Improving interpretation of seismic data using deep generative networks

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ABSTRACT

The pursuit of minerals and energy resources has driven the exploration and production activities into geologically complex environments. Given the geological complexity, geophysical imaging could become somewhat challenging. This lack of information, together with the repetitive, intensive, and sometimes biased interpretation and modelling of the subsurface conditions, geological evaluation, and geotechnical assessment poses significant challenges to the extraction of deeply buried resources.

Unlike the conventional manual interpretation and physics-driven modelling techniques, the recent trend of deep learning can accelerate and automate the process of pattern discovery in data, enabling the whole learning, reasoning, and decision-making process to be efficient and accurate. In addition, deep learning methods can be used to simulate the extreme, rare, and transient scenarios where the gathering of information is difficult or dangerous. It is well known that most of the geoscience processes are highly complex, nonlinear, hysteretic, and coupled. Under such light, this project aims to improve the interpretation and modelling techniques in geoscience. Taking the advantages of Generative Adversarial Network (GAN) and Convolutional Neural Network (CNN), this paper reports a case study that (1) quantify and characterise the uncertainties, and (2) simulate the extreme, rare, and transient scenarios for the seismic interpretation of one of the coastal regions surrounding Australia, namely the Northern Carnarvon Basin.