ROCKYFOR robot

Automation of rockfall trajectories analysis 3D from Laser Scanner

MAPANDO® **by GaspariAlfredo**
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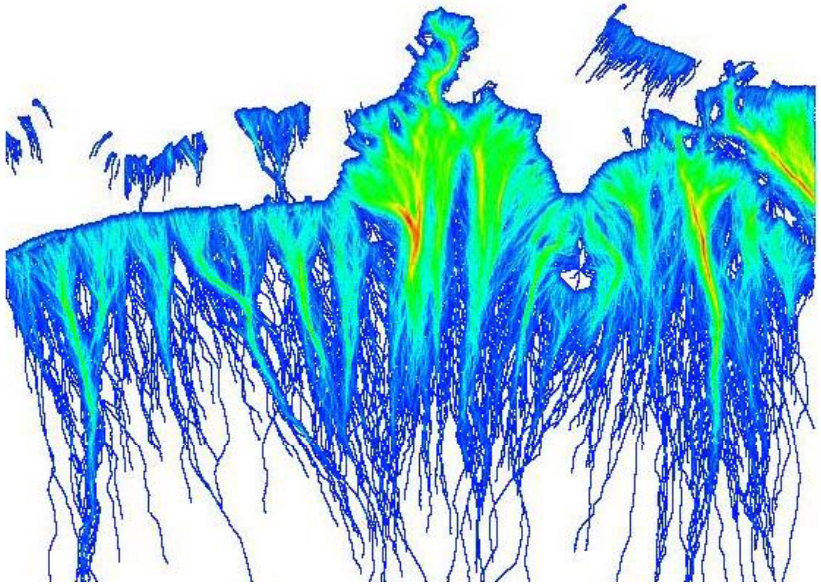
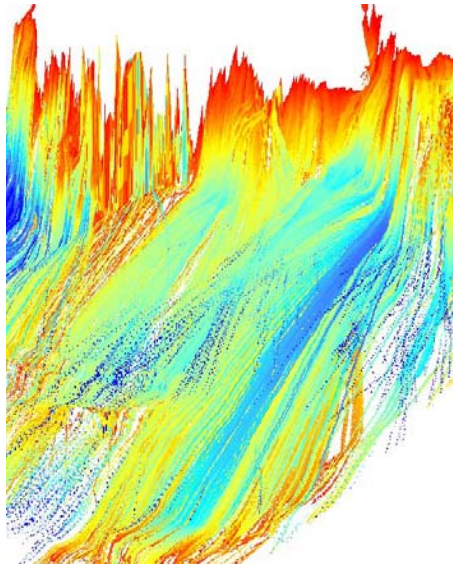
WHAT IS DONE WITH ROCKYFOR3D

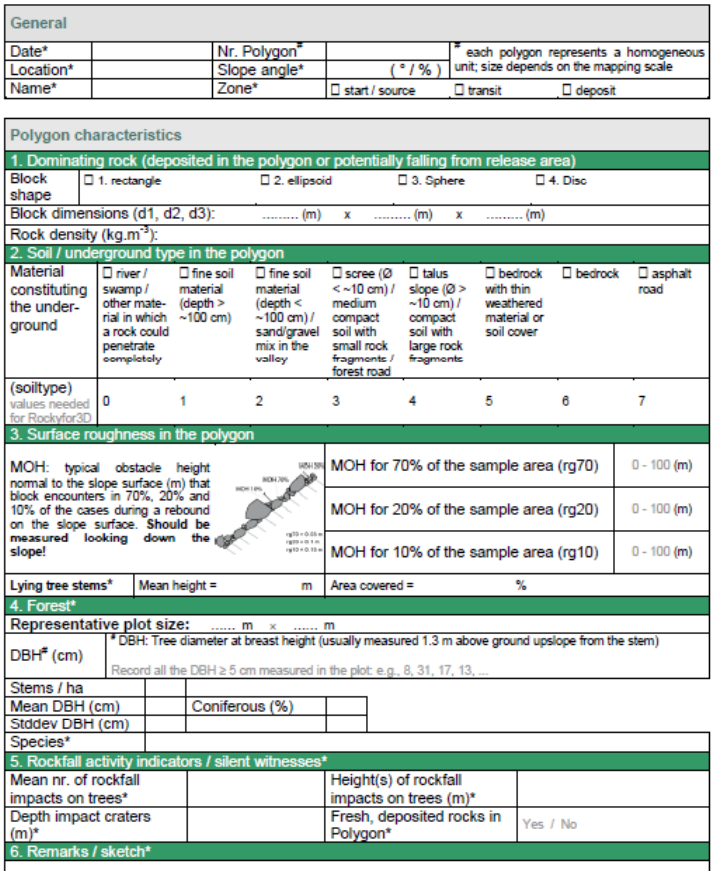
- **Rockfall trajectories analysis in three-dimensional maps**
- **Single or multiple block launching**
- **From Digital Model Terrain (DTM)**
- **For the creation of input maps software using the GIS**
- **Obtaining three-dimensional maps of the main parameters required for the study of the phenomenon, or design of the defense works**





HOW TO DO WITH ROCKYFOR3D

- **Depth survey in the field and on slope for the acquisition of the field survey data and next operations to be performed in the office**
- **Processing of data collected in the various maps created with GIS software**
- **These maps are the base (input data) of the simulations performed with Rockyfor3D software**
- **The output are two-dimensional maps and charts of energies, rebound heights, trajectories, etc ..**



General

Date*		Nr. Polygon#		# each polygon represents a homogeneous unit; size depends on the mapping scale
Location*		Slope angle*	(° / %)	
Name*		Zone*	☐ start / source	☐ transit ☐ deposit

Polygon characteristics

1. Dominating rock (deposited in the polygon or potentially falling from release area)

Block shape	☐ 1. rectangle		☐ 2. ellipsoid		☐ 3. Sphere		☐ 4. Disc
Block dimensions (d1, d2, d3):	..... (m)	x	..... (m)	x	..... (m)		
Rock density (kg.m^{-3}):							

2. Soil / underground type in the polygon

Material constituting the under-ground	☐ river / swamp / other material in which a rock could penetrate completely	☐ fine soil material (depth > ~100 cm)	☐ fine soil material (depth < ~100 cm) / sand/gravel mix in the valley	☐ scree (Ø < ~10 cm) / medium compact soil with small rock fragments / forest road	☐ talus slope (Ø > ~10 cm) / compact soil with large rock fragments	☐ bedrock with thin weathered material or soil cover	☐ bedrock	☐ asphalt road
(soiltype) values needed for Rockyfor3D	0	1	2	3	4	5	6	7

3. Surface roughness in the polygon

MOH: typical obstacle height normal to the slope surface (m) that block encounters in 70%, 20% and 10% of the cases during a rebound on the slope surface. **Should be measured looking down the slope!**	MOH for 70% of the sample area (rg70)	0 - 100 (m)
	MOH for 20% of the sample area (rg20)	0 - 100 (m)
	MOH for 10% of the sample area (rg10)	0 - 100 (m)

Lying tree stems*	Mean height = m	Area covered = %

4. Forest*

Representative plot size: ..... m × ..... m

DBH# (cm)	# DBH: Tree diameter at breast height (usually measured 1.3 m above ground upslope from the stem) Record all the DBH ≥ 5 cm measured in the plot: e.g., 8, 31, 17, 13, ...		
Stems / ha			
Mean DBH (cm)		Coniferous (%)	
Stddev DBH (cm)			
Species*			

5. Rockfall activity indicators / silent witnesses*

Mean nr. of rockfall impacts on trees*		Height(s) of rockfall impacts on trees (m)*	
Depth impact craters (m)*		Fresh, deposited rocks in Polygon*	Yes / No

6. Remarks / sketch*

THE PROBLEM

The trajectories analysis with Rockyfor3D require:

- **High capacity and knowledge of GIS software**
- **Elevated levels of inspection times for the collection of data on site**
- **Time high of preprocessing the data for creation of base input maps for Rockyfor3D:**
  - **Maps of soil types**
  - **Maps of the starting zones**
  - **Maps of vegetation zones**
  - **Map of the ground roughness**
  - **Map of defense works ....**

…. and also high time for small changes after the first simulations

THE SOLUTION: ROCKYFOR robot

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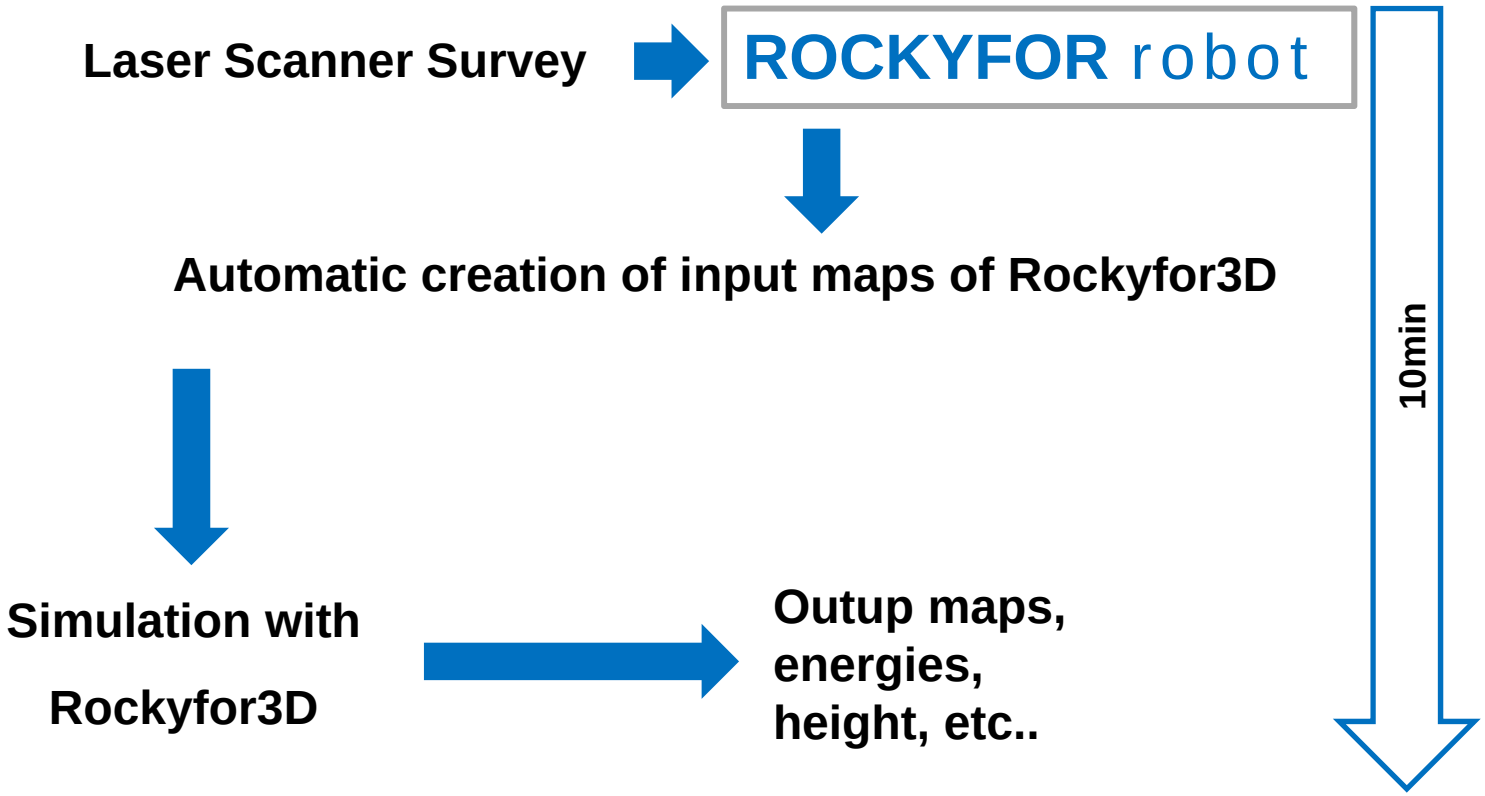
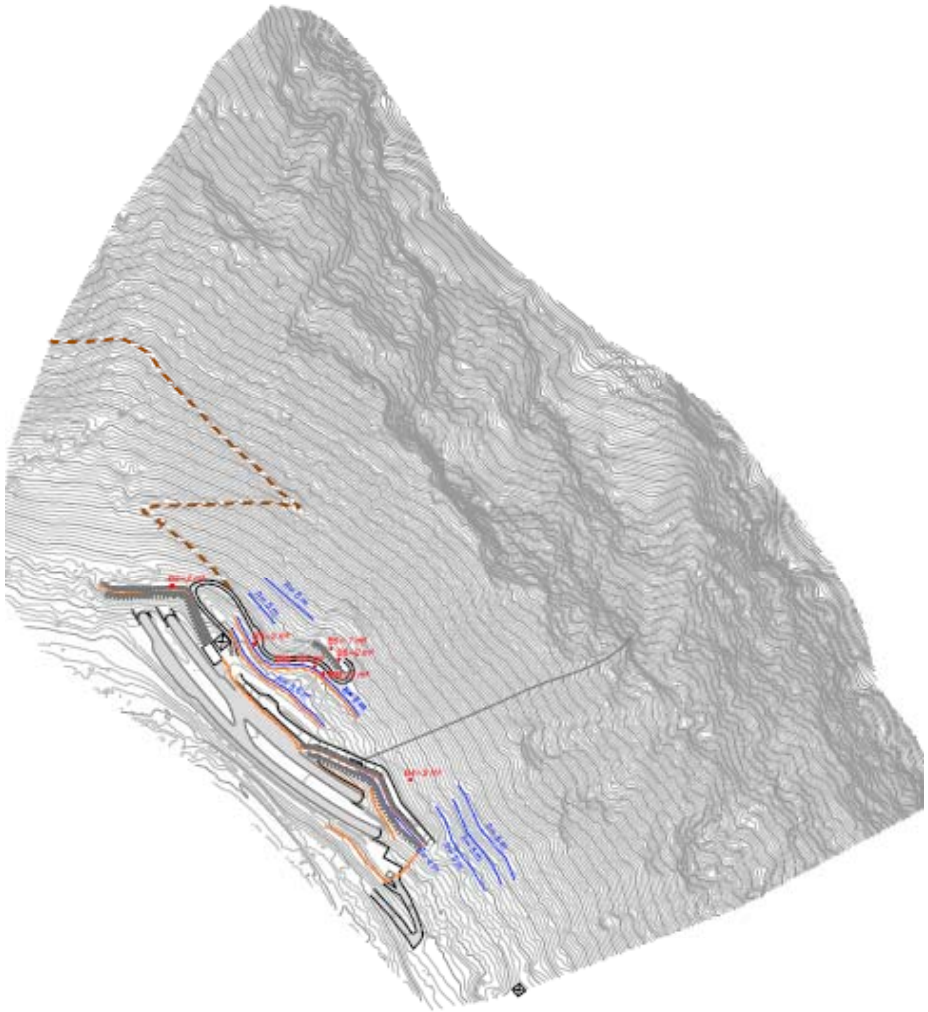
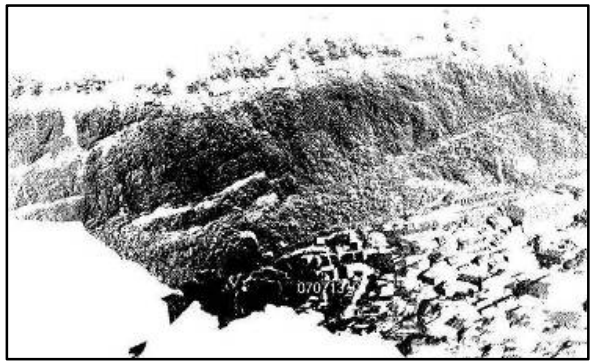


ROCKYFOR robot : **Laser scanner survey and creation of DTM**



- **On site laser-scanner survey an integration with drone photogrammetry**
- **Creation of cloud of poins**
- **Georeferencing**
- **Creation of DTM**



ROCKYFOR robot : From DTM to input maps of Rockyfor3D

- **Automatically filtering to create input maps(.asc):**
  - **filtering on geometric data**

    >>runout maps (rockdensity.asc, d1-d2-d3.asc, blshape.asc)

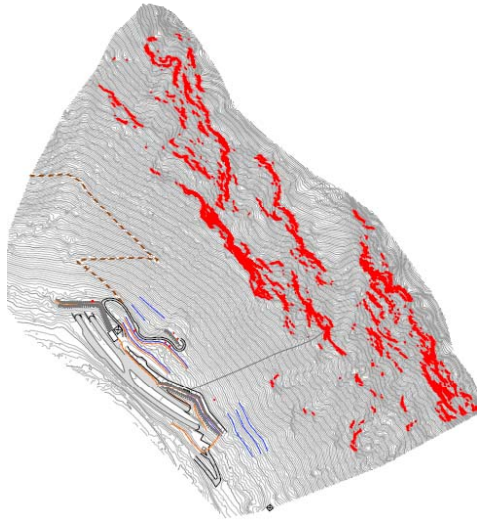
  - **filtering on geometric data, ortophoto, land maps, reflectance terrain maps form laser-scnner**

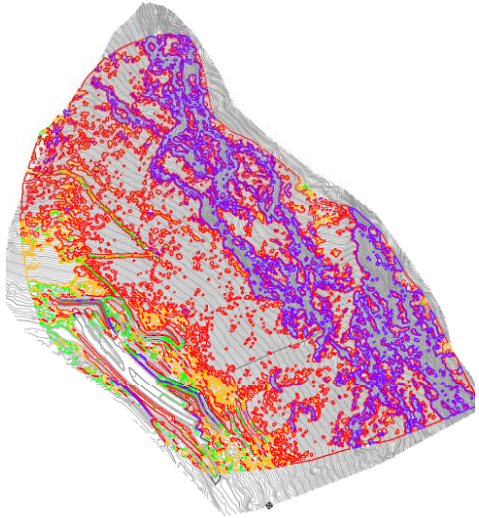
    >>>Soiltype maps(soiltype.asc, rg70-rg20-rg10.asc)

  - **filtering on geometric data, ortophoto, land maps, reflectance vegetation maps form laser-scnner**

    >>>vegetation maps (nrtrees.asc, dbhmin.asc, dbhstd.asc, conif_per.asc)

- **Import external boundary condition and automatic maps creation (.asc):**
  - **rockfall barriers, dams form .dxf files**





ROCKYFOR robot : When you use / How to use

- When you want to perform a fast trajectories analysis, to be used as a support for the subsequent visit on site or detailed surveys

- When inspection of the slopes is not considered necessary

- When you want to reduce the time of creation of the input maps Rockyfor3D

- When you want to perform analysis on macro-scale that would otherwise require higher processing time

- It does not replace the work of the geologist who must be present to define
  - the filtering parameter values
  - validation of input parameters
  - subsequent in-depth inspections

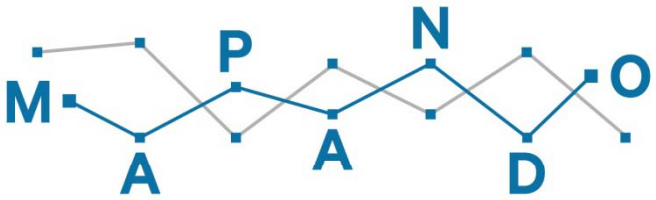
PROS of ROCKYFOR robot

- No need knowledge of GIS

- Better planning of the detailed inspections based on an automatic procedure validated

- Limited time for creating input maps Rockyfor3D

- After first simulation very easy to modify the subsequent calibration simulations



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