Estimating the CO2 Saturation Changes Using Machine Learning Based on Time-Lapse Seismic Data

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Abstract

Global warming, which is caused by Greenhouse gas emission, has attracted wildly attentions. Carbon capture and storage (CCS), which collects the carbon dioxide (CO2) from carbon source and stores CO2 into the underground, is the most promising way to reduce the emission of anthropogenic CO2 into the atmosphere. Time-lapse seismic reservoir monitoring is one of the most commonly used monitoring techniques in carbon capture and storage (CCS) sites. Analyses of time-lapse seismic data volumes can help improve the quality of storage reservoir characterization, track the movement of injected CO2 plume, and identify potential CO2 spillover/leakage from the storage reservoir. In this work, the generative adversarial neural network (GAN) is used to facilitate the solution of both the forward and inverse problems in time-lapse seismic inversion while honoring physical constraints. Results indicate that our proposed GAN can learn the bidirectional mappings well. It not only improves the reliability of time-lapse seismic inversion but also expedites the quantitative interpretation. Our deep learning-based workflow is generic and can be readily used for reservoir characterization and reservoir model updates involving the use of time-lapse seismic data.

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