Contribution ID: **521** Type: **Oral Presentation**

Geostatistical Inversion in Geologic CO2 Sequestration Using a Variational Autoencoder

Thursday, June 3, 2021 7:00 PM (15 minutes)

Geostatistical inversion problems in geologic CO2 sequestration (GCS) often involve matching observational data using a physical model that takes a large number of parameters. It is known that solving an inversion problem in a high-dimensional space with complex structure is usually a very time consuming process. In this work, a dimensionality reduction technique, variational autoencoder (VAE), was proposed to efficiently invert storage reservoir parameter fields (e.g., permeability) with the aim of improving predictions of important metrics such as pressure and CO2 saturation maps. A gradient-based optimization algorithm, L-BFGS, is utilized to minimize the observational and predictive data mismatch function. A VAE is trained to map to a low-dimensional set of latent variables with a simple structure to the high-dimensional parameter space (i.e., original space) that has a complex structure. The required optimization process to fit model to observational data will then be performed on a low dimensional latent space, making the gradient-based optimization (i.e., L-BFGS) more computationally efficient. The feasibility and efficiency of the proposed approach for GCS inverse analysis were demonstrated with a 3D synthetic case. A preliminary result is shown in the figure. (Figure caption: Predictions of CO2 saturation plume at the end of post-injection period based on the updated models under different monitoring durations (1 yr, 3 yrs, etc.))

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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Primary authors: Dr CHEN, Bailian (Los Alamos National Laboratory); HARP, Dylan (Los Alamos National Laboratory); O'MALLEY, Daniel; PAWAR, Rajesh (Los Alamos National Laboratort)

Presenter: Dr CHEN, Bailian (Los Alamos National Laboratory)

Session Classification: MS15

Track Classification: (MS15) Machine Learning and Big Data in Porous Media