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r.survey: a tool to assess whether elements of specific sizes can be visually detected during field surveys

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The concept of terrain visibility is vast and hard to summarise in a single definition. It can be generically said that it is a property that measures how observable a territory is from a single or multiple points of view.

The estimation or calculation of visibility indices has been used in multiple fields, including architecture, archaeology, communications, tourism, land planning, and military applications. Recently (Meinhardt et al., 2015, Bornaetxea et al., 2018, Knevels et al., 2020,) the concept of viewshed, i.e. the geographical area that is visible from one or more points of view, has been called into play for applications involving geomorphology. In particular, it has been used to identify the portions of territory in which existing landslide inventories, carried out through field surveys, can be considered valuable for the calculation of landslide susceptibility. The aim is to delineate the Effective Surveyed Area, i.e. the area that has actually been observed by the operators in the field.

However, this purely geometric approach cannot guarantee that objects are actually visible just because they are in a direct line-of-sight relationship with the observer. Due to their size and/or orientation in space, they may be (i) poorly or not at all detectable and/or (ii) observable from only a few viewpoints.

For this reason we have developed r.survey (Bornaetxea & Marchesini, 2021), a plugin (Python script) for GRASS GIS, which allows to simulate (i) from how many observation points each point of the territory is visible, (ii) from which point of observation each point of the territory is most effectively visible, (iii) whether an object of a specific size can be detected. Concerning, in particular, the last element, r.survey calculates the solid angle subtended by a circle of equivalent dimensions to those of the object to be surveyed and assumed to be lying on the territory, oriented according to the slope and aspect derived from a digital terrain model. The solid angle provides a continuous measure of the visibility of the object sought, which can be compared with typical values of a human visual acuity. What happens then is that the concept of 'Effective Surveyed Area' can be reworked into the more accurate 'Size-specific Effective Surveyed Area' (SsESA). The new concept makes it possible to identify those portions of territory in which, during fieldwork, it is possible to observe objects of equal or greater size than those of interest, also considering their orientation in space with respect to the observer.

The code of r.survey, which is based on the libraries and modules of GRASS GIS and was written to exploit multi-core processing, is open source and available for downloading (https://doi.org/10.5281/zenodo.3993140) together with a manual and some example data.