Appendix A

- The complete equations of the proposed longitudinal unsteady aerodynamic model are expressed as follows, where $\{a_j, b_j, c_j, d_j, e_j, f_j\}$, $j = 0,1,2,3,4$ are the unknown parameters to be estimated.

$$C_i(t) = C_{iatt}(\infty,\alpha) + C_{iq}(\infty,\alpha)\frac{\bar{c}\dot{\alpha}}{2V} + C_{idyn}(t,\alpha) \tag{1}$$

$$C_{idyn}(t,\alpha) = C_{idyn}^{W}(t,\alpha) + C_{idyn}^{T}(t,\alpha_t) \tag{2}$$

$$\alpha_t = \alpha - \alpha_d - \varepsilon(t,\alpha) \tag{3}$$

$$\tau_\varepsilon(\alpha)\dot{\varepsilon}(t,\alpha) + \varepsilon(t,\alpha) = \varepsilon(\infty,\alpha) \tag{4}$$

$$\tau_W(\alpha)\dot{C}_{idyn}^{W}(t,\alpha) + C_{idyn}^{W}(t,\alpha) = C_{idyn}^{W}(\infty,\alpha) \tag{5}$$

$$C_{ist}(\alpha) = C_{iatt}(\infty,\alpha) + C_{idyn}^{W}(\infty,\alpha) + C_{idyn}^{T}(\infty,\alpha_{t_\infty}) \tag{6}$$

$$\alpha_{t_\infty} = \alpha - \alpha_d - \varepsilon(\infty,\alpha) \tag{7}$$

$$C_{iatt}(\infty,\alpha) = a_0 + a_1\alpha + a_2\alpha^2 + a_3\alpha^3 + a_4\alpha^4 \tag{8}$$

$$C_{iq}(\infty,\alpha) = b_0 + b_1\alpha + b_2\alpha^2 + b_3\alpha^3 + b_4\alpha^4 \tag{9}$$

$$C_{idyn}^{T}(t,\alpha_t) = c_0 + c_1\alpha_t + c_2\alpha_t^{\,2} + c_3\alpha_t^{\,3} + c_4\alpha_t^{\,4} \tag{10}$$

$$C_{idyn}^{T}(\infty,\alpha_{t_\infty}) = c_0 + c_1\alpha_{t_\infty} + c_2\alpha_{t_\infty}^{\,2} + c_3\alpha_{t_\infty}^{\,3} + c_4\alpha_{t_\infty}^{\,4} \tag{11}$$

$$\tau_W(\alpha) = d_0 + d_1\alpha + d_2\alpha^2 + d_3\alpha^3 + d_4\alpha^4 \tag{12}$$

$$\tau_\varepsilon(\alpha) = e_0 + e_1\alpha + e_2\alpha^2 + e_3\alpha^3 + e_4\alpha^4 \tag{13}$$

$$\varepsilon(\infty,\alpha) = f_0 + f_1\alpha + f_2\alpha^2 + f_3\alpha^3 + f_4\alpha^4 \tag{14}$$

Appendix B

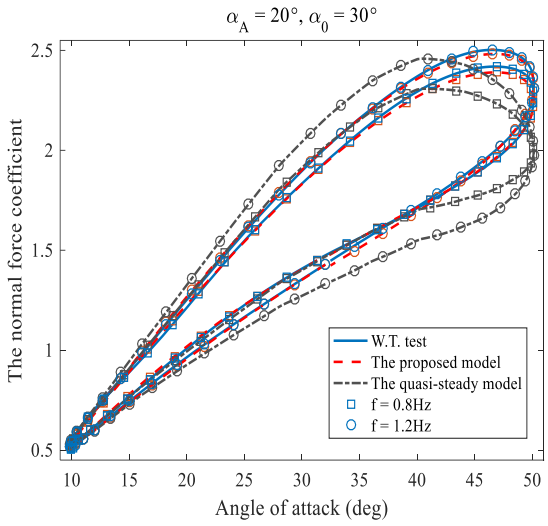
- Large amplitude pitching forced oscillation tests for model identification

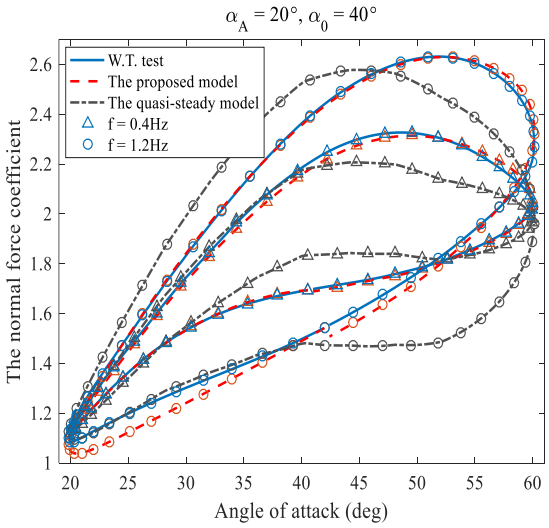
Data Group	α_A (deg)	α_0 (deg)	f (Hz)	R^2 (The proposed model)		R^2 (The quasi-steady model)	
				C_N	C_m	C_N	C_m
Model Identification	20	30	0.8	0.9994	0.9778	0.9703	0.9079
			1.2	0.9997	0.9631	0.9449	0.8845
		40	0.4	0.9984	0.9837	0.9643	0.9549
			1.2	0.9954	0.9810	0.8637	0.8762
		50	0.4	0.9962	0.9957	0.9014	0.9264
			0.8	0.9985	0.9949	0.8411	0.8588
	40	40	0.4	0.9994	0.9964	0.9856	0.9760
			0.6	0.9994	0.9982	0.9711	0.9638
			0.8	0.9994	0.9954	0.9527	0.9388
	50	50	0.2	0.9966	0.9981	0.9907	0.9924
			0.4	0.9987	0.9993	0.9840	0.9906
			0.6	0.9993	0.9994	0.9671	0.9820

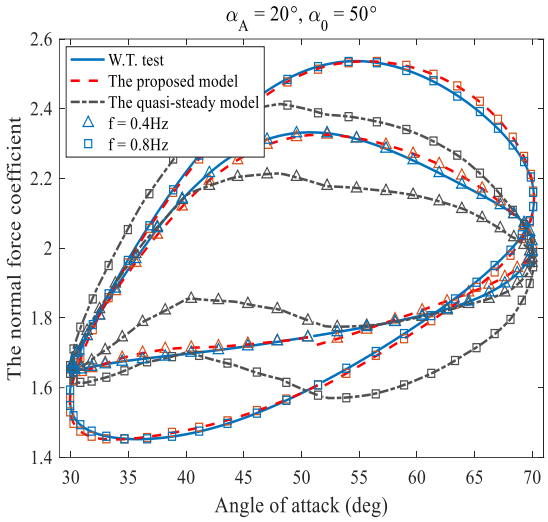
- Large amplitude pitching forced oscillation tests for model verification

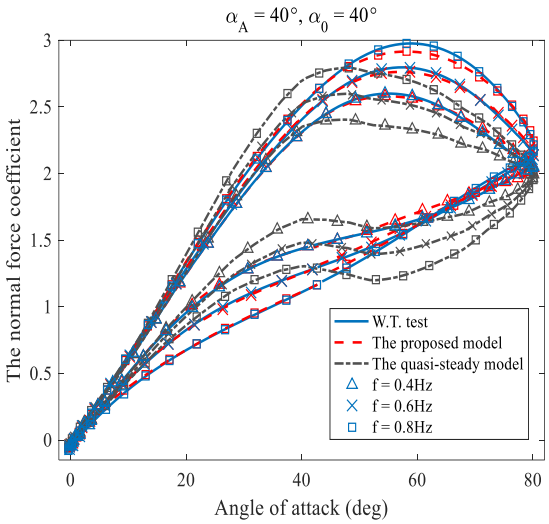
Data Group	α_A (deg)	α_0 (deg)	f (Hz)	R^2 (The proposed model)		R^2 (The quasi-steady model)	
				C_N	C_m	C_N	C_m
Model Verification	20	30	0.4	0.9995	0.9590	0.9928	0.9207
		40	0.8	0.9987	0.9900	0.9181	0.8715
		50	1.2	0.9869	0.9912	0.7720	0.8299
	40	40	0.2	0.9990	0.9891	0.9947	0.9820
	50	50	0.8	0.9990	0.9947	0.9454	0.9662
	45	45	0.2	0.9976	0.9892	0.9932	0.9897
			0.4	0.9989	0.9918	0.9870	0.9859
			0.6	0.9993	0.9949	0.9717	0.9757
			0.8	0.9992	0.9952	0.9537	0.9531

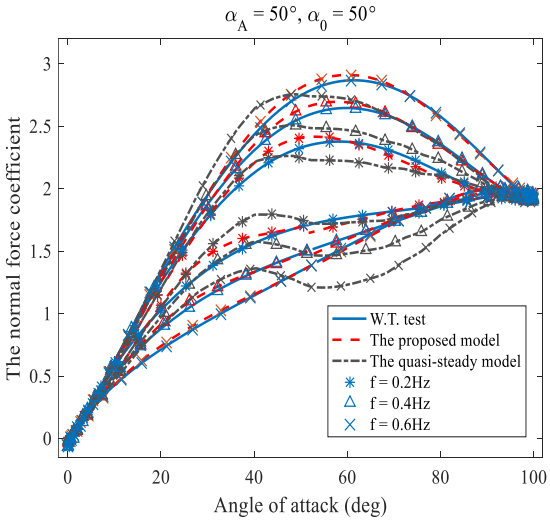
- The results of model identification for the normal force coefficient.



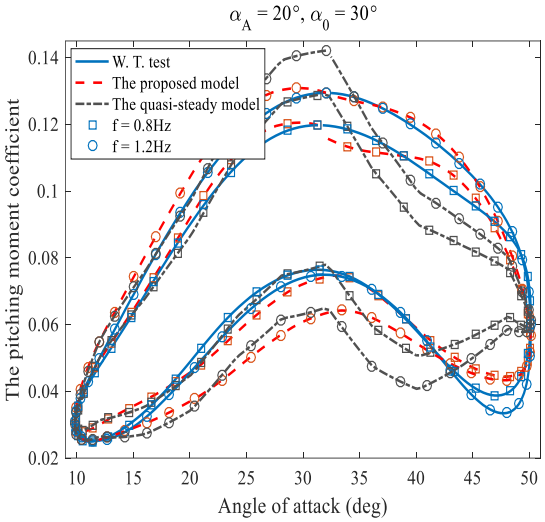


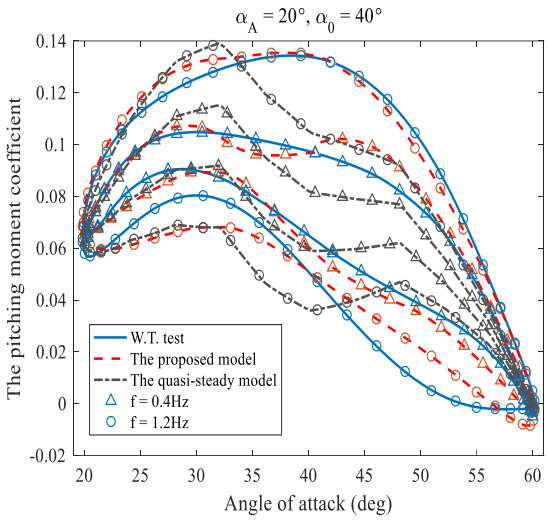


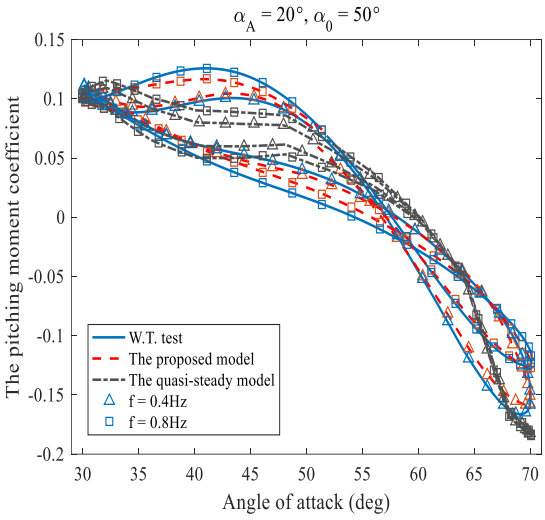


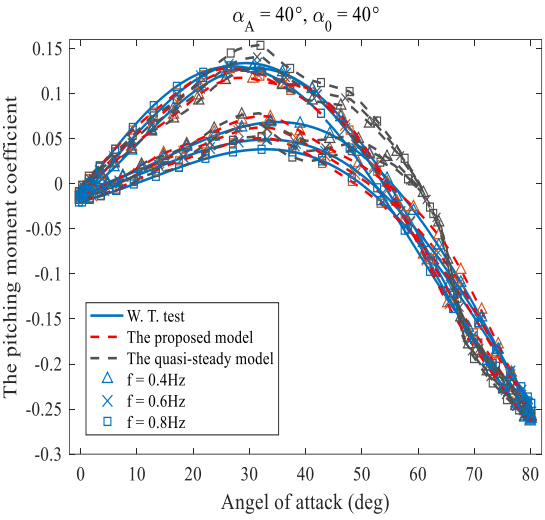


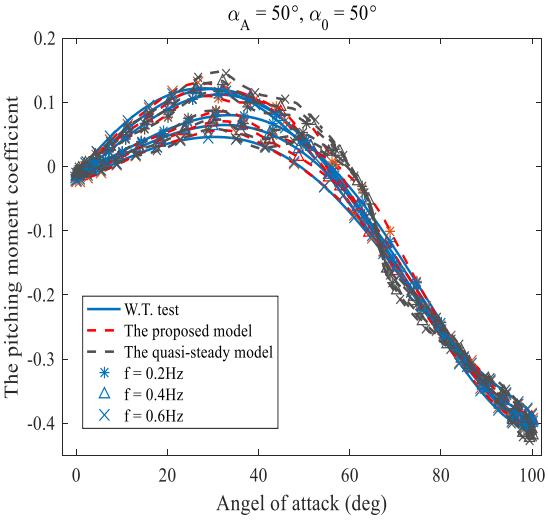
- The results of model identification for the pitching moment coefficient.



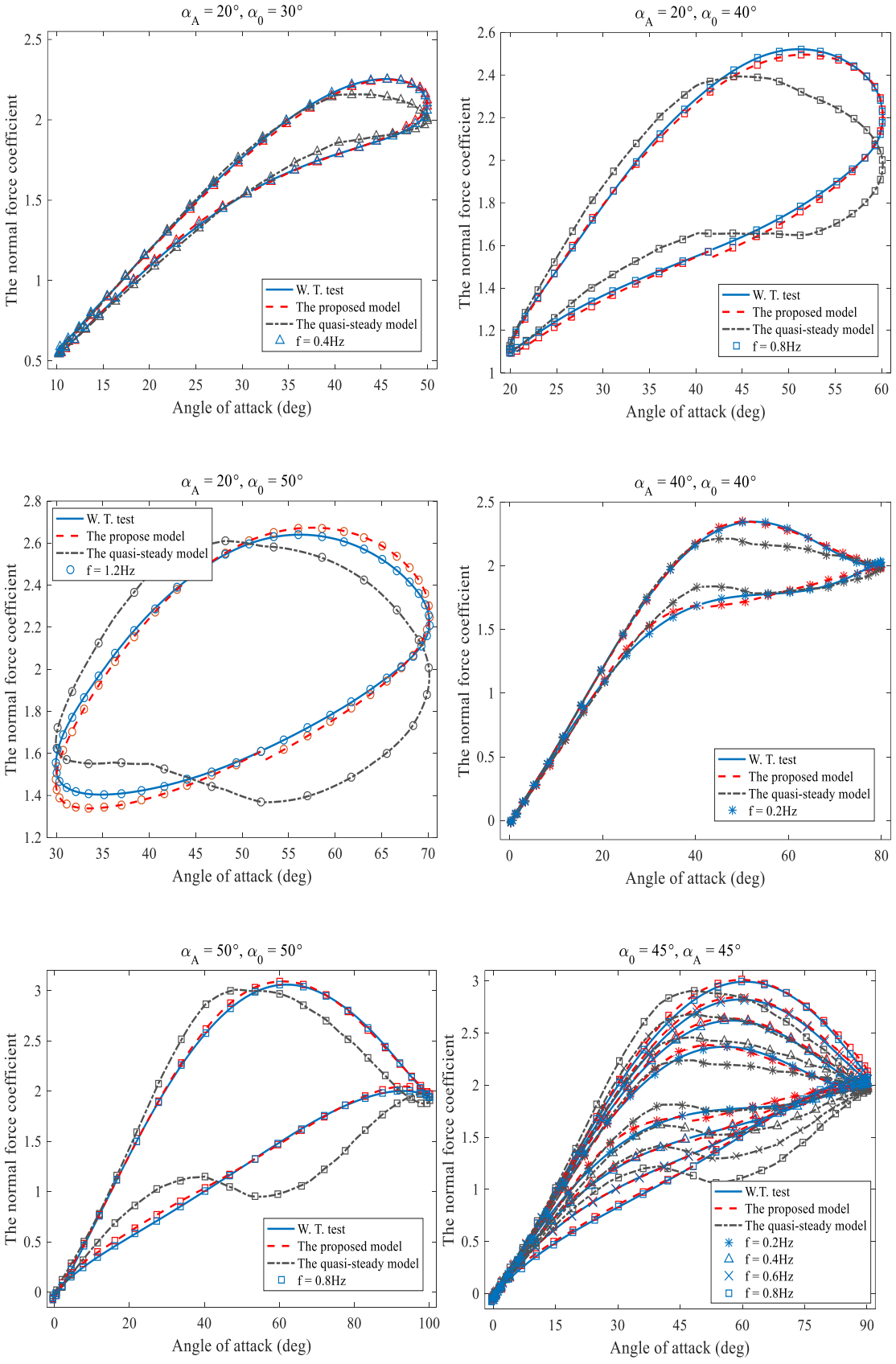








- The results of model verification for the normal force coefficient.



- The results of model verification for the pitching moment coefficient.