Research Theme: Technology

Case Study

Mathematical Modelling Improves Hydraulic Fracture Simulation Tools

RESEARCHERS

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THE OVERVIEW

A numerical algorithm has been developed by Aberystwyth University (AU) researchers to improve the performance of software that deals with fluid-solid interactions, particularly the propagation of fluid-filled cracks. This has been used by major companies in the petroleum industry to increase the speed and accuracy of their hydraulic fracture simulators, giving them a competitive edge and increasing their market share. Knowledge-exchange workshops with industry have given scientists increased knowledge, and also confidence to advise policy makers to implement hydraulic fracture at new sites across Europe.

THE RESEARCH

Modern analytical, asymptotic computational tools are used to study the coupling between fracture propagation and subsequent fluid flow. Professor Mishuris and his team devised a procedure for simulating liquid flow in a propagating fracture and simulated the transport phenomena of a non-Newtonian fluid within a propagating crack. This new, efficient algorithm outperformed existing simulators and provided improved rigorous semi-analytical benchmarks.

THE IMPACT

IMPACT ON COMMERCE

A special tip element proposed by Professor Mishuris' team was implemented and adopted by industrial partners. This has improved the accuracy and speed of a hydraulic fracturing model developed by one of the largest independent research and development contractors in Europe. Other companies are working on implementing the results of the HYDROFRAC project, including the software company Rockfield, who recognise the high demand in Carbon Capture, oil and gas R&D and industries to efficiently predict fracture propagation in all regimes.

IMPACT ON POLICY IN UKRAINE

In 2014, British Council funding enabled an exchange with Ukrainian partners to explore the exploitation of unconventional energy resources in the Ukraine. This led to a relationship with PETROPLY Research and Consulting Ltd, a Ukraine-based team of researchers and petroleum consultants.

Professor Mishuris joined an international team of advisors, coordinated by PETROPLY and supported by Shell Exploration and Production Ukraine and Ukrainian Unconventional Gas Institute, tasked with improving forecasts of oil and gas development. The AU software was used to assess the validity of their current operations, estimating water resource requirements, and developing practical recommendations for usage and optimisation of water and its reuse in technological processes.

As a result of increased confidence in the process, the Ukrainian national oil corporation ran successful hydraulic fracture operations between 2016 and 2018, exceeding expectations, and had an impact on the configuration of the long-term government plan for the oil and gas industry.

IMPACT ON LEARNING

The HYDROFRAC project has contributed to the learning and development of a new generation of young researchers, capable of solving complex physics problems. The availability of a faster simulator and a skilled workforce has had tangible benefits for the sector.

The Ukrainian company AGS Construction have been able to analyse case studies more accurately with AU's simulator. This has improved their reputation, saved money, and supported growth in their workforce.

Polish SME EUROTECH also reported growth in their workforce as a result of being able to employ trained staff, increasing available opportunities.

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