1 "Ciavarella - Papangelo" alternative to the Dalmquist criterion for a full fractal surface

There is some confusion in the literature about adhesion for rough surfaces and no model is actually predictive of pull-off (see Ciavarella, 2017).

Ciavarella-Papangelo (2017) start by the *postulate* that, as in sinusoidal case the pull-off value depends mainly on the Johnson parameter $\alpha = \frac{2}{\pi^2}\frac{W}{E}\frac{\lambda}{h^2}$ (at intermediate range of Tabor parameters), the multiscale problem will depend mostly on a generalized Johnson α_{CP} "Ciavarella-Papangelo" parameter defined in terms of the entire Power Spectrum Density (PSD) of the (isotropic) rough surface up to a certain magnification. But in practical terms, most surfaces have low fractal dimension $D \simeq 2.2$ (or Hurst exponent $H = 0.8$), and combining eqt.5,8,10 of Ciavarella-Papangelo (2017) we get that α_{CP} is independent on magnification and is

$$\alpha_{CP} = \frac{w}{\pi h_{rms}^2 \frac{0.8}{0.6}} \frac{\lambda_0}{E} \tag{1}$$

where λ_0 is the largest wavelength in the roughness (strictly, where the power law regime starts), E is elastic modulus, h_{rms} the rms heights, w work of adhesion, and E the Young elastic modulus. We postulate that adhesion is "strong" if $\alpha_{CP} > 1$ and this results in

$$E < \frac{w\lambda_0}{4h_{rms}^2} \tag{2}$$

Compared to the original Dalmquist criterion $E_c = 0.3MPa$ —- we obtain the exact correspondence for example using $h_{rms} = 1\mu m$, when $\lambda_0 = 30\mu m$. Higher λ_0 lead to higher E_c.

M.Ciavarella (2017). Some open problems in adhesion (of rough surfaces). http://imechanica.org/node/21873

Ciavarella M, Papangelo A, A generalized Johnson parameter for pull-off decay in the adhesion of rough surfaces, Physical Mesomechanics 20 (5), 65-72, December 2017

"https://www.researchgate.net/publication/320622786_A_generalized_Johnson_parameter_for_pull-off_decay_in_the_adhesion_of_rough_surfaces"