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

Project Title: Improved understanding of borehole instability mechanisms through development of an enhanced visualization-numerical modelling approach

Host institution: University of Exeter

Supervisor 1: Professor John Coggan

Supervisor 2: Dr Matthew Eyre

Project description:

Visualization of complex three-dimensional data is an important part of successful stakeholder engagement and dissemination/management of geoscientific data. For example, evaluation of borehole stability requires an understanding of the complex interaction of the underlying geology, fracture mechanics of the host rock mass and the detrimental effects of the changing stress redistribution during extraction of the hydrocarbon reservoir. This research will utilize digital reconstruction of borehole data and incorporation of three-dimensional numerical modelling of borehole instability mechanisms to demonstrate how innovative use of both virtual and augmented reality (VR and AR) can provide improved visualization and enhanced understanding of complex phenomena controlling deformation and failure of rock surrounding a borehole at depth. Wellbore case studies from a number of different geological settings and depths will be provided by GeoScience Limited to provide a wellbore stability database covering a rich variety of different geology and stress environments. The project, through analysis of case study data, will provide new approaches for documentation and communication of modelled results through a virtual environment, highlighting spatial and temporal changes resulting from evolution of stress induced wellbore failure. AR and VR platforms provide easily distributed file formats that can be used by a wide range of stakeholders exploring the data in virtual space, from any angle, in a dynamic environment. The research project will also demonstrate how the integrated visualization-modelling approach can be used as a platform for data evaluation, monitoring and optimization of hydrocarbon exploitation.

CDT Research theme(s):
a. Effective production of unconventional hydrocarbons
d. Environmental Impact and Regulation

Research context:
The studentship would complement an existing EPSRC DTA studentship on discrete fracture network characterization and current/previous PhD research within the Department/College on numerical modelling of rock fracture networks.

Research costs:
£20k over four years (£5k/annum): Travel costs to Central Training Academy activities and liaison with GeoScience Limited. Participation at conferences. Purchase of VR interface equipment/headset, Project Tango development kit, 360 degree camera and workstation/high-powered PC.

Career routes:
The recipient of the award could have career routes that could be directly employed by the oil and gas sector in geology, reservoir engineering, geomechanics, environmental impact or regulation. Careers could also be explored with geomechanics consultants, specialising in numerical modelling utilising this enhanced visualization approach.