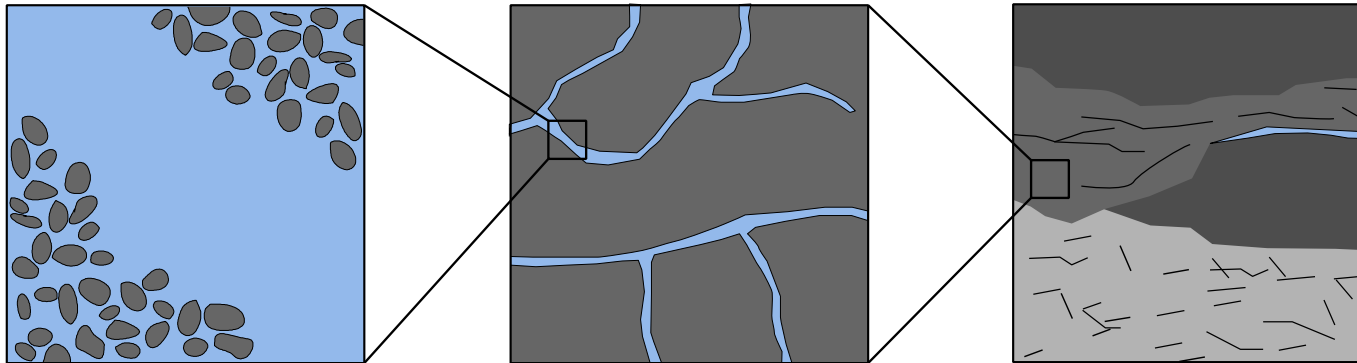


# Dual Porosity Modeling and Multi-scale Finite Volume Methods

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# Motivation

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## Challenges:

- heterogeneous parameters on multiple scales
- strongly discontinuous material properties, e.g.  $K$  spans multiple length scales and has multiscale structure  
→ all scales impact flow behaviour

high-resolution of all details computationally not possible

# Modeling Flow in Fractured Porous Media

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Problem:

two-phase flow neglecting gravity and capillary pressure

$$\phi \frac{\partial S_\alpha}{\partial t} - \nabla \cdot (\lambda_\alpha K \nabla p) = q_\alpha , \quad \alpha \in \{w, o\}$$

Mass conservation  
for incompressible  
fluid  $\alpha$

Common modeling approaches

- Continuum approaches
- Discrete approaches
- Multi-scale methods

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multi-scale structure:

- spans orders of magnitude
- discontinuous (fractures)

Common modeling approaches

- Continuum approaches
- Discrete approaches
- Multi-scale methods

# Modeling Flow in Fractured Porous Media

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## ➤ Continuum approaches

- upscaled representation of geometries and parameters



- efficient at cost of losing fine-scale information
- determination of effective parameters and exchange functions not straightforward

## ➤ Discrete Approaches

## ➤ Multi-scale methods

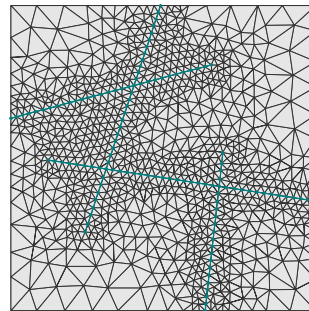
# Modeling Flow in Fractured Porous Media

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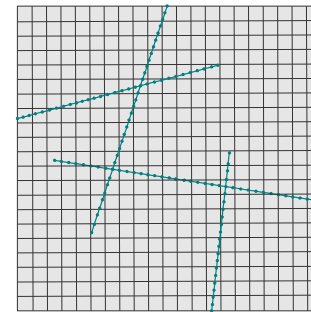
- Continuum approaches
- **Discrete approaches**
  - explicit resolution of fractures in the domain



fracture network



DFM



EDFM

- accurate
- applicability limited to smaller scales (extensive data requirement, huge systems)

- Multi-scale methods

# Modeling Flow in Fractured Porous Media

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- Continuum approaches
- Discrete approaches
- **Multi-scale methods**
  - resolve fine-scale data, but solve coarse-scale system

# Motivation

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- Thought:

What and how can we learn from multi-scale basis functions concerning the applicability and parametrization of dual-continuum models?



# Hierarchical Fracture Modeling (HFM)

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- $y$

# Dual-Porosity Model

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- $y$

# The Multi-Scale Restricted Smooth Basis

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## Method for Fractured Porous Media (F-MsRSB)

- $y$

# Closer Look at Basis Functions

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- $y$