$h(\sigma)$ calculation

This document briefly explains some minor modifications made to the original $h(\sigma)$ function described in [1], as well as some technical details related to δ calculation.

- sigma_medio: $\frac{1}{m}\sum_{i=1}^{m}|\sigma_i|$
- sigma_min: $\min(\sigma_i)$, where σ_i is the determinant of the weighted Jacobian matrix associated with the i-th tetrahedron of the local mesh.
- $delta\_min = Re(\sqrt{EpsilonEfectivo(EpsilonEfectivo - sigma\_min)})$
- $\delta = \max\{delta\_min, 10^{-4} sigma\_medio\}$

The program uses a default effective epsilon, given by:

$$EpsilonEfectivo = machine\_epsilon * EpsSafetyFactor$$

where $machine\_epsilon$ is a typical machine epsilon for double precision numbers and $EpsSafetyFactor$ is a “safety” factor used to prevent numerical problems. Values in this implementation are:

$$machine\_epsilon = 2.220446^{-16}$$

$$EpsSafetyFactor = 10^{11}$$

Asymptotic epsilon ε has the following value: $asimptotic\_epsilon = 10^{-10}$. Note that $\varepsilon \ll \delta$. Figure 1 shows a modification of $h(\sigma)$ function presented in [1]. This new function is given by

$$h(\sigma) = \frac{1}{2}(\sigma + \sqrt{(\sigma - 2\varepsilon)^2 + 4\delta^2})$$

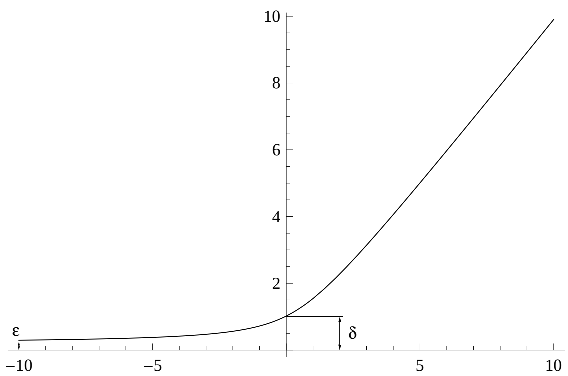

Figure 1: Representation of $h(\sigma)$ function

References

[1] J.M. Escobar, E. Rodríguez, R. Montenegro, G. Montero, J.M. González-Yuste, Simultaneous untangling and smoothing of tetrahedral meshes, *Computer Methods in Applied Mechanics and Engineering*, 192 (25) 2775–2787 (2003).