Geological Registration and Interpretation Toolbox (GRIT): A Visual and Interactive Approach for Geological Interpretation in the Field

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Digital interpretation software is increasingly used in geology to study photorealistic surface models of outcrops generated using lidar or photogrammetry/structure-from-motion (SfM). The results of 3D modelling can be used for presentation, manipulation and interpretation of acquired surface models to support the understanding of geological concepts and analogues. Interpretations (e.g. stratigraphic logs, demarcation of structural and sedimentological features) can be imported in as application-specific software, e.g. for hydrocarbon reservoir modeling (Buckley, 2010). Workflows have been developed to provide sedimentary and structural data by combining field observations into virtual outcrop analogues (Rittersbacher, 2013).

A recent trend has been to adapt workflows further towards field integration, as envisaged by McCaffrey et al. (McCaffrey, 2005), using laptop-executable software for modelling purposes (e.g. SIGMA (Jordan, 2009)) and mobile devices for digital data acquisition (e.g. MAP-IT (De Donatis & Bruciatelli, 2006), FieldMove by Midland Valley Ltd.; SedMob (Wolniewicz, 2014)). Here, the goal is to maximize efficiency in the field, capture relevant geological measurements, and reduce or enhance post-fieldwork digitization. Although the use of mobile devices for conducting geological fieldwork is increasing, the exploited capabilities of handheld devices currently do not reach their full potential. Modern mobile devices (i.e. smartphones and tablets) are able to process data more rapidly, conduct more complicated analysis than simple measurement acquisition, and thus can be used for more complex tasks in the field. Their processors, in combination with integrated digital cameras, apply well to for direct 2D photo manipulation. In addition, motion, orientation and positioning sensors facilitate full 3D image registration, and their processing units allow photorealistic outcrop models to be displayed with interactive frame rates. The potential has been previously demonstrated by Viseur et al. (2014), using the commercial off-the-shelf Unity3D engine. Viseur et al. (2014) further introduces the motivation for the development of mobile device field tools.

In this research, we explore the computing capabilities of mobile devices, and their contribution to geological fieldwork. In contrast to Viseur et al., we use available 3D data directly during fieldwork and excursions. This is done within a new tool that closely links field observation in photos with an outcrop model. The application allows for fully geo-referenced photo captures and their geological interpretation on a sketching basis (fig. 1, left), using integrated Image-to-Geometry registration procedures (Kehl et al., 2015). Furthermore, a virtual outcrop viewer provides rendering and navigation for 3D data (fig. 1, right) analogous to previous approaches, but utilizing open source graphics software. All software components run entirely on the mobile device and independent of network connectivity, which can be an issue in remote locations.

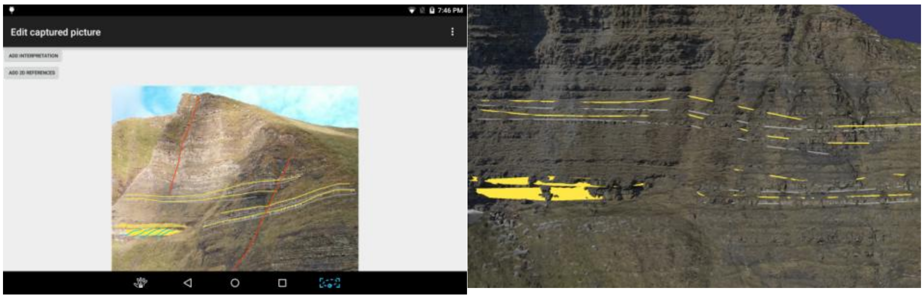

Figure 1: GRIT comprises a 2D interpretation mode (left) for polgon- and line interpretations of stratigraphic (yellow,grey) and structural (red) features and a 3D viewer (left) of the virtual outcrop and interpretations (right), running on mobile devices

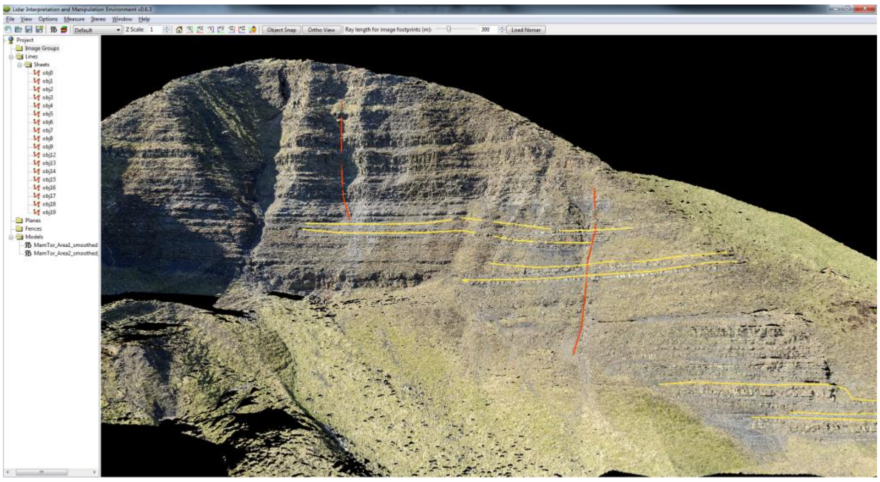

Figure 2: Imported 3D interpretation structures in desktop Lidar Interpretation and Manipulation Environment (LIME), based on projected mobile photo-interpretations

Case studies assess the approach using outcrop localities in the UK. The field tests show the application of the software for deriving stratigraphic interpretations in a 3D-registered environment for the purpose of reservoir modelling. The derived interpretations are exported for quality control to LIME, a desktop environment for virtual outcrop interpretation and data export to reservoir modeling packages. Experiences on device and user interface limitations are in line with Viseur et al. (2014). These shortcomings and challenges are discussed further and taken as a basis for upcoming research directions.

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