CONSORTIUM

Editorial

MODERN TECHNOLOGIES OF GEOMATICS APPLIED TO ENGINEERING GEOLOGY

Riccardo Salvini

Via Vetri Vecchi, 34, San Giovanni Valdarno, Province of Arezzo, Italy.

Keywords: Geomatics, Engineering Geology, Remote Sensing, Digital Photogrammetry, LIDAR, RPAS

History:
Received: December 21, 2016
Accepted: December 27, 2016
First Published: December 29, 2016
Collection year: 2016
Confirmation of publication: Published

Identifiers and Pagination:
Year: 2016
Volume: 1
First Page: 1
Last Page: 3
Publisher ID: AdvGeoSci-1-1
DOI: http://dx.doi.org/10.21065/

Corresponding author:
Riccardo Salvini, Via Vetri Vecchi, 34, San Giovanni Valdarno, Province of Arezzo, Italy.
E,: riccardo.salvini@unisi.it
Tel.: +390559119441

Citation:
Salvini R. Modern technologies of geomatics applied to engineering geology. Adv Geo Sci 2016. Vol. 1, *p* 1-3

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.[1-5] 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.[6-7] 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.[8-12] 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.[13-15] 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.[16-19] 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.[20-23]

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.[24-25] 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

CONSORTIUM

Editorship:
Angela Calia PhD
Senior Researcher, National Research Council (CNR) Institute of Archaeological Heritage. Monument and Sites (IBAM) University Campus Prov.le Lecce - Monteroni 73100 Lecce Italy.

Funding:
The authors received no direct funding for this research.

Competing Interests:
The authors declare no competing interests

Additional information is available at the end of the article.

inherent limitations in one or other technology.[26-28]

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

References

1. Pradhan B, Mansor S, Pirasteh S, Buchroithner MF. Landslide hazard and risk analyses at a landslide prone catchment area using statistical based geospatial model. *Int J Remote Sens.* 2011; 32(14):4075-4087.
2. Jaboyedoff M, Oppikofer T, Abellán A, Derron MH, Loye A, Metzger R, Pedrazzini A. Use of LIDAR in landslide investigations: a review. *Nat Hazards*. 2012; 61(1):5-28.
3. Barra A, Monserrat O, Mazzanti P, Esposito C, Crosetto M, Scarascia Mugnozza G. First insights on the potential of Sentinel-1 for landslides detection. *Geomatics, Natural Hazards and Risk*. 2016; (pp. 1-10).
4. Salvini R, Mastrorocco G, Seddaiu M, Rossi D, Vanneschi C. The use of an unmanned aerial vehicle for fracture mapping within a marble quarry (Carrara, Italy): photogrammetry and discrete fracture network modelling. *Geomatics, Natural Hazards and Risk.* 2016; (pp. 1-19).
5. Kanwal S, Atif S, Shafiq, M. GIS based landslide susceptibility mapping of northern areas of Pakistan, a case study of Shigar and Shyok Basins. *Geomatics, Natural Hazards and Risk.* 2016; (pp. 1-19).
6. Pirasteh S, Tripathi NK, Mansor S, Pradhan B, Ramli MF. Landscapes rendition in Zagros Mountain, Iran using geoinformation technology. *J. Geomatics.* 2009; 3:33-39.
7. Salvini R, Francioni M, Riccucci S, Bonciani F, Callegari I. Photogrammetry and laser scanning for analyzing slope stability and rock fall runout along the Domodossola–Iselle railway, the Italian Alps. *Geomorphology*. 2013; 185:110-122.
8. Rawat PK, Tiwari PC, Pant CC. Climate Change accelerating hydrological hazards and risks in Himalaya: A case study through remote sensing and GIS modeling. *International Journal of Geomatics and Geosciences.* 2011; 1(4):678-699.
9. Brideau MA, Sturzenegger M, Stead D, Jaboyedoff M, Lawrence M, Roberts NJ, ... Clague JJ. Stability analysis of the 2007 Chehalis lake landslide based on long-range terrestrial photogrammetry and airborne LiDAR data. *Landslides.* 2012; 9(1):75-91.
10. Akbarimehr M, Motagh M, Haghshenas-Haghighi M. Slope stability assessment of the sarcheshmeh landslide, Northeast Iran, investigated using inSAR and GPS observations. *Remote Sensing.* 2013; *5*(8):3681-3700.
11. Francioni M, Salvini R, Stead D, Litrico S. A case study integrating remote sensing and distinct element analysis to quarry slope stability assessment in the Monte Altissimo area, Italy. *Eng Geol.* 2014; 183:290-302.
12. Scaioni M, Feng T, Barazzetti L, Previtali M, Lu P, Qiao G, ... Li R. Some applications of 2-D and 3-D photogrammetry during laboratory experiments for hydrogeological risk assessment. *Geomatics, Natural Hazards and Risk*, 2015; 6(5-7):473-496.
13. Lato M, Hutchinson J, Diederichs M, Ball D, Harrap R. Engineering monitoring of rockfall hazards along transportation corridors: using mobile terrestrial LiDAR. *Nat Hazard Earth Sys*. 2009; 9(3):935-946.
14. Wang Y, Liang X, Flener C, Kukko A, Kaartinen H, Kurkela M, ... Alho P. 3D modeling of coarse fluvial sediments based on mobile laser scanning data. *Remote Sensing.* 2013; 5(9):4571-4592.
15. Michoud C, Carrea D, Costa S, Derron MH, Jaboyedoff M, Delacourt C, ... Davidson R. Landslide detection and monitoring capability of boat-based mobile laser scanning along Dieppe coastal cliffs, Normandy. *Landslides*. 2015; 12(2):403-418.
16. Eltner A, Mulsow C, Maas HG. Quantitative measurement of soil erosion from TLS and UAV data. *ISPRS-International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*. 2013; 1(2):119-124.
17. Gasperini D, Allemand P, Delacourt C, Grandjean P. Potential and limitation of UAV for monitoring subsidence in municipal landfills. *International Journal of Environmental*

Technology and Management. 2014; 17(1):1-13.
18. Eltner A, Baumgart P, Maas HG, Faust D. Multi-temporal UAV data for automatic measurement of rill and interrill erosion on loess soil. *Earth Surf Proc Land.* 2015; 40(6):741-755.
19. Neugirg F, Stark M, Kaiser A, Vlacilova M, Della Seta M, Vergari F, ... Haas F. Erosion processes in calanchi in the Upper Orcia Valley, Southern Tuscany, Italy based on multitemporal high-resolution terrestrial LiDAR and UAV surveys. *Geomorphology*. 2016; 269:8-22.
20. Abellán A, Vilaplana JM, Calvet J, García-Sellés D, Asensio E. Rockfall monitoring by Terrestrial Laser Scanning–case study of the basaltic rock face at Castellfollit de la Roca (Catalonia, Spain). *Nat Hazard Earth Sys.* 2011; 11(3):829-841.
21. Salvini R, Vanneschi C, Riccucci S, Francioni M, Gullì D. Application of an integrated geotechnical and topographic monitoring system in the Lorano marble quarry (Apuan Alps, Italy). *Geomorphology.* 2015; 241:209-223.
22. Bar N, Parker R, Thomas SJ. Managing landslide risks associated with erosion-driven slope instabilities using near real-time deformation monitoring systems. In *Rock Mechanics and Rock Engineering: From the Past to the Future*. 2016; (pp. 1191-1196). CRC Press.
23. Xie M, Huang J, Wang L, Huang J, Wang Z. Early landslide detection based on D-InSAR technique at the Wudongde hydropower reservoir. *Environmental Earth Sciences*. 2016; 75(8):1-13.
24. Rosser NJ, Petley DN, Lim M, Dunning SA, Allison RJ. Terrestrial laser scanning for monitoring the process of hard rock coastal cliff erosion. *Q J Eng Geol Hydroge.* 2005; 38(4):363-375.
25. Abellán A, Jaboyedoff M, Oppikofer T, Vilaplana JM. Detection of millimetric deformation using a terrestrial laser scanner: experiment and application to a rockfall event. *Nat Hazard Earth Sys.* 2009; 9(2):365-372.
26. Chai J, Wei SM, Chang XT, Liu JX. Monitoring deformation and damage on rock structures with distributed fiber optical sensing. *Int J Rock Mech Min.* 2004; 41:298-303.
27. Wang BJ, Li K, Shi B, Wei GQ. Test on application of distributed fiber optic sensing technique into soil slope monitoring. *Landslides.* 2009; 6(1):61-68.
28. Zhu HH, Shi B, Zhang J, Yan JF, Zhang CC. Distributed fiber optic monitoring and stability analysis of a model slope under surcharge loading. *J Mt Sci.* 2014; 11(4):979-989.