Automated Image Analysis – assessment of core quality from legacy data

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Today's energy challenges often require geologists from operators and/or regulators to revisit legacy core to use as analogues for new sites or new processes, for example subsurface storage. Compared with the cost of drilling boreholes to acquire new core, the cost of new analysis on these cores is small. Technological developments also allow for the collection of more and more data without destructing the core material. This changes a financial liability to a research asset.

Scanning technology allows collection of consistent measurements of properties from core such as X-Ray Fluorescence (XRF), Magnetic Susceptibility and P-wave Velocity. This presents users with the opportunity to collect vast amounts of data from multiple boreholes which can then be upscaled into reservoir models without the need to break ground.

However two cores, even taken from the same stratigraphic unit are seldom the same and changes in diameter, drilling method, storage conditions, lithology and handling can all drastically impact their degradation during acquisition and storage. To ensure consistency of outputs from core scanning requires a method of assessing the condition of legacy core. This could also be used to assess uncertainty in core scanner data. These are key challenges for the new Core Scanning Facility (CSF) at the British Geological Survey (BGS) at Keyworth.

The CSF is co-located with the National Geological Repository which hosts over 200 kilometres of core from the UK Continental Shelf (UKCS) alone. This presents the opportunity to develop new data analyses for legacy core to serve and enhance the requirements of regulators, researchers and operators. Efficient operation of the facility and consistency of outputs therefore requires new information on core quality to maximise its value. This will also aid researchers seeking suitable material in stratigraphic units to sample more effectively. This will reduce time and effort spent examining material too degraded to allow for collection of the coherent samples, which are needed for many laboratory tests.

An existing data asset which can be used to directly assess core quality is the BGS archive of optical visible light photographs (https://www.bgs.ac.uk/data/offshoreWells/pgc8.html) of UKCS core. This contains a very large database of over 125,000 images of core condition at the time this material arrived at NGR, with more data being acquired on a monthly basis. Consequently automation is the only realistic way of efficiently extracting additional value from this resource.

To investigate whether an automated solution could be used to assess core quality a machine learning approach was undertaken. This used pre-trained neural networks on an initial training dataset of 62 images. The approach fist segmented and then analysed each image to classify the number of core fragments in each image, including the surface area of each fragment.

Results from this study show that analytical outputs from image analyses may be used to describe and index core condition. The outputs include simple metrics which can be presented alongside complimentary datasets such as core scanning or core plug analysis. When combined with the extant

(large) databases of UKCS core depths and preexisting stratigraphic interpretations of the core this information can be used for identifying the best material for specific sampling activities. Some core scanning techniques, such as XRF, require a completely flat surface to collect reliable data. Careful assessment of core condition prior to its extraction from the archive is essential to improve efficiency both for operators of the scanners, and the clients.

This will allow any researchers working on field scale studies the chance not just to process large volumes of optical images but to give an idea of variation in core quality between wells. Such variations may also be used to target intervals to improve sampling success rates. These techniques are being further analysed to understand if they may also allow be used to directly assess physical properties of core parameters.