Virtual Geoscience Conference 2016: where geomatics meets geoscience [Editorial]

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Editorial

VIRTUAL GEOSCIENCE CONFERENCE 2016: WHERE GEOMATICS MEETS GEOSCIENCE

WE ARE CURRENTLY WITNESSING an exciting period for the geomatics sector as the fundamental role of spatial data is increasingly recognised in our society. Driven by hardware developments, software innovations and a general convergence of previously unconnected disciplines, geomatics methods are being rapidly adopted in novel ways, both within the scientific community, as well as by industry and the public sector. Geoscience is one broad field that is currently benefitting from developments in geomatics acquisition, processing and data exploitation methods made over the last decade. It is here, at the confluence between geomatics, computer science, visualisation and the broad arms of the geosciences, where the *Virtual Geoscience* conference series has been established. The second Virtual Geoscience Conference 2016 (VGC 2016) was characterised by consolidation and growth following an earlier event in 2014, as explored in this Editorial.

BACKGROUND TO THE CONFERENCE THEME

Geoscience disciplines, such as geology, glaciology and natural hazards, have long been reliant on spatial measurement, derived for example from maps, aerial photography and regional elevation models, traditional surveying techniques or field photography. Policy shifts towards free or low-cost access to geospatial data products (embodied by Google Earth and similar viewing software) have given unprecedented reach towards the mainstream.

Arguably, the early adoption by geoscientists of terrestrial laser scanning (TLS) in the mid-2000s initiated the current explosion of interest in geomatics. The relative ease of use of TLS equipment combined with “instant” dense and precise 3D point clouds served to facilitate the entry point for many geoscientists, particularly because other methods (e.g. photogrammetry) were reliant on high levels of expertise to achieve similar datasets. More recently, the 'reinvention' of photogrammetry through key hardware developments (computing power and digital cameras) and software innovations feeding in from computer vision (for example fast interest operators, feature matching and dense point-cloud reconstruction) have resulted in SfM photogrammetry software packages. These are now also allowing geoscientists to create high-resolution 3D photo-textured models of surface topography and morphological features but with minimal interaction/expertise and at low cost.

Digital cameras are now ubiquitous and embedded in many modern consumer electronic devices. Combined with increasingly mature unmanned aerial vehicle (UAV) platforms and dynamic positioning devices, geoscientists are now empowered to acquire their own application-dependent field data. This is a significant change that is creating a paradigm shift as spatial data becomes a foundation for addressing – and defining – scientific research questions.

Aside from the 3D measurement aspects of laser scanning and photogrammetric modelling, new imaging sensors, such as multi/hyperspectral and thermal cameras, and terrestrial interferometric synthetic aperture radar (InSAR), are rapidly developing and adding new information to geoscientific studies. Integration of such remote sensing devices allows 3D data to be combined with analysis of surface properties in new ways. With the move towards miniaturisation and demand for UAVs, multi-sensor devices become increasingly common, having ramifications on the quantity of spatial information flowing in to geoscience applications, and how to process and communicate results to end users.

The proliferation of close range measurement techniques within geoscience research and practise has increased exponentially over the last five years. While data acquisition and processing have become increasingly accessible, exploitation of 3D models, point clouds and imagery still requires novel and custom solutions for many applications, creating an interface for active research. Here, conventional geomatics is connected to virtual and augmented reality, visualisation, spatial databases, big data and machine learning, and increasingly, mobile devices and gaming sensors. Based on this array of technically-complex and multidisciplinary inputs, the need for collaborative efforts becomes increasingly apparent. However, with the trend for increasing accessibility and proliferation of journals related to specific geoscience disciplines, comes the potential danger that geoscientists adopt these techniques without a formal geomatics background and associated knowledge related to error sources, uncertainty and means of exploiting the results efficiently. Old lessons need relearning and occasionally, apparently "new research" does not always build upon or acknowledge work conducted in the past. This is unfortunate because many of the developments, data analysis, and applications are of high interest to both the wider geoscience and geomatics communities, rather than being restricted to narrow sub-disciplines.

A COMMON FORUM AND VGC 2016

Recognising the need for a forum where the geomatics and geoscience (sub-) communities could interact equally (not part of specific larger conferences where one is always in the minority), the *Vertical Geology Conference* was organised by the University of Lausanne in 2014. The conference successfully brought together experts from the earth sciences, primarily in geology and natural hazards, as well as researchers working on methods and technology (Jaboyedoff et al., 2015).

Based on the interest and feedback around this conference, it was decided to proceed with a second conference, but to broaden with more general geoscience disciplines (Table I) and wider technical themes (Table II). This would create an opportunity for researchers who would rarely interact, because of the naturally different focus of their own disciplines, yet who based their investigations on common data types, methods and analysis requirements grounded in spatial science. Consequently, the conference name was adjusted to *Virtual Geoscience* to reflect this broadening of scope, and the second Virtual Geoscience Conference (VGC 2016) took place in Bergen, Norway from 21st to 23rd September 2016.

The conference attracted close to 150 delegates from 20 countries. A technical programme comprised two keynote speeches, 41 oral and 55 poster presentations, through a mixture of plenary and parallel-streamed sessions (Buckley et al., 2016). In addition, two short courses and a project workshop were run on the first day of the conference. Readers will find a full report of VGC 2016 in Chandler (2016).

TABLE I. Main geoscience disciplines within the VGC remit.

Discipline
Geology and petroleum geology sedimentological mapping, reservoir analogues
Structural geology: fracture mapping and network modelling
Geomorphology: characterisation of surface processes
Natural hazards: rockfalls, landslides, coastal erosion
Glaciology/cryosphere: glacier front monitoring
Volcanology: lava flow mapping, crater modelling, laboratory methods
Hydraulics/through-water mapping
Climate/environment
Infrastructure: tunnelling, railway, roads
Mining and natural resources, energy

TABLE II. Core geomatics and data analysis themes.

Discipline
Laser scanning, photogrammetry (SfM) and novel 3D mapping sensors
Sensor integration (multi/hyperspectral, radar, thermal, geophysical)
Novel platforms (for example UAVs)
Mobile and real-time computing
Laboratory-scale measurement (fossils, flumes, sediment tanks)
Virtual and augmented reality in fieldwork
Visualisation, computer graphics
Big data, machine learning
Interpretation and automation
Change detection, monitoring
Numerical modelling and simulation

Establishment of VGC Steering Group

At a panel discussion at the end of the VGC 2016 event, a strong wish was expressed from the audience to ensure that the VGC series continues to a third event and beyond. To ensure the longevity of the series, a final act of VGC 2016 was to form the core of a steering committee (S. Buckley, M. Jaboyedoff, M.H. Derron, S. Viseur, E. Lev, T. Dewez, J. Chandler, J. Howell, T. Kurz), which aims to define the general aims and goals of the series, and oversee the preparations for future events.

CONTRIBUTIONS

This Special Issue includes nine peer-reviewed papers derived from material presented at the conference, which best reflects the diverse range of research currently being carried out within the virtual geoscience community. Directly following this Editorial, are also a collection of visually provocative illustrations by Wagner, which visually reflect the scope of the theme. Though related mostly to geology, the content is analogous to the requirements, challenges and focus that are pertinent to all geoscience sub-disciplines.

FINAL NOTE

For regular readers of *The Photogrammetric Record*, we hope that this selection of contributions, while not all connected to basic research in photogrammetry, offer a taste of the vibrant research community that has sprung up around virtual geoscience. *The Photogrammetric Record* has had a long tradition of publishing the work of photogrammetrists, and a wide range of other scientists, in this field of application since its inception in 1953. For readers new to this journal, we encourage you to investigate further the wide range of methodological innovations published, which may be relevant to many geoscience disciplines.

We hope you enjoy reading about the Virtual Geoscience series and invite you to engage in future work and events organised by this interdisciplinary group. The third Virtual Geoscience Conference will take place at Queen’s University, Kingston, Canada, from 22nd to 24th August 2018 (http://virtualoutcrop.com/vgc2018). We look forward to seeing you there physically!

ACKNOWLEDGEMENTS

The organisation of VGC 2016 and the realisation of this Special Issue of *The Photogrammetric Record* is due to the hard work and dedication given by many people and organisations. For helping to bring this issue to fruition, we thank all authors and reviewers for their contributions and for keeping to the tight timescale required to meet the publication deadlines. The journal team at Wiley is thanked for constant support through the conceptual and production phases, as is the Editor, Stuart I. Granshaw, for his usual meticulousness in overseeing and editing all content prior to publication.

For VGC 2016, our thanks go primarily to the local organising team, overseen by Dr Nicole Naumann (Christian Haug Eide, Kari Ringdal, Benjamin Dolva, our student helpers and the administration in Uni Research CIPR), for making the conference a success at the high international level it achieved. The scientific committee reviewed over 100 abstracts. Our partner organisations (Geological Remote Sensing Group, Geological Society of London, Geological Society of Norway) ensured promotion to relevant communities as well as aiding with financial support, where possible. We are grateful to the Research Council of Norway for a conference arrangement grant (FRINATEK project number 249999/F20). In addition, we acknowledge Institut Carnot BRGM, the University of Lausanne, HySpex, MEAS-IT, 3D Laser Mapping, Wiley and 3D Teknikk for invaluable financial support. Finally, Uni Research and the University of Bergen is thanked for ongoing commitment to Virtual Geoscience activities.

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