Paper No: SPE-198251-MS
Impacting Factors on Horizontal Coal Seam Gas Well Production and Proxy Model Comparison

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What is the basic idea of a proxy model?

- PCE proxy models deliver an accurate approximation by summing carefully chosen individually **weighted** functions over multiple input parameter space.

\[ = C_0 \]
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\[
\begin{align*}
\begin{aligned}
= & \ c_0 \\
= & \ c_0 + c_1
\end{aligned}
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\]
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\[
\begin{align*}
  &= c_0 \\
  &= c_0 + c_1 \\
  &= c_0 + c_1 + c_2 \\
  &= c_0 + c_1 + c_2 + c_3
\end{align*}
\]
What are the advantages of proxy modelling?

- PCE proxy models deliver accurate approximation by strategically summing weighted functions over multiple input parameter space.

\[ M(x) = c_0 + c_1 + c_2 + c_3 + \ldots \]

- Polynomials are orthogonal with respect to statistical distribution input parameters:
  - reducing complexity;
  - capturing uncertainty in the input parameters;
  - identifying sensitivity of the model to key input parameters.
Horizontal wells: modelling of cumulative gas production & peak gas rate

- For 10 years, with uncertainty in 6 inputs: reservoir permeability, porosity, gas content, gas saturation, horizontal well angle wrt principal permeability.

- Training data: use simulator to evaluate cum. gas production, \((x, C(x))\) & peak gas rate \((x, P(x))\).

- Validation data: use simulator to evaluate cum. gas production \((v, C(v))\) & peak gas rate \((v, P(v))\).

- On training data construct linear, quadratic and cubic PCE proxy models & linear, quadratic and UK proxy models from a commercial software package.

- On validation data calculate error between simulator and proxy model estimates.

- For best performing proxy model conduct sensitivity analysis & check confidence intervals.
How do the various proxy modelling techniques perform?

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How the variables impact on the gas production?

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Cumulative distributions of the gas production

CDFs for cumulative gas

CDFs for peak gas

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In Summary

• Proxy modelling tools provide fast, first pass simulations for the production of valuable forecasting information.
• Proxy models based on PCE techniques compare well with proxy modelling tools available through some commercial packages.
• PCE provides additional benefits including direct access to sensitivity analysis.

Thank You For Listening / Questions