NERC Centre for Doctoral Training in Oil & Gas (2017 start)

Project Title: **Application of Artificial Intelligence (AI) for pattern recognition and reconstruction in petroleum reservoir modelling.**

Host institution: University of Manchester
Supervisor 1: Dr. David Hodgetts
Supervisor 2: Dr. Emma Finch

Project description: This project aims to developed new artificial intelligence approaches for the reconstruction of reservoir heterogeneity, at both facies and petrophysical levels, using artificial neural networks (ANN's) and utilising a variety of existing high resolution reservoir models as training images.

The process of petroleum reservoir modelling involves reconstructing reservoir heterogeneity around directly measured well data using a statistical approaches including object modelling, sequential simulations and multipoint statistics (MPS). These approaches suffer for many limitations such as maintaining relationships between facies positions in object and indicator simulations, and limitations in training image design for MPS. These limitations can be overcome by using ANN's, one property of which is the ability, once trained on completed models, to reconstruct patterns based on limited input information. ANN's have been used successfully in the petroleum industry for a variety of purposes including interpretation of seismic and well data, but have yet to be applied in any great depth to the problem of modelling reservoirs. The geocellular nature of reservoir models also lends itself well to ANN approaches,

The ANN will be trained on a variety of existing reservoir models built in previous projects, typically built at higher resolution and with more detail than are traditionally used in the industry making them ideal for testing and developing the approach. Once trained the ANN will be used initially to reconstruct reservoir models around pseudo-wells extracted from the training models as a way of testing the validity of the approach, before being finally tested and applied to real well data from datasets outside of the training models. This new modelling approach will also allow both facies and petrophysics to be modelled in a single step, rather than the 2 stage approach currently used in reservoir modelling (populate facies first, then populate petrophysics into the facies model using the facies model as additional conditioning data).

The successful candidate will require a strong background in either computing or mathematics. Training in the relevant areas of geoscience will be provided as the prospective student will also need to be able to validate training datasets, as well as the final ANN reconstructed reservoir models.

CDT Research theme(s): This research applies primarily to theme b) Extending the life of mature basins by addressing reservoir modelling limitations to improve existing reservoir models therefore improving recovery through better reservoir management, but also to themes a) as this modelling approach will work equally well with for unconventional reservoirs.

Research context: 5 current PhD's at Manchester working in reservoir modelling, 2 of which are working on numerical simulation of fluvial systems. Large existing database of reservoir models as training datasets and strong links with industry for access to subsurface data.

Research costs: Main expenses are high end PC with tesla GPU card. Approximated £6000, and attendance at conferences.

Career routes: The potential student be highly numerate with experience and understanding of reservoir modelling. This will open up careers routes in both major oil companies in reservoir development and production, as well as service companies developing new software.