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Quantification of rock slope terrain properties

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Rockfall trajectory simulation codes need information on the terrain properties to formulate appropriate rebound models. Usually, the manuals of rockfall simulation codes give sketches or photographs of terrain samples [1,2]. Based on these the user can select suitable terrains for the simulation area. We now would like to start a discussion whether it is possible to numerically quantify the terrain properties which would make the ground assignment more objective.
Different ground properties play a role for the interaction between a falling rock and the ground:

- Elastic deformation
- plastic deformation
- Energy absorption
- friction
- hardness
- roughness
- surface vs. underground
- etc.

The question is now whether it is possible to quantify above parameters and to finally provide tables that contain appropriate simulation parameters. In a first attempt we suggest different methods or parameters that might be evaluated in situ:

- Small scale drop tests
- Light weight deflectometer (LWD)
- Particle sizes
- Sliding angle
- Particle distribution
- Soil cover
- Water content

Of course, above measurements will never perfectly fit to different mountain slopes. However, if a number of measurements has been made their spreading will give an idea on the natural variability of the ground properties. As an example, the following table gives an idea on how the M_E and E_{vd} values vary for different soils.

Table 1: LWD measurements on different soil types [3]

Ground type	Soil layer	Soil humidity	E_{vd} (median)	σ (median)	E_{vd} (average)
Humus-carb.	$< 10cm$	dry	17.4	6.8	15.6
Regosol	$10-30cm$	dry	8.6	3.9	9.4
Brownish	$30-50cm$	dry	12.1	3.2	11.7
Calcaric	$30-50cm$	dry	7.5	3.3	7.0
Acid brownish	$70-100cm$	dry	7.8	2.1	7.7
Fahlgley	$10-30cm$	dry	9.2	4.0	7.7

References

[1] Bartelt P et al (2016) RAMMS::rockfall user manual v1.6. SLF, Davos.
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[3] Hoffmann P. (2015) Härte von Böden. Bsc thesis, ZHAW Waedenswil.