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Quantitative geology from digital outcrop data for the characterisation of hydrocarbon reservoirs.

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LiDAR mapping is rapidly becoming a regular addition to the field geologists toolkit. Using LiDAR data it is now easy to make photorealistic models which involve producing a triangulated irregular network (TIN) or mesh of the point cloud, and then texture mapping digital images onto the mesh via projective texturing techniques. This approach produces visually pleasing models which are easy to interpret, however this is only the case if the features of interest are clearly visible in the digital photograph , which in rocks of fairly uniform colour may not always be the case.
The high resolution nature of LiDAR derived digital outcrop models facilitates the generation of surface attributes (such as curvature, co-planarity and roughness for example) which may be used to highlight features not easily seen in the photo-realistic model . These surface attributes not only make manual interpretation of the data easier, but facilitate the development of more automated mapping and tracking tools, which are essential in the large datasets provided by terrestrial and airborne laser scanning.
In-house software called VRGS (Virtual Reality Geological Studio) has been developed to aid in the interpretation and analysis of LiDAR and other digital data, and allow traditional field data collection methodologies and data types to be integrated and digitised into with the digital dataset. This integrated dataset then facilitates a whole new range of approaches which help analyse and interpret the data. Combining the surface attribute method with the photorealistic approach provides a digital outcrop model from which a very large amount of information can be derived. Both manual and automated approaches to the mapping of geological features within laser scan data will be presented including the use of Artificial Neural Networks (ANN) to classify the LiDAR datasets into categories of similar orientation and attributes.
The information extracted from these outcrop analogue datasets include geostatistics on the underlying geological control on the surface morphology such as bedding orientation, fault geometry and facies distribution, which may then be used to better model geological heterogeneity in subsurface hydrocarbon reservoirs of similar age and depositional environment to the outcrop analogue.
Several examples of outcrop datasets will be presented, illustrating how an integrated approach to digital and more traditional data collection techniques leads to improved data quality, reduced uncertainty and improved time efficiency in the field.