Test Case 1b.4:Pure Yaw

Conditions

- Captive pure yaw motion in still water
- Pitch and heave free; roll fixed
- With rudder
- With Propeller

Prescribed PMM motions:

- Sway motion : $\eta_{PMM} = -2S_{mm} \sin(2\pi\omega t)$
- Sway velocity : $v_{PMM} = -2(2\pi\omega) S_{mm} \cos(2\pi\omega t)$
- Sway acceleration : $\dot{v}_{PMM} = 2(2\pi\omega)^2 S_{mm} \sin(2\pi\omega t)$
- Heading angle : $\Psi = -\Psi_0 \cos(2\pi\omega t)$
- Yaw rate : $r_{PMM} = \Psi_0 (2\pi\omega) \sin(2\pi\omega t)$
- Yaw acceleration : $\dot{r}_{PMM} = \Psi_0 (2\pi\omega)^2 \cos(2\pi\omega t)$
- Non-dimensionalized yaw velocity : $r' = \max(r_{PMM}) * L_{pp}/U$

where $2S_{mm}$ is the sway amplitude [m] and Ψ_0 is the yaw motion amplitude [rad] ω is the frequency of PMM rotations [Hz].

F_n [-]	R_n [-]	L_{PP} [m]	U_c [m/s]	n [rps]	δ [deg]	$2S_{mm}$[m]	Ψ_0 [deg]	ω [Hz]	r' [-]
0.142	4.6×10^6	5.52	1.047	8.59	0.0	1.0	13.36	0.0389	0.30

Items and Remarks

Figure Number	Items	Remarks
Fig 1b.4-1	Time series of non-dimensionalized X-force (X')	To be compared with experimental results.
Fig 1b.4-2	Time series of non-dimensionalized Y-force (Y')	To be compared with experimental results.
Fig 1b.4-3	Time series of non-dimensionalized Y-aw-moment (N')	To be compared with experimental results.
Fig 1b.4-4	Time series of non-dimensionalized Thrust force (T'_x)	To be compared with experimental results.
Fig 1b.4-5	Time series of non-dimensionalized Rudder X-force (R'_x)	To be compared with experimental results.
Fig 1b.4-6	Time series of non-dimensionalized Rudder Y-force (R'_y)	To be compared with experimental results.

- Coordinate system for comparisons is fixed to midship on the undisturbed water plane. (see Figure 1)
- Froude number F_n and Reynolds number R_n are defined using towing carriage speed (U_c) and length between perpendiculars (L_{PP}):

$$F_n = \frac{U_c}{\sqrt{g \cdot L_{PP}}}, \quad R_n = \frac{U_c \cdot L_{PP}}{\nu}$$

  where g is the gravitational acceleration and ν is the kinematic viscosity.
- n is the propeller revolution rate [rps] and δ is rudder angle [deg].

- All CFD predicted force coefficients should be reported using the provided ship length L_{PP}, mean draft T_m and ship speed U. Force coefficients are defined as follows:

$$X' = \frac{X + M(\dot{u} - rv - X_G r^2 - Y_G \dot{r})}{\frac{1}{2}\rho U^2 L_{PP} T_m}, \quad Y' = \frac{Y + M(\dot{v} + ru - Y_G r^2 + X_G \dot{r})}{\frac{1}{2}\rho U^2 L_{PP} T_m}$$

$$N' = \frac{N + I_z \dot{r} + M(X_G(\dot{v} + ru) - Y_G(\dot{u} - rv))}{\frac{1}{2}\rho U^2 L_{PP}{}^2 T_m}$$

$$T'_x = \frac{T}{\frac{1}{2}\rho U^2 L_{PP} T_m}, \quad R'_x = \frac{X_R}{\frac{1}{2}\rho U^2 L_{PP} T_m}, \quad R'_y = \frac{Y_R}{\frac{1}{2}\rho U^2 L_{PP} T_m}$$

where M is mass of a ship and r is the yaw rate. N' is around the origin of the coordinates.

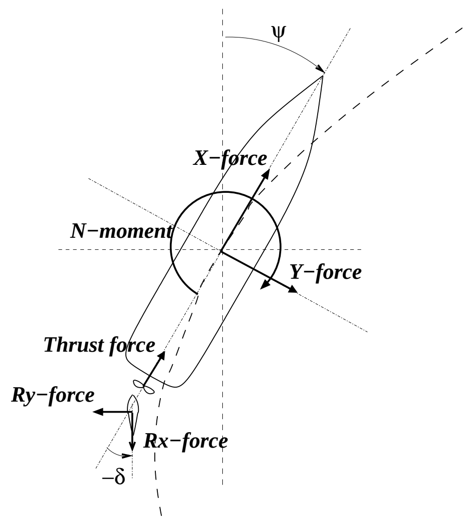

Figure 1: Coordinate system for hydrodynamic forces and moment for dynamic PMM