Development of an interface-aware, higher-order-accurate transport scheme for reservoir simulation

Research Problem
The combination of discontinuities of geological interface and strong non-linear behaviours of two-phase flow yields difficulties in predicting the flow pattern.

Research Objective
1. Extending the hybrid Finite Element – Finite Volume Method (FEFVM) to correctly represent the geological discontinuities.
2. Developing numerical algorithm to
   - Capture quick coupled/de-coupled state of flow variables at material interfaces.
   - Work with complex geometry such as multiple material layers or branched interfaces.
   - Work for all multi-dimensional 1D, 2D and 3D models.

![Image 1](image1.png)

Fig 1. Two different discretization methods for three regions $R_1$, $R_2$ and $R_3$ and their interfaces $I_{1-2}$, $I_{1-3}$ and $I_{2-3}$: (a) FEFVM and (b) DFEFVM. The discontinuities were introduced by inserting new nodes $N_{11}$, $N_{12}$, $N_{13}$ and $N_{14}$.

![Image 2](image2.png)

Fig 2. The infiltration of dense non-aqueous phase liquid (DNAPL) into low permeable lens. Material heterogeneity results discontinuities on saturation field at material interfaces.

![Image 3](image3.png)

Fig 3. The effects of entry pressure of the lens on DNAPL flow pattern. Low entry pressure on the left and high entry pressure on the right.

More Information

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