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Self-Propulsion of an Oscillatory Wing

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In this paper we show that the oscillatory motion of a wing in an incompressible inviscid fluid can determine the apparition of a propulsive force. In the framework of the linearized theory the dimensionless lifting surface equation for oscillatory wings is: $\frac{\varpi}{4\pi}\int\int_D^* \tilde{f}(\xi,\eta)\exp(-i\tilde{\omega}(x-\xi))\left(\int_{-\infty}^{x_0}\frac{\exp(i\tilde{\omega}u)}{(u^2+\varpi^2(y-\eta)^2)^{3/2}}du\right)d\xi d\eta = -\left(\frac{\partial h(x,y)}{\partial x}+i\tilde{\omega}h(x,y)\right)$, where $Re[\tilde{f}(x,y)\exp(i\omega t)]$ is the pressure coefficient, ω is the frequency of the oscillation, $\widetilde{\omega}$ is the reduced frequency, and $z = h(x,y)\exp(i\omega t)$ is the equation of the wing. Employing adequate quadrature formulas, we discretize the integral equation and we obtain the values of $\tilde{f}$ in the nodes of the grid. For certain oscillatory delta wings we calculate the drag coefficient and we notice that if ω surpasses a critical value, the drag coefficient becomes negative i.e. there appears a *propulsion force*.

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