

Test case 3a.10: Pure yaw



Conditions

- Captive pure yaw motion in still water
- Fixed (heave=5.855mm & pitch=-0.136°)
- Without rudders
- With bilge keels

Pre scribed PMM motions:

- Sway motion: $\eta_{PMM} = -2S_{mm} \sin\left(\frac{2\pi N}{60}t\right)$
- Sway velocity: $v_{PMM} = -2\left(\frac{2\pi N}{60}\right)S_{mm} \cos\left(\frac{2\pi N}{60}t\right)$
- Sway acceleration: $\dot{v}_{PMM} = 2\left(\frac{2\pi N}{60}\right)^2 S_{mm} \sin\left(\frac{2\pi N}{60}t\right)$
- Heading angle: $\psi = -\psi_0 \cos\left(\frac{2\pi N}{60}t\right)$
- Yaw rate: $r = r_{PMM} = \psi_0 \left(\frac{2\pi N}{60}\right) \sin\left(\frac{2\pi N}{60}t\right)$
- Yaw acceleration: $\dot{r} = \dot{r}_{PMM} = \psi_0 \left(\frac{2\pi N}{60}\right)^2 \cos\left(\frac{2\pi N}{60}t\right)$

F_n [-]	R_n [-]	U_C [m/s]	N [rpm]	S_{mm} [m]	ψ_0 [deg]	r'_{\max} [-]
0.280	4.643×10^6	1.531	8.0210	0.1636	10.2	0.30

Items and Remarks

Figure Number	Items	Remarks
Fig. 3a.10-1	Axial velocity contours and cross flow vectors ($x/L_{PP}=0.135$)	4 PMM phases; 0°, 45°, 90°, 135° To be compared with experiment results pdf
Fig. 3a.10-2	Transverse velocity contours ($x/L_{PP}=0.135$)	
Fig. 3a.10-3	Vertical velocity contours ($x/L_{PP}=0.135$)	
Fig. 3a.10-4	Turbulent kinetic energy contours ($x/L_{PP}=0.135$)	
Fig. 3a.10-5	Axial vorticity contours ($x/L_{PP}=0.135$)	
Fig. 3a.10-6	Axial velocity contours and cross flow vectors ($x/L_{PP}=0.535$)	4 PMM phases; 0°, 45°, 90°, 135° To be compared with experiment results pdf
Fig. 3a.10-7	Transverse velocity contours ($x/L_{PP}=0.535$)	
Fig. 3a.10-8	Vertical velocity contours ($x/L_{PP}=0.535$)	
Fig. 3a.10-9	Turbulent kinetic energy contours ($x/L_{PP}=0.535$)	
Fig. 3a.10-10	Axial vorticity contours ($x/L_{PP}=0.535$)	
Fig. 3a.10-11	Axial velocity contours and cross flow vectors ($x/L_{PP}=0.935$)	4 PMM phases; 0°, 45°, 90°, 135° To be compared with experiment results pdf
Fig. 3a.10-12	Transverse velocity contours ($x/L_{PP}=0.935$)	
Fig. 3a.10-13	Vertical velocity contours ($x/L_{PP}=0.935$)	
Fig. 3a.10-14	Turbulent kinetic energy contours ($x/L_{PP}=0.935$)	
Fig. 3a.10-15	Axial vorticity contours ($x/L_{PP}=0.935$)	

- Coordinate system for comparison is ship-fixed at FP on the undisturbed waterplane (x positive downstream, y positive starboard side, z positive upward).

- $$F_n = \frac{U_C}{\sqrt{gL_{PP}}}, R_n = \frac{U_C \cdot L_{PP}}{\nu}$$

where, U_C is towing carriage speed, g is the gravitational acceleration and ν is the kinematic viscosity of water.

- All quantities are non-dimensionalized with water density (ρ), carriage speed (U_c), and the length between perpendiculars (L_{pp}).

$$U = \frac{\bar{U}}{U_c}, V = \frac{\bar{V}}{U_c}, W = \frac{\bar{W}}{U_c}, k = \frac{1}{2}(\overline{uu} + \overline{vv} + \overline{ww})$$

$$\text{where, } \overline{uu} = \frac{\overline{uu}}{U_c^2}, \overline{vv} = \frac{\overline{vv}}{U_c^2}, \overline{ww} = \frac{\overline{ww}}{U_c^2}$$