panel method notes

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1 Source influenced potential computation

Source influenced potentials

$$\Phi_{\text{source}} = -\frac{1}{4\pi} \sum_{\text{panel edges}} \left\{ \frac{(x-x_a)(y_b-y_a)-(y-y_a)(x_b-x_a)}{d_{ab}} \log\left(\frac{r_a+r_b+d_{ab}}{r_a+r_b-d_{ab}}\right) - z\left[\tan^{-1}\left(\frac{m_{ab}e_a-h_a}{zr_a}\right)-\tan^{-1}\left(\frac{m_{ab}e_b-h_b}{zr_b}\right)\right] \right\} \tag{1}$$

Source terms

Doublet influenced potentials

$$\Phi_{\text{doublet}} = \frac{1}{4\pi} \sum_{\text{panel edges}} \left[\tan^{-1}\left(\frac{m_{ab}e_a-h_a}{zr_a}\right)-\tan^{-1}\left(\frac{m_{ab}e_b-h_b}{zr_b}\right)\right] \tag{2}$$

Thus

$$\Phi_{\text{source}} = -\frac{1}{4\pi} \sum \text{sources terms (not highlighted)} + z\Phi_{\text{doublet}}$$

Notes:

1. We combine the two $\tan^{-1}$ to avoid numerical issues and use the half-angle rule to change from atan2 to a function of atan.

2. For lifting surfaces, we can always just compute doublet_ic_p_name first, and use declare_variable in SourcePotential class to get the part. For non-lifting surfaces, we need to compute the doublet part first and then compute the whole source-induced potential. Note that even if there's no doublet element on the panel for non-lifting surfaces, these are just coefficients that happen to be the same.