Automation of Microseismic Events Analysis and ML Image Classification

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Abstract

Passive microseismic monitoring is a tool to help monitor seismic deformation within and surrounding petroleum reservoirs. It is used to assess cap rock integrity, mitigate fracture generation, fault re-activation, and track fluid movements. Petroleum Development Oman (PDO) utilizes microseismic technology for permanent reservoir surveillance and for hydraulic frac monitoring with more than 20 years of experience. Currently within PDO, there are three fields equipped with permanent microseismic networks. Those fields are undergoing enhanced oil recovery processes including steam and chemical injections.Microseismic events for the three fields are processed by the vendor. The surveillance team in PDO receives daily and weekly report s that contain information about these microseismic events. The analysis of these reports can take considerable time to quality control the processing of the identified/picked microseismic events, analyse and interpret the microseismic events locations. The main objective of the microseismic network is monitoring reservoirs cap-rock integrity, which is sometimes picked up only by a few microseismic events. Unfortunately, these often come buried in the midst of the large number of daily events recorded through the microcosmic network. Therefore, it is critical that these few events get very quickly identified, isolated, analyzed, and sometimes resulting in immediate action taken by the asset team.As part of the digitalization program in PDO, we have automated the microseismic events analysis and reporting. It has improved accuracy, eliminated the human error usually encountered from reading and analyzing the data and cut out the process tedious and unproductive tasks from geophysics team; allowing them to focus more on the geophysical analysis and advanced interpretation and processing.Furthermore, the team receives real-time alerts for any microseismic events occurring in the three fields. The alerts are sent via email with the waveform image attached. However, due to the tens of daily alerts sent from those fields it is often very difficult and time-consuming process to investigate and analyse these alerts. To address this, we have developed a machine-learning image classification model that will read, analyse and classify the received alerts into real events, noise, or operational events. This work has helped on the identification of “real” Microseismic events and reduced the time taken for analysis, which improved the overall real time monitoring process and the decisions taken.Both automation and machine learning works have saved a time for the surveillance team achieving 0.4 full time equivalent.