Propagation of a Radial Fluid-driven Fracture in Nonlinear Solid

--around the tip of a fluid-driven fracture: process zone vs deviated fluid flow

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Solid nonlinearity vs fluid flow

Fracture roughness

Process zone size

Solid non-linearity

Length scale of fluid flow

Fluid flow in small rough apertures

Decrease of the permeability of the fracture tip

Growth of hydraulic fractures

[Lhomme 2005]

[Porson 2016]
Problem description

- Axisymmetric geometry
- Zero leak-off
- Constant injection rate
- No wellbore
- No compressibility

\[
\sigma_{coh} = \begin{cases} 
\sigma_T (1 - w/w_c), & w \leq w_c \\
0, & w > w_c 
\end{cases}
\]

\[w_h^3 = \frac{w^3}{f}, \quad f = 1 + \left(\frac{w_R}{w}\right)\alpha\]

Fluid front vs Process zone

Fluid deviation

Fracture opening
Material properties
Net pressure
Normal stress
Injection condition
Fracture radius

Asymptote

Fluid front

bubbling effect
squeezing effect
deviation
cohensive traction $\sigma_{coh}$

$\text{normal stress} \quad p=p_{f}$
$\text{suction} \quad p=p_{\text{cur}} \approx 0$
$\text{cohensive traction} \quad \sigma_{coh}$

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