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Gravity combined with laser-scan in Grotta Gigante: a benchmark cave for gravity studies

Tommaso Pivetta and Carla Braitenberg
University of Trieste, Matematica e Geoscienze, Trieste, Italy (tommasopivetta@yahoo.it)

Laser scanning has become one of the most important topographic techniques in the last decades, due to its ability to reconstruct complex surfaces with high resolution and precision and due to its fast acquisition time. Recently a laser-scan survey has been acquired (Fingolo et al., 2011) in the "Grotta Gigante" cave near Trieste, Italy, the biggest cave worldwide according to the Guinness Awards.
In this paper this survey is used to obtain a 3D discretization of the cave with prisms. Then through this new model, with the densities derived from campaign measurements, the exact gravimetric effect of the structure was computed (Nagy et al., 2000) and compared with the gravity observation at the surface.
The transition from the cloud of laser-scan points to the prism model was carried out by different computer elaborations; first of all the reduction of the data density through an averaging process that allows to pass from over 10000 points/m2 to less than 10points/m2. Then the whole dataset was filtered from the outliers by the means of a simple quadratic surface that fit the data (Turner, 1999). The reduced data points should be divided into the 2 surfaces of top and bottom, that are used to define the prisms. This step was performed using the local regression method (Loess) to calculate a surface located halfway between top and bottom points. Once the top and bottom interfaces were obtained it was possible to get the final prism representation and calculate the gravity signal. The observed Bouguer field is explained very well by our model and the residuals are used to evaluate possible secondary caves. The final prism model together with the gravity database on surface and inside the cave form a perfect benchmark to test forward and inverse potential field algorithms.

References

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