Used Fuel Disposition Campaign

Integrating Discrete Fracture Networks with Performance Assessment

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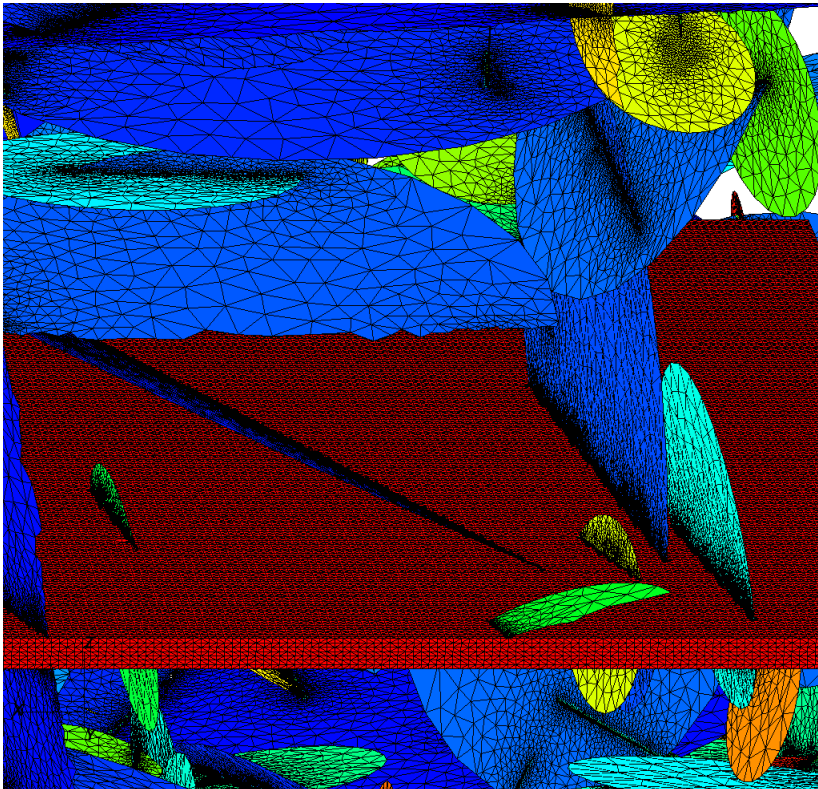
Las Vegas, NV

Motivation

■ **Crystalline Reference Case requires:**

- Representing fractured media and porous media
- Simulating heat and fluid flow
- Simulating advective and diffusive transport
- Computational efficiency

Options

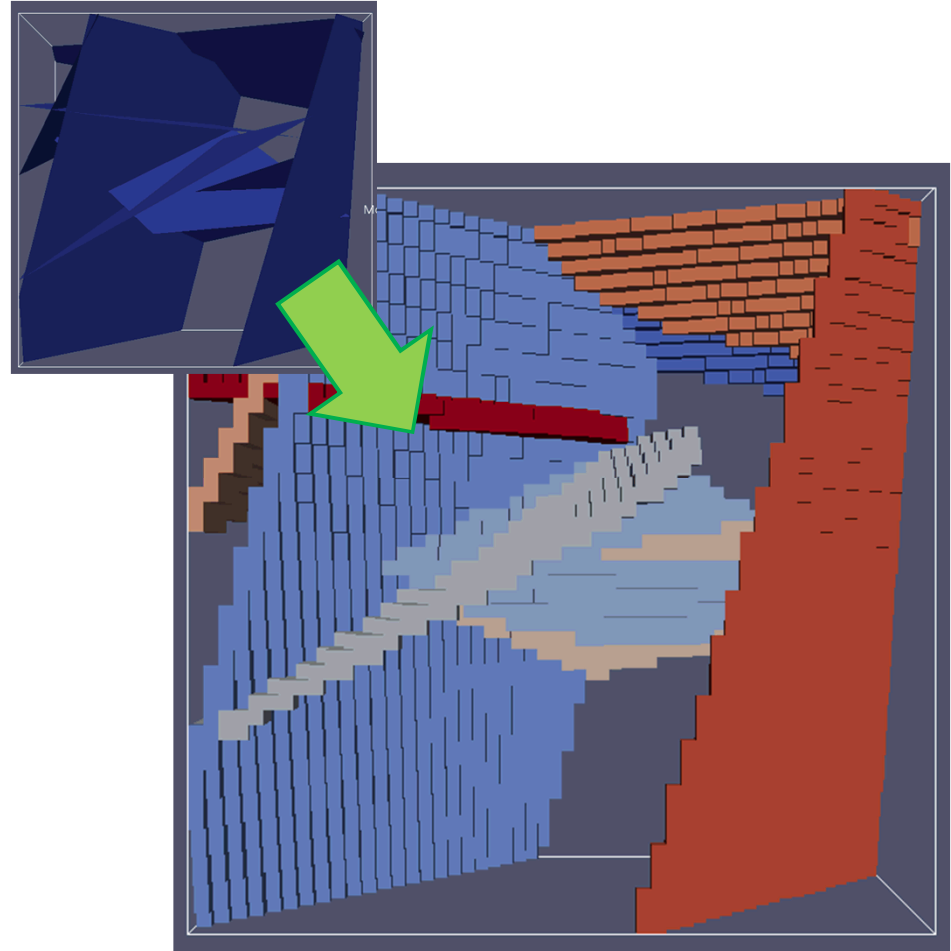- **Couple Discrete Fracture Network with Continuous Porous Medium**
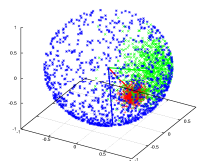
OR

- **Map *DFN* to *CPM***

Method

DFNWorks

1. **Generate DFN**
2. **Assign aperture and transmissivity to each fracture**
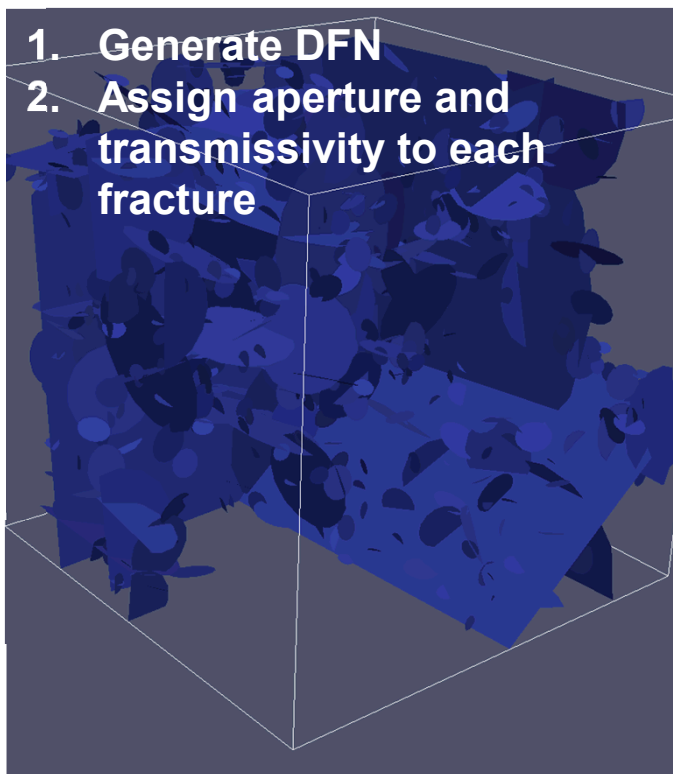
$$k = T\rho g/\mu b$$

$$\phi = V_f/V_{cell}$$

$$b = (12T\mu/\rho g)^{1/3}$$
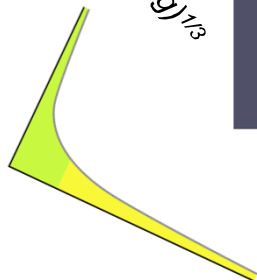
$$T = \log(1.6*10^{-9}*r^{0.8})$$
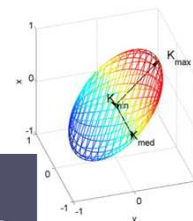
3. **Discretize CPM and locate fractures in grid cells**
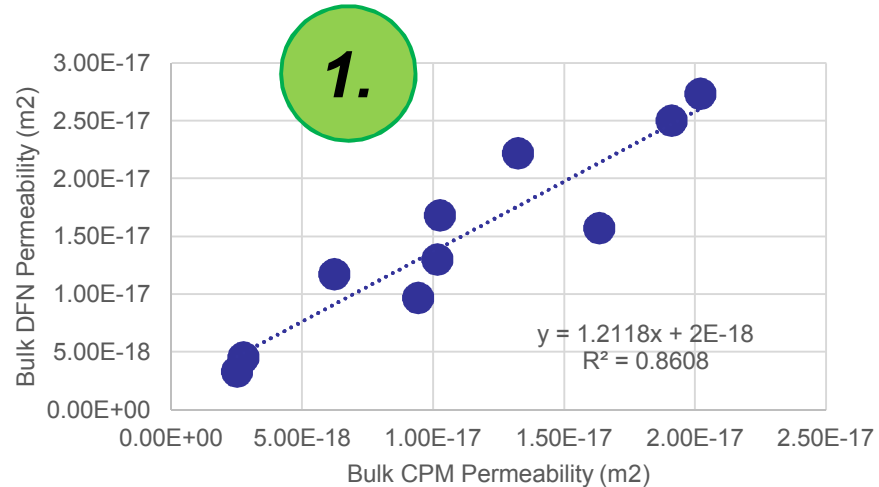4. **Sum local fracture transmissivities and volumes to calculate cell permeability (anisotropic) and porosity**
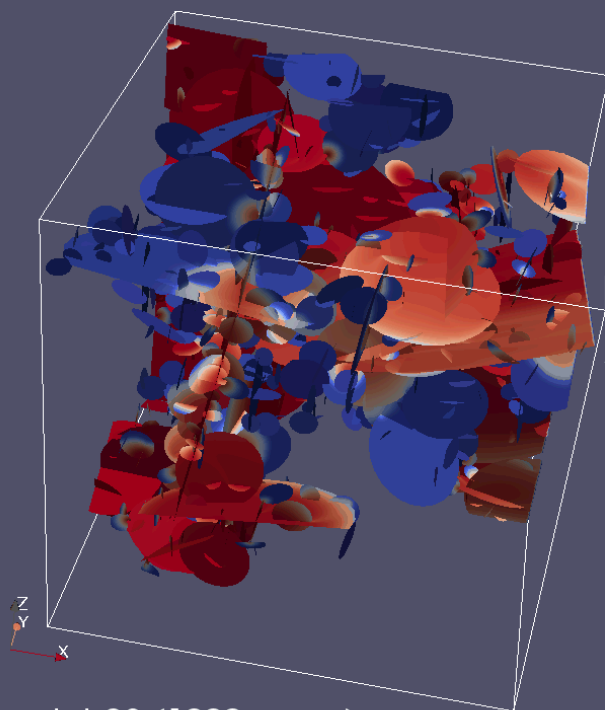
mapDFN

Compare:

Used Fuel Disposition

	DFN	CPM
Number of cells	~1.7 million	287,496
Time to 1 My	103 minutes	1.9 minutes
Path length	the standard	longer
Connectivity	the standard	greater

1.

3.

$y = 1.2118x + 2E\text{-}18$
$R^2 = 0.8608$

(scatter plot: Bulk DFN Permeability (m2) vs Bulk CPM Permeability (m2))

2.

small8 DFN

small8 CPM

VS.

Total_Tracer
1.000e-03
0.0001
1e-5
1e-6
1e-7
1.000e-08

Total_Tracer (M)
1.000e-03
0.0001
1e-5
1e-6
1e-7
1.000e-08

Time point 28 (1000 years)

Time: 1000 years

Success!

■ **DFN mapped to CPM:**

- Behaves like DFN
- Allows simulation of heat conduction
- Allows advective AND diffusive transport
- Is computationally efficient

Time: 3000 years