Fracture modeling using effective media and wave propagation techniques

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Background

- Education
  - University of Texas
    - BS Geophysics 2012 (*expected*)
  - Will be working toward a Master's degree this fall
- Work Experience
  - Cabot Oil and Gas
    - Summer Intern 2012

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Research

- 2011: Undergraduate Research Assistant for Dr. Paul Mann
  - Digitized and Georeferenced maps for Caribbean Basin research
- 2012: Undergraduate Research Assistant for Dr. Kyle Spikes
  - Modeling fracture systems for seismic attribute analysis

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Current Project

Goal:

Working toward an understanding of effective elastic properties in fractured rock using two techniques

- Effective medium modeling
- Numerical wave propagation

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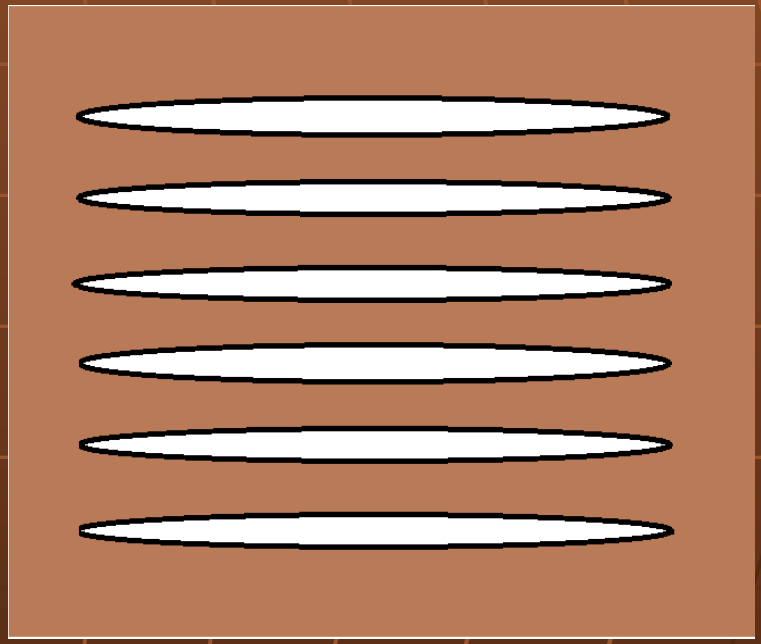
Photo: Woodford Shale
http://www.aapg.org/explorer/divisions/2006/11emd.cfm

Effective Medium Model

(Hudson, 1981)

Hudson Method:

- Estimate the effective elastic moduli of a rock in terms of its constituents and pore space



Assumptions:

- Isolated penny-shaped cracks with small aspect ratios and small crack density in an isotropic background

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Numerical Wave Propagation

(Basabe et al. 2009)

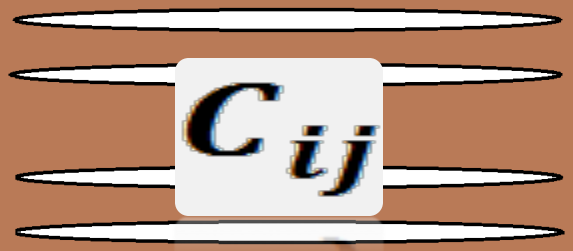
Discontinuous Galerkin Method:

- Compute plane wave reflection coefficients from normal and tangential compliance

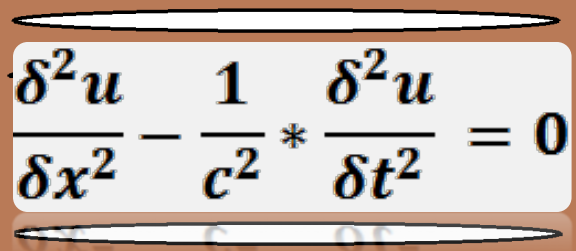
Assumptions:

- Continuity is imposed using the weak form of the wave equation
- Background is isotropic but can be heterogeneous
- Fracture end points are aligned with the mesh

Hudson Model



Numerical Model



Expected Results

- The numerical wave propagation method will likely give more realistic results for complex systems
  - o Allows for individualized crack properties/fills
  - o Allows for empty cracks
- Implications:
  - o Comparison of seismic attributes with varying position of a cemented fracture

Hudson Model

$$C_{ij}$$

Numerical Model

$$\frac{\delta^2 u}{\delta x^2} - \frac{1}{c^2} * \frac{\delta^2 u}{\delta t^2} = 0$$

Thank you!

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