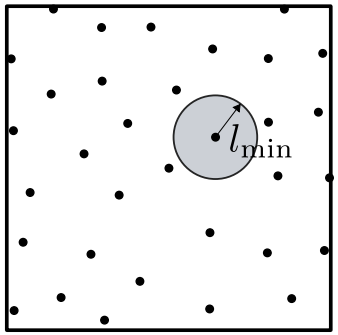
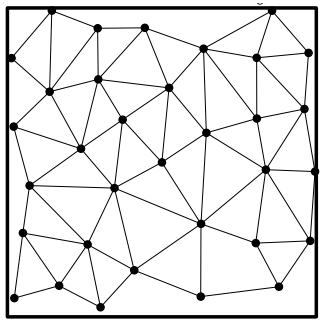
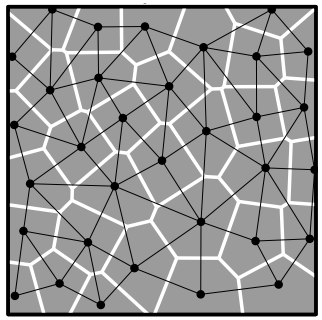
Validation of the WLM Using Fine-Scale Stochastic Discrete Element Computation



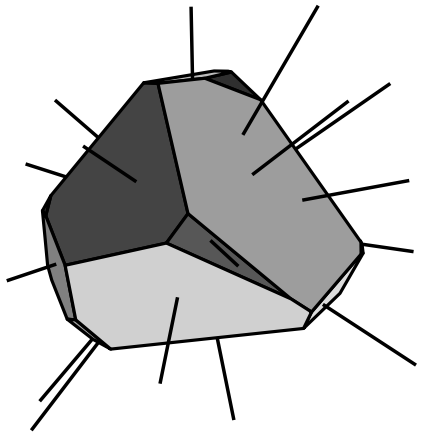
Random nuclei



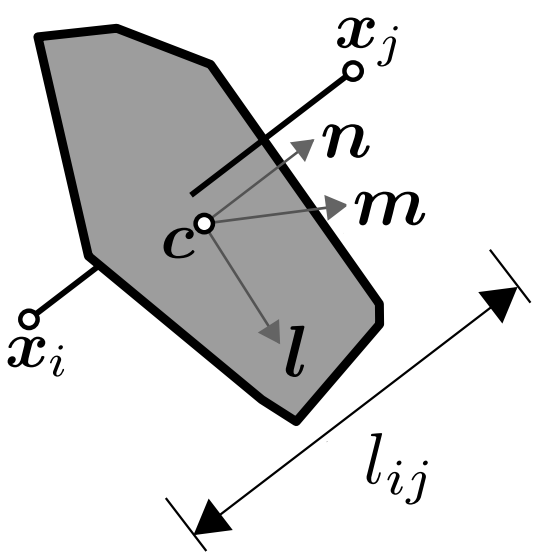
Delaunay triangulation



Voronoi tessellation



Voronoi body



Facet

Displacement jump:

$$\boldsymbol{\Delta}_{ij} = \boldsymbol{A}_j \cdot \begin{pmatrix} \boldsymbol{u}_j \\ \boldsymbol{\theta}_j \end{pmatrix} - \boldsymbol{A}_i \cdot \begin{pmatrix} \boldsymbol{u}_i \\ \boldsymbol{\theta}_i \end{pmatrix}$$

DOFs of nuclei of Voronoi bodies *i* and *j*

Le et al., *J. Appl. Mech.* 2018

Stochastic Discrete Element Model — Constitutive Law

Continuum damage model for traction-displacement relationship of facets:

$$\begin{pmatrix} t_n \\ t_l \\ t_m \end{pmatrix} = E_0(1-\omega) \begin{pmatrix} e_n \\ \alpha e_l \\ \alpha e_m \end{pmatrix}$$

Damage parameter (Cusatis and Cedolin 2007):

$$\omega = 1 - \frac{s_{\text{eq}}}{E_0 e_{\text{eq}}} \quad \text{and} \quad s_{\text{eq}} = f_{\text{eq}} \exp\left(\frac{K}{f_{\text{eq}}} \left\langle \chi - \frac{f_{\text{eq}}}{E_0} \right\rangle\right); \quad e_{\text{eq}} = \sqrt{e_n^2 + \alpha(e_m^2 + e_l^2)}$$

Dynamic equilibrium equation for forces and moments at nuclei :

$$\boldsymbol{M}\ddot{\boldsymbol{u}} + \boldsymbol{C}\dot{\boldsymbol{u}} + \boldsymbol{K}(t)\boldsymbol{u} = \boldsymbol{F}(t)$$

Equation of motion is solved by using the Implicit Newmark method.