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Statistical Characterisation of Porous Media at the Pore Scale

Ellipsoidal Model

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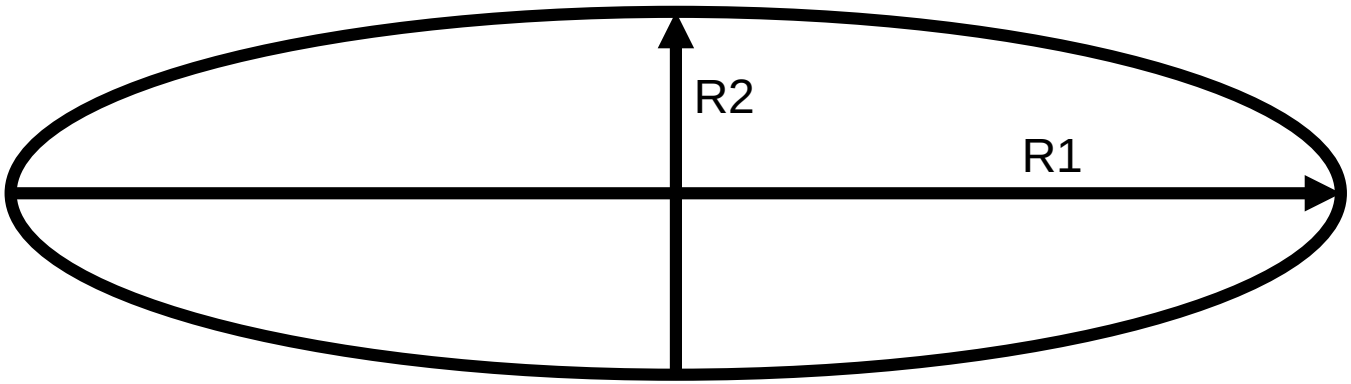
Presentation Outline

- **Ellipsoidal Model**
  - **Review prior results**
  - **Conceptual Model**
  - **Scaling Relationship**

Conceptual Model

- Ellipsoidal Model:
  - Keep one axis same and change the other two to equal value
    - R1 long axis
    - R2 short axis
  - Axisymmetric Ellipsoids
  - Change in anisotropy in one coordinate axis expected
  - Rhino 3D: Now able to compute many of these models, no mesh editing
- Scaling Relationship:
  - Both Beta 102 and Beta 202 scale exponentially with the ratio of radii
  - $R^* = \frac{R_1 - R_2}{R_1} = 1 - \frac{R_2}{R_1}$
  - Experimental result NOT analytical



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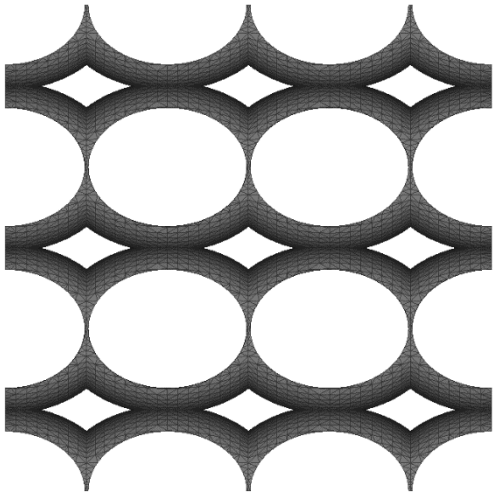
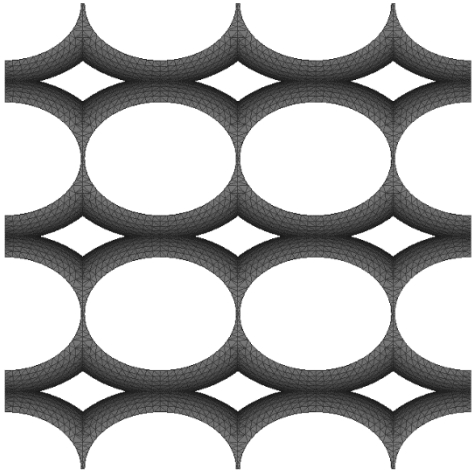
Asymmetric Parametric Pore – R1 = 1.4, R2=1.4-1.1

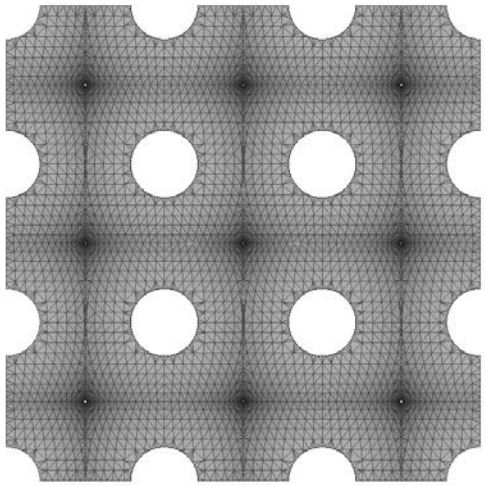
X-Y View



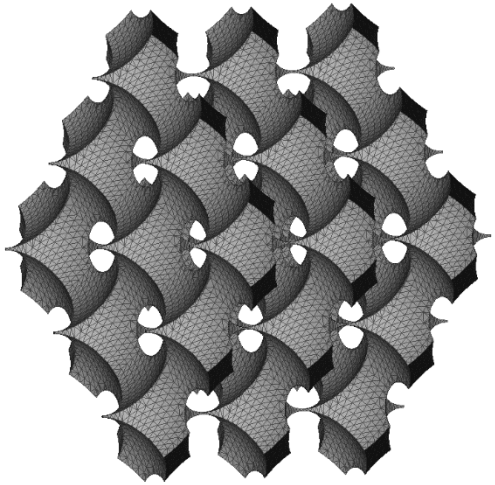
Y-Z View



X-Z View



3D View



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Minkowski Tensors – R1 = 1.4, R2=1.3

Minkowski Tensor	Eigenvectors	Eigenvalues	Anisotropy Index
$\widehat{W}_1^{0,2} = \begin{bmatrix} 0.157 & 0 & 0 \\ 0 & 0.685 & 0 \\ 0 & 0 & 0.158 \end{bmatrix}$	$\begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ $\begin{bmatrix} 0 \\ -1 \\ 0 \end{bmatrix}$ $\begin{bmatrix} 0 \\ \end{bmatrix}$	$\{11.9 \quad 51.8 \quad 11.9\}$	$= 0.23$
$\widehat{W}_2^{0,2} = \begin{bmatrix} 0.168 & 0 & 0 \\ 0 & 0.688 & 0 \\ 0 & 0 & 0.164 \end{bmatrix}$	$\begin{bmatrix} -1 \\ 0 \\ 0 \end{bmatrix}$ $\begin{bmatrix} 1 \\ 0 \end{bmatrix}$	$\{-7.8 \quad -30.9 \quad -7.8\}$	$= 0.25$

Hidden Elements in manual mesh editing skewed results!

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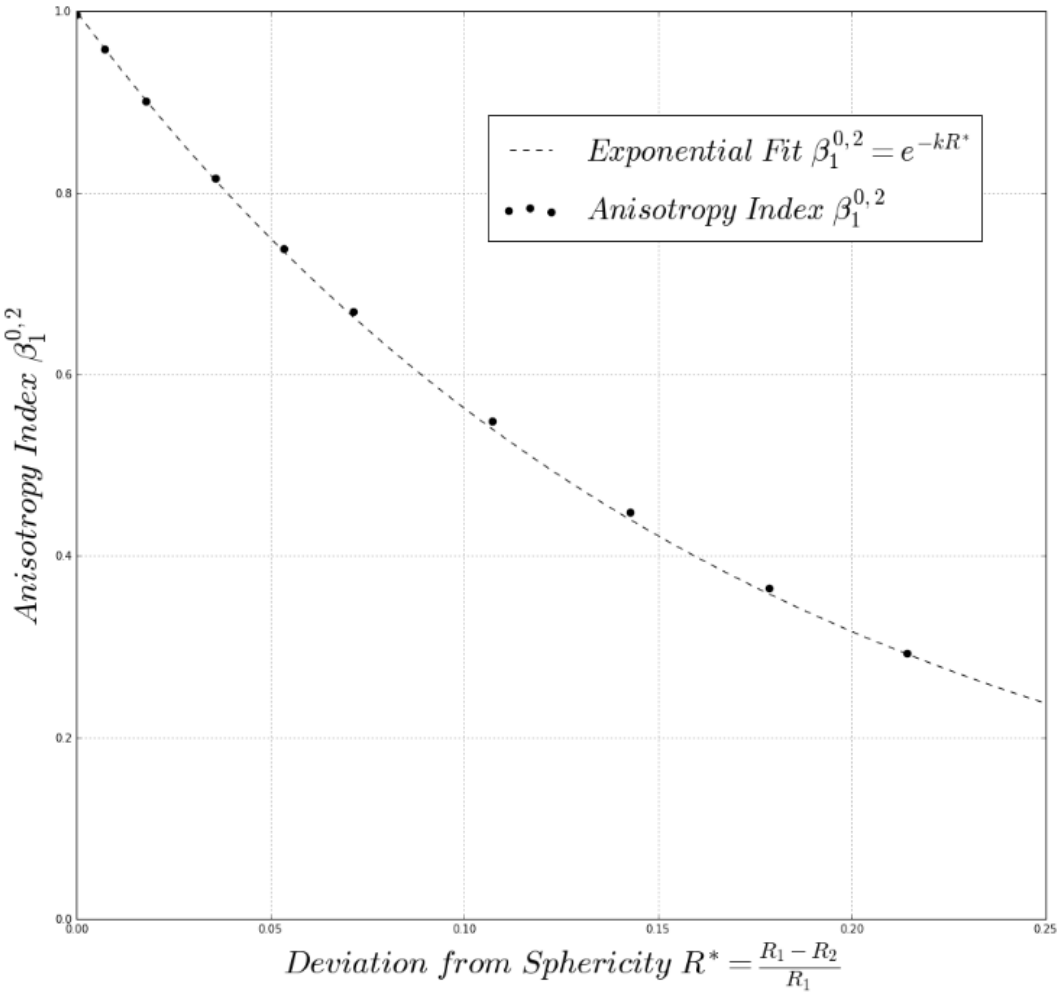
Scaling Relationship

- Anisotropy Index beta 102
  - Scales exponential with deviation from sphericity



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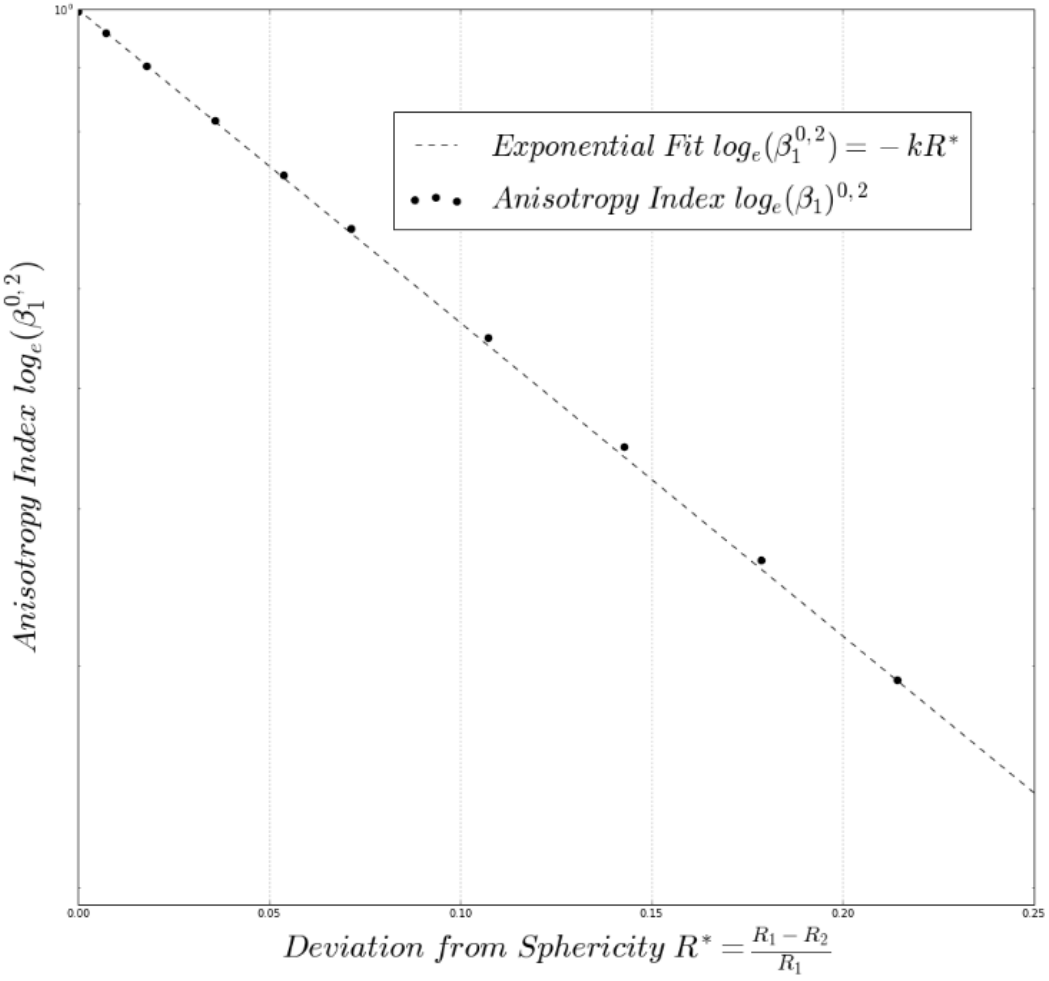
Scaling Relationship

- Anisotropy Index beta 102
  - Scales exponential with deviation from sphericity



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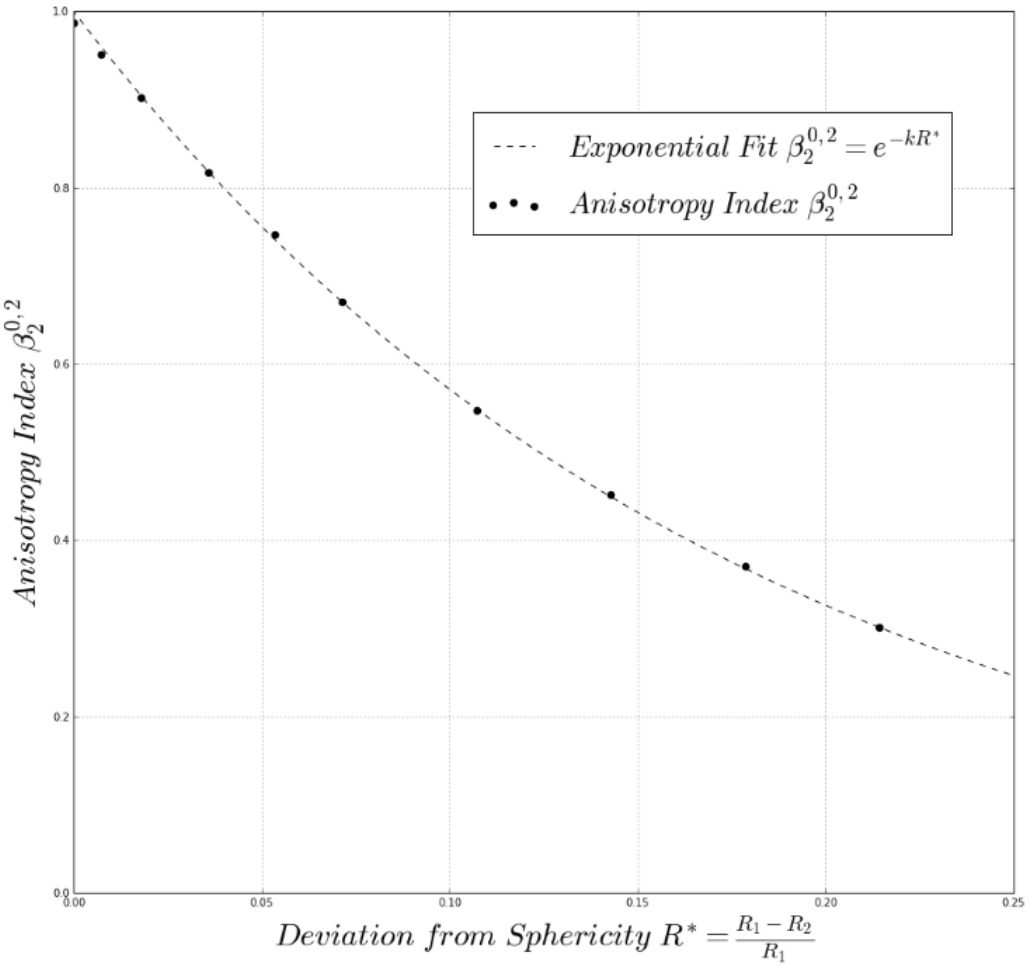
Scaling Relationship – Beta 202

- Anisotropy Index beta 202
  - Scales exponential with deviation from sphericity
  - Same scaling behavior as Beta 102



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Scaling Relationship – Beta 202

- Anisotropy Index beta 202
  - Scales exponential with deviation from sphericity
  - Same scaling behavior as Beta 102