Equations Used

$$
\begin{aligned}
EI\frac{d^2\theta^*}{ds^{*2}} &= \frac{1}{2}\rho u^2 C_D \int_{s^*}^{l} \cos^2\theta\cos(\theta-\theta^*)ds + \frac{1}{2}\rho u^2 C_L \int_{s^*}^{l} \cos^2\theta\sin(\theta-\theta^*)ds && (1)\\
\frac{d^2\theta^*}{ds^{*2}} &= \frac{\rho u^2 l}{2EI}\left[C_D \int_{s^*}^{1} \cos^2\theta\cos(\theta-\theta^*)ds + C_L \int_{s^*}^{1} \cos^2\theta\sin(\theta-\theta^*)ds\right] && (2)\\
\frac{d^2\theta^*}{ds^{*2}} &= \frac{\rho u^2 l}{2EI}\left[\int_{s^*}^{1} \cos^2\theta\left(C_D\cos(\theta-\theta^*) + C_L\sin(\theta-\theta^*)\right)ds\right] && (3)\\
\frac{d^2\theta^*}{ds^{*2}} &= \frac{\rho u^2 l}{2EI}\sqrt{C_D^2+C_L^2}\left[\int_{s^*}^{1} \cos^2\theta\left(\frac{C_D}{\sqrt{C_D^2+C_L^2}}\cos(\theta-\theta^*) + \frac{C_L}{\sqrt{C_D^2+C_L^2}}\sin(\theta-\theta^*)\right)ds\right] && (4)\\
\frac{d^2\theta^*}{ds^{*2}} &= \frac{\rho u^2 l}{2EI}\sqrt{C_D^2+C_L^2}\left[\int_{s^*}^{1} \cos^2\theta\sin\left(\theta-\theta^*+\sin^{-1}\left(\frac{C_D}{\sqrt{C_D^2+C_L^2}}\right)\right)ds\right] && (5)\\
\frac{d^2\theta^*}{ds^{*2}} &= a\left[\int_{s^*}^{1} \cos^2\theta\sin\left(\theta-\theta^*+\sin^{-1}\left(\frac{C_D}{\sqrt{C_D^2+C_L^2}}\right)\right)ds\right] && (6)\\
\frac{d^3\theta^*}{ds^{*3}} &= a\left[-\cos^2\theta^*\frac{C_D}{\sqrt{C_D^2+C_L^2}} - \int_{s^*}^{1} \cos^2\theta\cos\left(\theta-\theta^*+\sin^{-1}\left(\frac{C_D}{\sqrt{C_D^2+C_L^2}}\right)\right)ds\right] && (7)\\
\frac{d^4\theta^*}{ds^{*4}} &= a\left[2\cos\theta^*\sin\theta^*\frac{C_D}{\sqrt{C_D^2+C_L^2}} + \cos^2\theta^*\frac{C_L}{\sqrt{C_D^2+C_L^2}} - \int_{s^*}^{1} \cos^2\theta\sin\left(\theta-\theta^*+\sin^{-1}\left(\frac{C_D}{\sqrt{C_D^2+C_L^2}}\right)\right)ds\right] && (8)\\
\frac{d^4\theta^*}{ds^{*4}} &= a\left[\sin 2\theta^*\frac{C_D}{\sqrt{C_D^2+C_L^2}} + \cos^2\theta^*\frac{C_L}{\sqrt{C_D^2+C_L^2}}\right] - \frac{d^2\theta^*}{ds^{*2}} && (9)\\
\frac{d^4\theta^*}{ds^{*4}} + \frac{d^2\theta^*}{ds^{*2}} &= \frac{a}{\sqrt{C_D^2+C_L^2}}\left[C_D\sin 2\theta^* + C_L\cos^2\theta^*\right] && (10)\\
\frac{d^4\theta^*}{ds^{*4}} + \frac{d^2\theta^*}{ds^{*2}} &= \frac{a}{\sqrt{C_D^2+C_L^2}}\left[\frac{C_L}{2} + C_D\sin 2\theta^* + \frac{C_L}{2}\cos 2\theta^*\right] && (11)\\
\frac{d^4\theta^*}{ds^{*4}} + \frac{d^2\theta^*}{ds^{*2}} &= \frac{a}{\sqrt{C_D^2+C_L^2}}\left[\frac{C_L}{2} + \sqrt{C_D^2+\frac{C_L^2}{4}}\left(\frac{C_D}{\sqrt{C_D^2+\frac{C_L^2}{4}}}\sin 2\theta^* + \frac{C_L}{2\sqrt{C_D^2+\frac{C_L^2}{4}}}\cos 2\theta^*\right)\right] && (12)\\
\frac{d^4\theta^*}{ds^{*4}} + \frac{d^2\theta^*}{ds^{*2}} &= a\left(\lambda + b\sin(2\theta^*+\mu)\right) && (13)
\end{aligned}
$$

where,

$$
\begin{aligned}
C_D &= 1.95\\
C_L &= 0.178\\
\lambda &= \frac{C_L}{2\sqrt{C_D^2+C_L^2}}\\
&= 0.00454521\\
b &= \frac{\sqrt{C_D^2+\frac{C_L^2}{4}}}{\sqrt{C_D^2+C_L^2}}\\
&= 0.99689635\\
\mu &= \sin^{-1}\left(\frac{C_L}{2\sqrt{C_D^2+\frac{C_L^2}{4}}}\right)\\
&= 0.04561
\end{aligned}
$$

And the boundary conditions being,

$$
\begin{aligned}
\theta^*(0) &= 0 && (14)\\
\frac{d\theta^*}{ds^*}(1) &= 0 && (15)\\
\frac{d^2\theta^*}{ds^{*2}}(1) &= 0 && (16)\\
\frac{d^3\theta^*}{ds^{*3}}(1) &= -a\frac{C_D}{\sqrt{C_D^2+C_L^2}}\cos^2\theta^*(1) && (17)\\
&= -0.99585965a\cos^2\theta^*(1) && (18)
\end{aligned}
$$