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Erratum

Induced Drag Minimization: A Variational Approach Using the Acceleration Potential

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DUE to a production error, Eqs. (21), (22), (50), (A8) and (D11) were published incorrectly. The correct versions appear below. The online version of this paper is correct.

Using Eqs. (17) and (18), and remembering that $z_1 = +H/2$, Eq. (20) can give the normalwash for wing 1:

$$u_{n1}(y) = -\frac{1}{4\pi V_\infty} \int_{-b_w}^{+b_w} \frac{m_1(y_d)}{(y - y_d)^2}\, \mathrm{d}y_d - \frac{1}{4\pi V_\infty} \int_{-b_w}^{+b_w} m_2(y_d) \frac{(y - y_d)^2 - H^2}{\left[(y - y_d)^2 + H^2\right]^2}\, \mathrm{d}y_d \tag{21}$$

Similarly for wing 2, it can be shown that

$$u_{n2}(y) = -\frac{1}{4\pi V_\infty} \int_{-b_w}^{+b_w} \frac{m_2(y_d)}{(y - y_d)^2}\, \mathrm{d}y_d - \frac{1}{4\pi V_\infty} \int_{-b_w}^{+b_w} m_1(y_d) \frac{(y - y_d)^2 - H^2}{\left[(y - y_d)^2 + H^2\right]^2}\, \mathrm{d}y_d \tag{22}$$

Using the second relation of Eqs. (49) and (48), the minimum induced drag [Eq. (45)] becomes

$$(D_i)_{\text{opt}} = -\frac{\rho_\infty}{\pi V_\infty^2}\left(-\bar{m}\frac{\pi}{b_w}\right)\left(\bar{m}\frac{b_w \pi}{2}\right) = \frac{\rho_\infty \pi}{2V_\infty^2}\bar{m}^2 = \frac{\rho_\infty \pi}{2V_\infty^2}\left(-\frac{\bar{L}}{\rho_\infty \pi b_w}\right)^2 = \frac{\bar{L}^2}{2\pi\rho_\infty b_w^2 V_\infty^2} \tag{50}$$

Using this result and imposing $\delta_2 \equiv 0$,

$$2C_1 \int_{-b_w}^{+b_w} \delta_1(y_d) \int_{-b_w}^{+b_w} m_{1\,\text{opt}}(y)^S \bar{Y}\, \mathrm{d}y\, \mathrm{d}y_d + 2C_1 \int_{-b_w}^{+b_w} \delta_1(y_d) \int_{-b_w}^{+b_w} m_{2\,\text{opt}}(y)^R \bar{Y}\, \mathrm{d}y\, \mathrm{d}y_d - C_2\lambda \int_{-b_w}^{+b_w} \delta_1(y_d) g(y_d)\, \mathrm{d}y_d = 0 \tag{A8}$$

Instead of working with the coefficients of lift and induced drag, it is possible to work with the lift and induced drag. This is useful for the comparison with the biplane (because such comparison is done using the same lift force). Remembering the relations

$$(D_i)_{\text{opt}} = \tfrac{1}{2}\rho_\infty V_\infty^2 2b_w l \left(C_{D_i}\right)_{\text{opt}}, \qquad \bar{L} = \tfrac{1}{2}\rho_\infty V_\infty^2 2b_w l \bar{C}_L \tag{D10}$$

it is possible to write

$$\bar{m} = 2\bar{L}/(\rho_\infty \pi b_w) \qquad (D_i)_{\text{opt}} = \bar{L}^2 \Big/ \left(2\pi\rho_\infty b_w^2 V_\infty^2\right) \tag{D11}$$