**Introduction**

In the field of reservoir engineering, lower dimensional reparameterization for complex geological models is an important but challenging problem. Properties for complex geological models such as facies are non-Gaussian. Existing methods such as principal component analysis (PCA) and optimization-based PCA (O-PCA) need improvement especially for unconditional models [1]. In this study, we explore the application of neural style transfer for the reparameterization of non-Gaussian geological models. Our idea is to use the neural style transfer algorithm as a post-processing step after traditional PCA transformation. The purpose is to apply the neural style transfer algorithm to transfer the Gaussian-like PCA model to match the style of the original non-Gaussian model.

**Procedures & Equations**

- **PCA:**
  \[ X_c = [m_1 - \bar{m} \quad m_2 - \bar{m} \quad \ldots \quad m_N - \bar{m}] \]
  \[ X_c = \sqrt{N_r - 1}U^T \sqrt{N_r - 1}U^T \]
  \[ m = \Phi + \bar{m} \]

- **Neural Style Transfer using PCA model as content image, original model as style image:**
  \[ L_t = \sum_{i=1}^N m_i \|x_i - \sum_k w_k^i \|_2 + \omega \sum_k \|w_k\|^2 \]

- **Post-processing with O-PCA:**
  \[ m = \arg \min_h \left\{ \|\Phi \bar{m} - x_m\|_2^2 + \gamma x^T(1-x) \right\}, x_i \in [0, 1] \]

**Methodology**

**Neural Style Transfer**

- **Fast Neural Style Transfer**
  - **Style Target**
  - **Content Target**

**Post-processed Reservoir Models**

**Flow Statistics**

**Conclusions**

- Applied both neural style transfer and fast neural style transfer algorithm for reservoir reparameterization problem.
- Included hard data loss in the style transfer algorithm to ensure that output model honors hard data.
- The CNN-PCA algorithm outperforms O-PCA method in terms of preserving channel connectivity and flow statistics, especially for unconditional models.

**Reference**