



## Editorial

### MODERN TECHNOLOGIES OF GEOMATICS APPLIED TO ENGINEERING GEOLOGY

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Geomatics, also known as geospatial technology or geomatics engineering, refers to the set of disciplines that deal with gathering, interpreting, processing, modelling, storing and delivering spatial information. Geomatics, among the others, includes tools and techniques referable to land surveying and positioning (i.e. topography, Global Navigation Satellite Systems - GNSS), satellite, aerial and ground-based remote sensing (i.e. digital photogrammetry, Light Detection And Ranging - LIDAR, Remotely Piloted Aircraft System - RPAS), Geographic Information Systems (GIS), digital mapping and geostatistics.

In recent decades, thanks to technological advances, these methods have been increasingly spread and used for the study and management of geological hazard and risk.<sup>1-5</sup> This is because they provide innovative tools in supporting cartographic products and in the analysis and the quantitative measurement of geological processes located in inaccessible areas at different scales.<sup>6-7</sup> Additionally, Geomatics provides spatial data for informing decision making processes and ensuring compliance with regulations.

Recent advances in the information technology industry have provided the capability to obtain accurate, fully geo-referenced, three-dimensional datasets that can be used to characterize in detail the structural and geological setting and the geomorphology of a study area.

Engineering geology applications, as for example the geo-hydrological risk assessment, the rock fall runout modelling, or the slope stability analysis, can have a great benefit by the use of remote sensing data based on satellite platforms, aircrafts and RPAS.<sup>8-12</sup> Deterministic series of data can be interrogated for providing engineering-based solutions to characterize soils and rock masses, monitor deformation processes, and to add insight into any underlying failure mechanisms. For example, understanding characteristics and changes in slope geometry and knowledge of engineering geological properties of a soil or a rock mass, are essential to reduce risks associated with slope failure.

Many currently operational missions (i.e. optical, multispectral, Synthetic Aperture Radar - SAR), as well as ground-based methodologies (i.e. total station, laser scanning, Infrared - IR thermography) continue their widespread use, as proved by the increasing number of scientific papers based on such applications. Recently, mobile terrestrial laser scanning is also emerging as a remote data collection technique capable of generating accurate fully three-dimensional virtual models while moving at different speeds.<sup>13-15</sup> Satellite imagery and photos, both from aircraft and RPAS, can be processed in association with 3D data for producing digital models to be used in the collection of engineering geological information. Topographic and geothematic information can be extracted and additional methods developed for producing spatial data containing numerical records even with a multi-temporal character.<sup>16-19</sup> Geological features of interest can be spatially located and mapped, as well as information on displacement or deformation rate in critical sections or regions of a slope provided.<sup>20-23</sup>

Finally, several benefits can be obtained by incorporating different geomatic techniques and conventional measurement devices to provide a comprehensive database required for development of an effective monitoring and risk management program.<sup>24-25</sup> Different techniques, such as high accuracy discrete point measurement at critical locations or optical fibers along lines of inspection, can be integrated and used to combine datasets from different technologies with the aim of complementing missing data resulting from

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inherent limitations in one or other technology.<sup>26-28</sup>

Indeed, often only an integrated approach guarantees of having valuable and spatially accurate data for subsequent reliable analyses and associated interpretations.

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