EDEM JKR model overview

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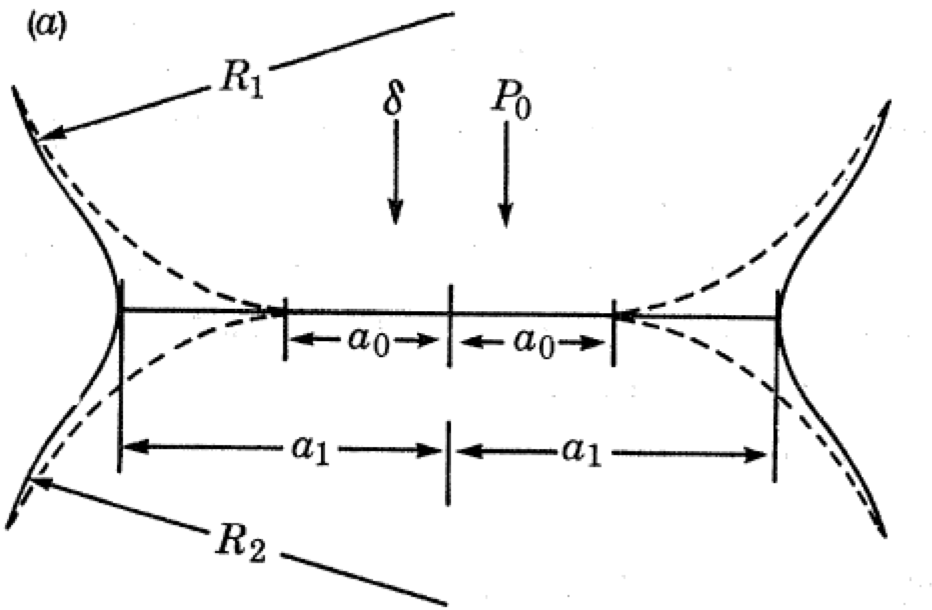
DEMSolutions

JKR background

- Johnson, K.L., Kendall, K., and Roberts, A.D., 1971, "*Surface Energy and the Contact of Elastic Solids*", Proceedings of the Royal Society of London, A324, pp. 301-313.



- Assumes contact area is increased due to cohesion

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EDEM JKR Model

- Normal force depends on the overlap δ and the surface energy γ in the following way

$$F_{JKR} = -4\sqrt{\pi\gamma E^*}\, a^{3/2} + \frac{4E^*}{3R^*} a^3$$

$$\delta = \frac{a^2}{R^*} - \sqrt{4\pi\gamma a / E^*}$$

- Here

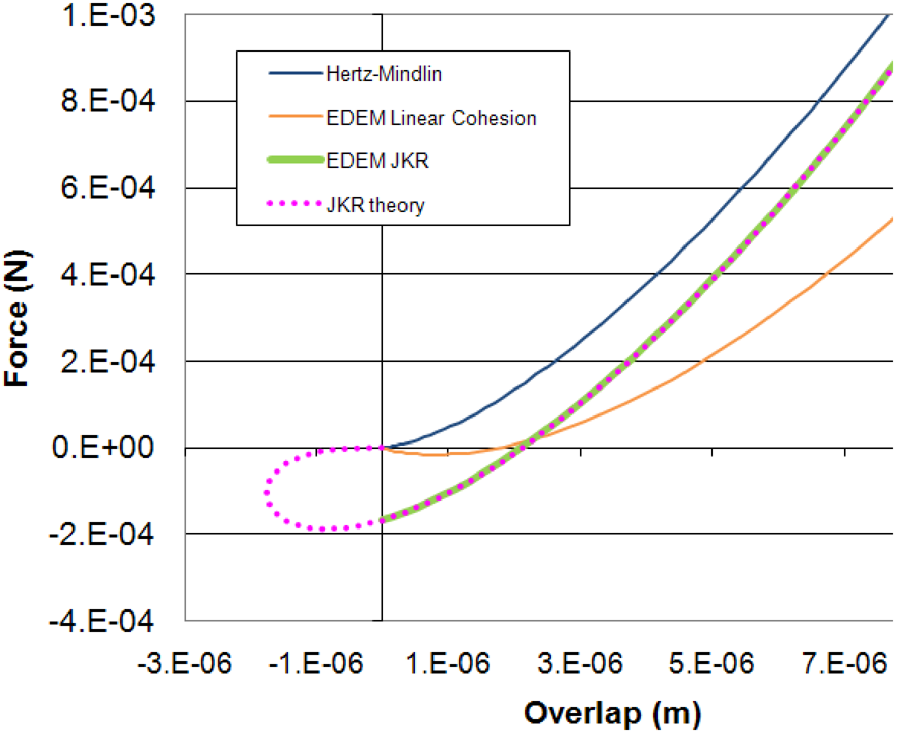
$$\frac{1}{E^*} = \frac{(1-\nu_1)}{2G_1} + \frac{(1-\nu_2)}{2G_2} \qquad \frac{1}{R^*} = \frac{1}{R_1} + \frac{1}{R_2}$$

- For γ=0 force turns into

$$F_{Hertz} = \frac{4}{3} E^* \sqrt{R^*}\, \delta^{\frac{3}{2}}$$

- For δ=0, the force is max:

$$F_{pullout} = -\frac{8}{3}\pi\gamma R^*$$



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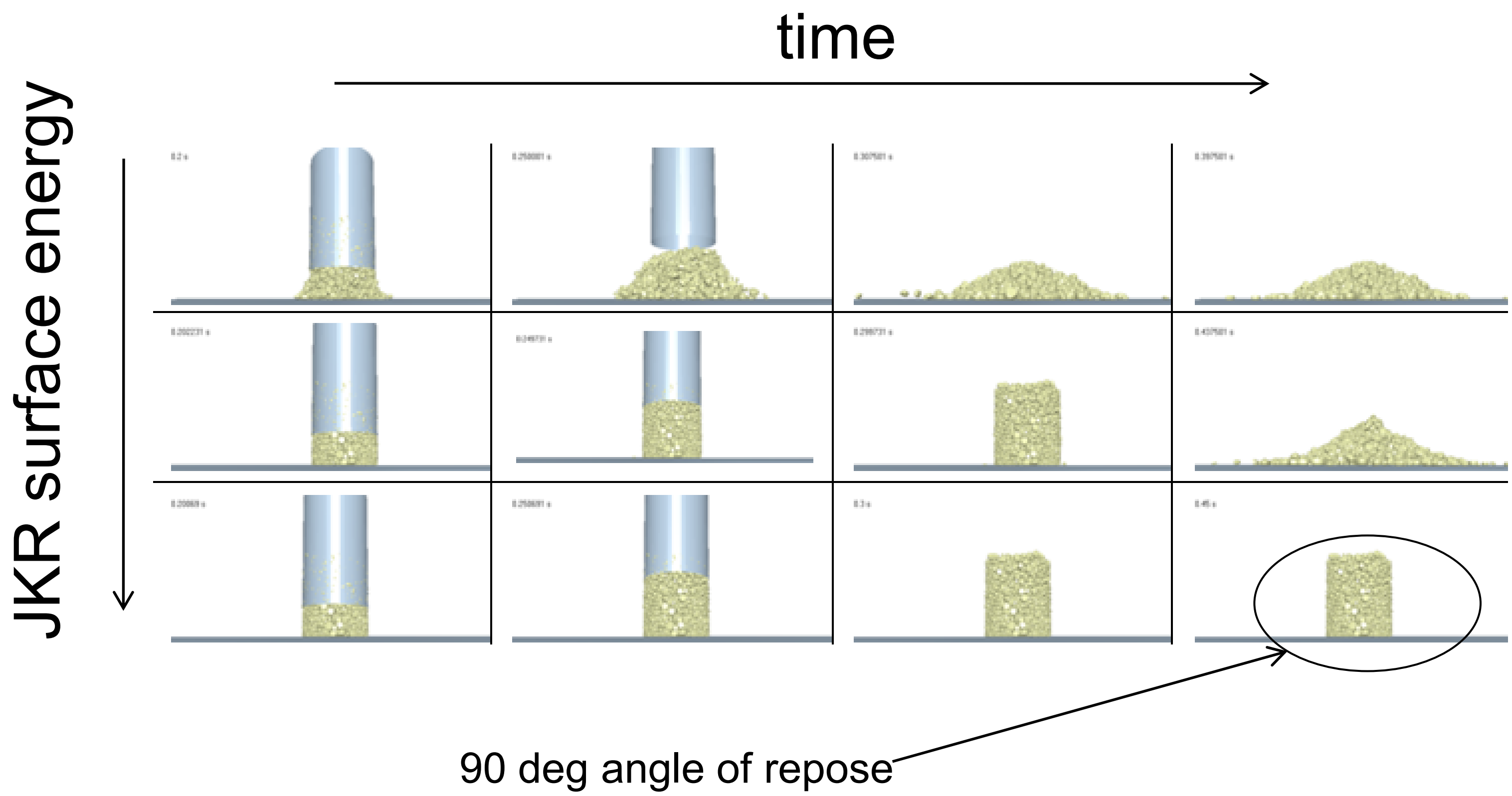
Angle of repose tests

Cylindrical container with open bottom filled with particles is positioned on flat surface at t=0. When container is moved up particles form a pile on the surface.



More on surface energy parameter

- In wet materials the force needed to separate two particles depends on the liquid surface tension γ_s and wetting angle

$$F_{pullout} = 2\pi\gamma_s \cos(\theta)\sqrt{R_i R_j}$$

- Equating above force to JKR max force $F_{pullout} = \frac{8}{3}\pi\gamma R^*$ allows JKR surface energy parameter estimation if EDEM particle size is not scaled.