*.xcf), FARO (*.fls), LiDAR (LAS/LAZ) and E57 (*.e57). This application can use any number of files if it has available space in disk. Also it is possible to export a percentage of points of active project.

All the points are analyzed with regard to the horizontal alignment and they are classify automatically, being able to be viewed as a whole or by portions.
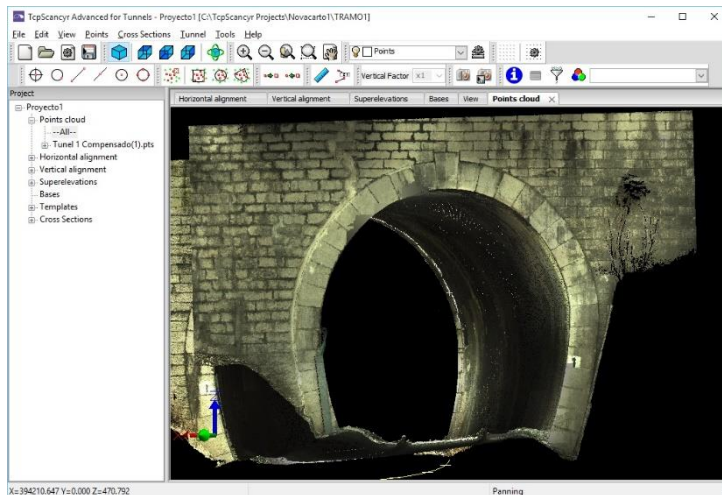


The symbology of the points can be set by different methods, such as station, displacement with regard to the horizontal alignment, difference of height regarding the vertical alignment, angle, inside/outside, distance to the base station, or by natural color. The range of color is defined by the user.

## Viewing

The points can be examined with a 3-D view, with the possibility of changing to an orthogonal view or to a perspective view using the corresponding icons. If we activate the perspective projection, the position of the camera can be controlled directly over the horizontal alignment or in a relative position, allowing modifying the station and the height.
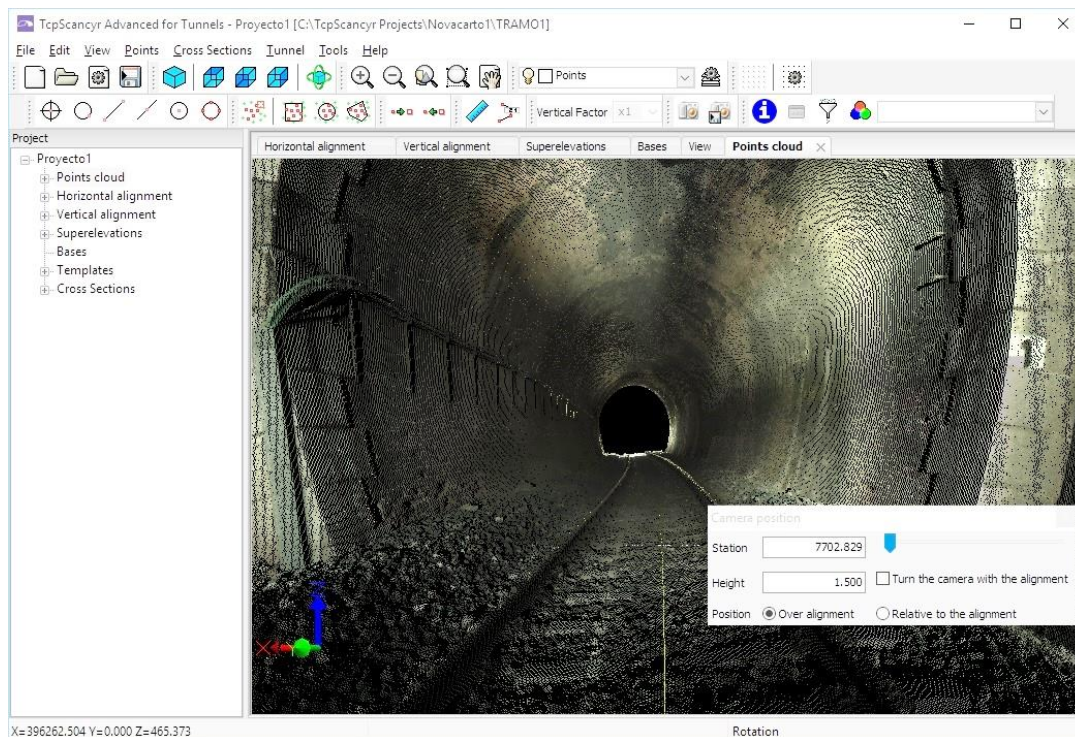


Other controls are zoom out, zoom in, zoom window, pan, 3D orbit, show or hide layers, grid, etc. Also it has tools as information of points, measure of distances 3D, etc.

## Filtering Tools

This program incorporates a series of interactive tools for filtering points by different criteria:

- Distance to the project template
- Displacement with regard to the horizontal alignment
- Height difference
- Angle regarding to the origin of the project template

The majority of the filters have as parameters the station´s range, as well as the values of minimum and maximum. The volume that defines the filter to apply in the space is viewed in an interactive way.
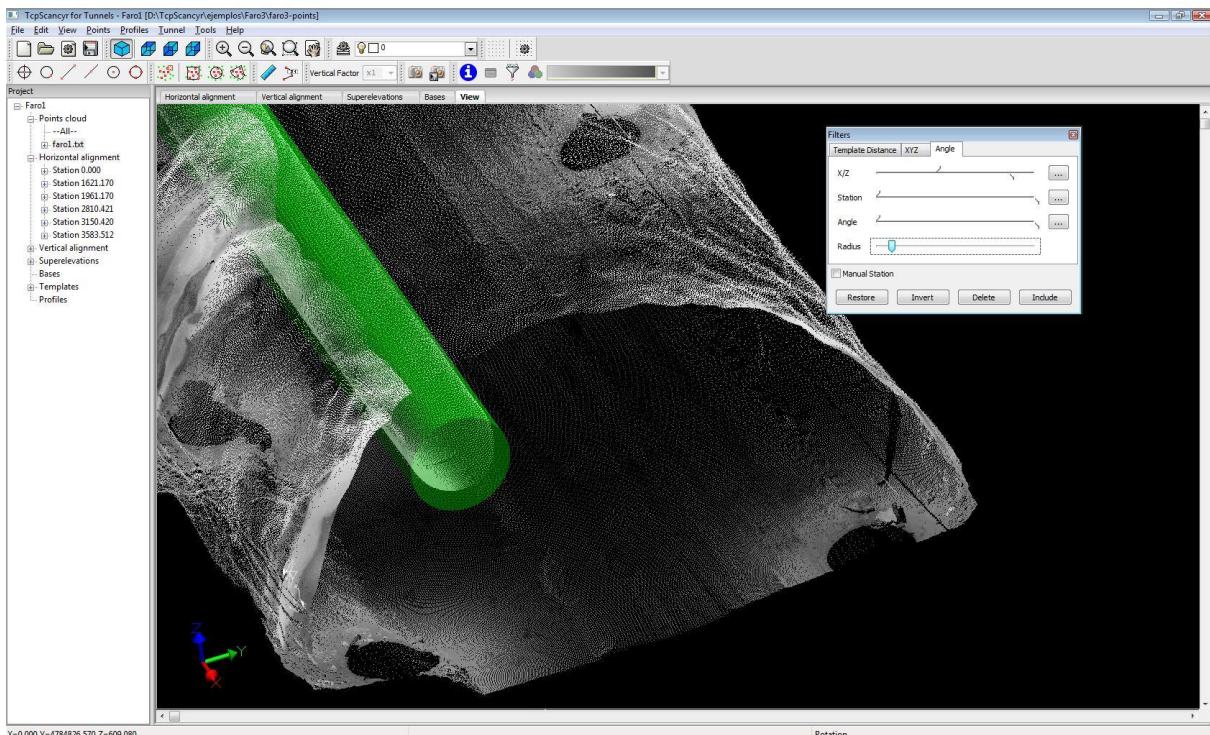


The filtered points are marked over the cloud of points and are deactivated, they won`t be used for a posterior calculation of profiles. In addition the filters can invert the selection, be restored and combined between them.

Also it is possible the graphical manual selection of points by window, circle or polygon.


## Calculation and Edition of Cross-Sections

Now with all the compiled information it is possible to calculate the cross sections, and it is not needed to give the theoretical template of the tunnel demanded by most of the commercial applications.

For it we specify the station´s range, the interval of generation, and the bandwidth we use to select the plane closed points that every cross section define.

The cross sections can be calculated perpendicular to the vertical alignment, or perpendicular to the XY plane. Also can be computed by regression.
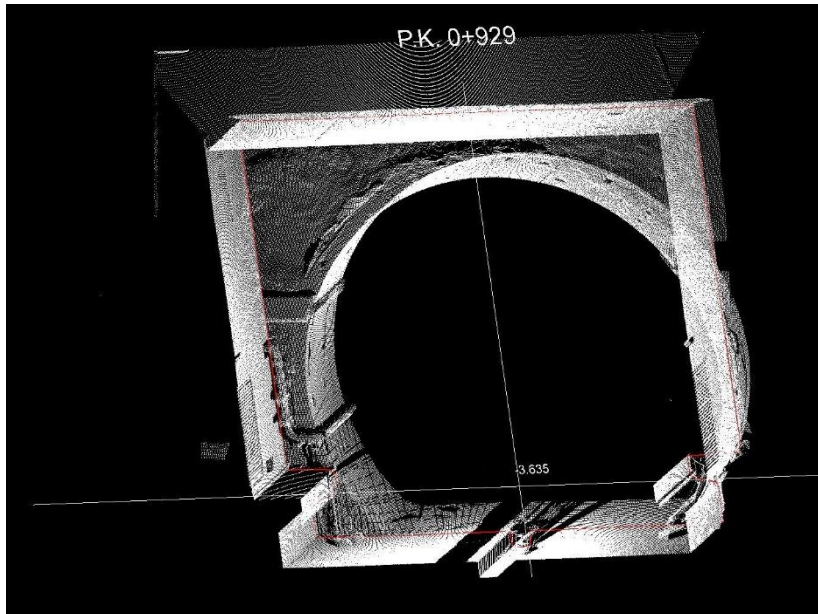
The filtration of the cross sections can be activated to eliminate peaks. Only the activated points are used in the calculation.

The program incorporates a powerful cross sections editor. It has options for add, move or erase vertices, apply filters, etc.

Also it offers the possibility of deactivating invalid points by rectangle, circle or polygon and re-calculating the cross-section. Cross sections can be open or closed, and it can be discarded those with not enough information for they not to take part in the volume calculation. Every project can have associated several cross section files.

Once the cross sections are calculated, they can be represented in 3D or with a frontal view, showing or hiding the cloud of points, dimensions, etc.

If the project template has been defined, the infra and over excavation zones and their numerical values appear with different colors.

The cross sections can be exported to DXF in 2D or 3D, in an individual or in a whole form, with many options about the elements to include.
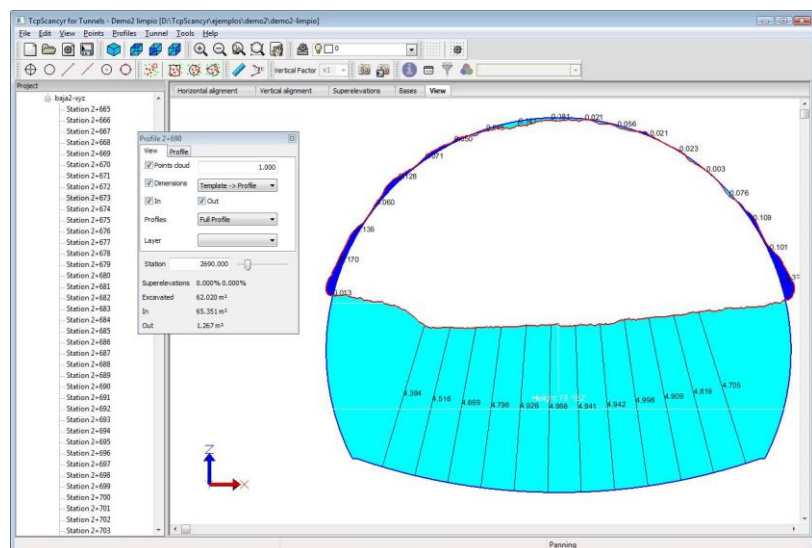


Also you can join cross section files, open and close cross sections, calculate parallel cross section given an offset, export profiles to other file formats, etc.

## Drawing of cross sections

The program can also export in 2D or 3D one or a range of cross sections to a DXF file, and you can customize the paper format, drawing options, scale, labels, etc.
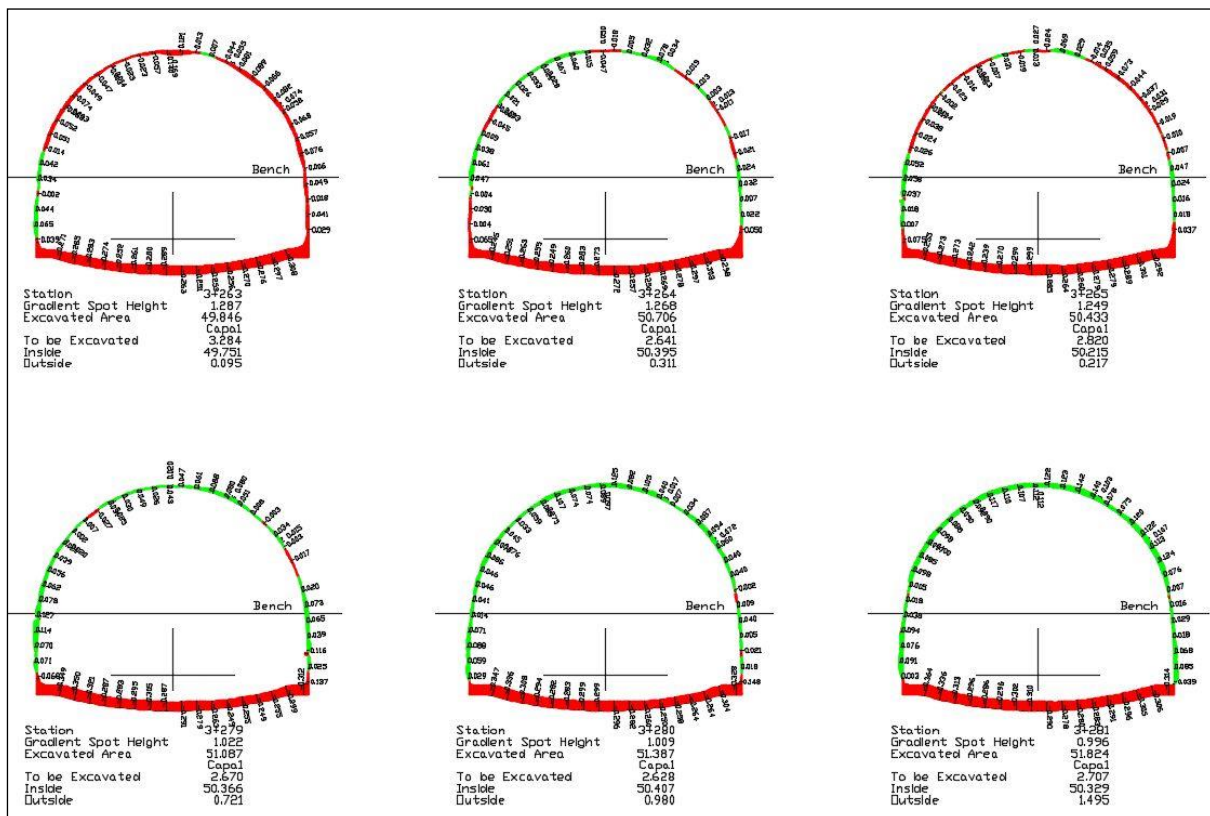


## Reports

If the templates have been defined, the program calculates automatically the areas and volumes inside and outside the template, as well as missing, separating the advance and destroy results. These data can be drawn over the cross section or generate a report to print, export to Excel or HTML.

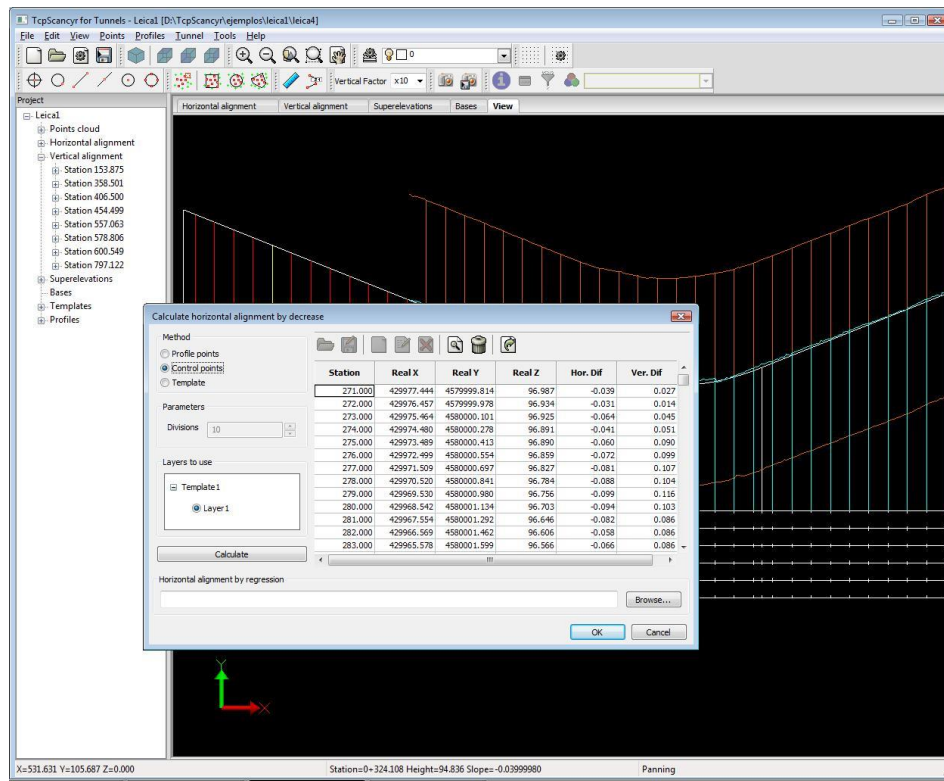Using profile comparative option you can calculate an area and volume report from cross section files, or from a cross section and an offset.

Another utility is calculate the real alignment by regression using control points defined in template, extreme points of every cross section, dividing the template in equal parts or fitting circles.



The program create a report with horizontal and vertical differences for every layer. They can be used to check maximum height sign, etc. The alignment deviation is also drawn over horizontal and vertical alignments, to compare them with project ones.

Also real and theoretical alignment can be exported to DXF as 3D polylines.

Other interesting reports are points on cross sections, control points, gauge report, bolts reports, etc.

## Inspection Map

Using this option a bitmap image is generated, in which the color in each pixel means the distance to the project template, allowing you to configure the range of distances, color palettes for positive and negative values, etc.
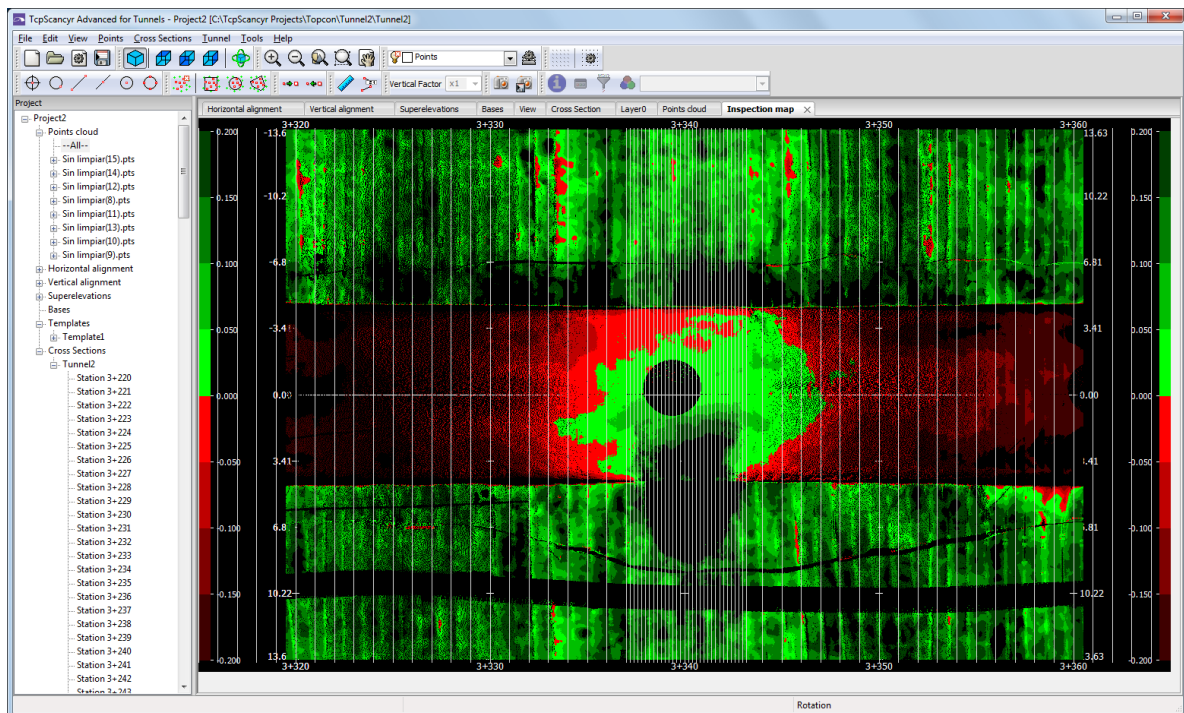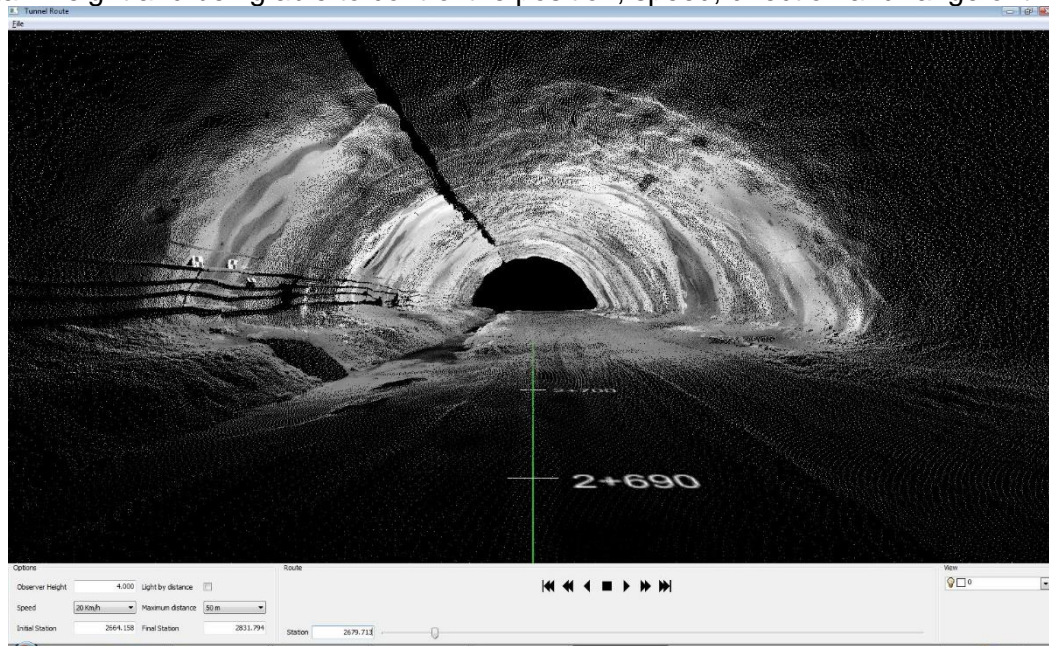


## Orthoimages

It also can generate orthoimages for the tunnel templates developed using the natural color or the intensity for of the pixels.
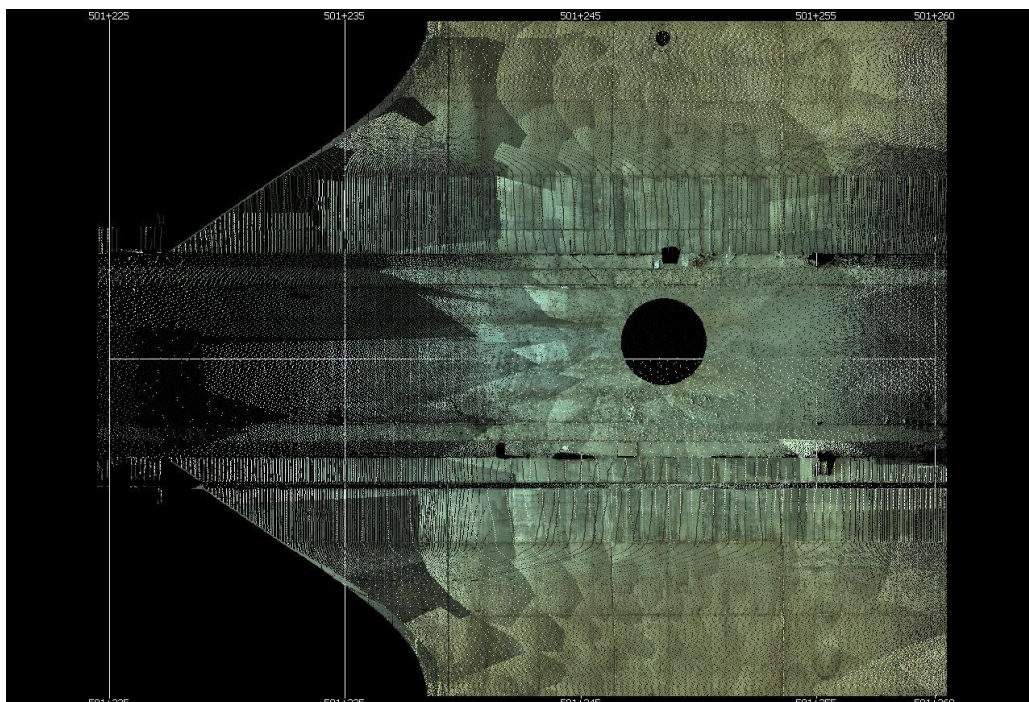
## Tunnel Tour

This program offers the user the simulation of a tunnel tour, placing the user inside this one to a certain height and being able to control the position, speed, direction and range of the view.



By means of a panel it is possible to control the position over the horizontal alignment being able to advance, move back, stop, go to the first or to the last station, or enter it directly.

Also theoretical and calculated templates, the horizontal alignment, surfaces, etc., can be activated as optional layers. Finally, with this animation we can generate a video in AVI format.

## Minimum Requirements

| Operating system | Windows XP, 7, 8/8.1, 10 in 32 and 64 bits |
|---|---|
| Peripherals | Mouse or pointing device, CD-ROM Reader |
| Video Card | Minimal Resolution 1024x768 pixels, compatible with OpenGL |
| Disk | 10 Gb free disk space |
| Memory | Minimum 2 Gb |
| Processor | Intel Dual Core 2 Ghz or better |
| File formats | Text (*.txt)<br>Topcon (*.clr, *.cl3)<br>Cyclone (*.pts, *.ptx)<br>Leica HDS 4500/6000 (*.fzs)<br>Leica Nova MS-50 (*.xcf)<br>LiDAR (*.las, *.laz)<br>FARO (*.fls)<br>E57 (*.e57) |

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