This Mathcad sheet will calculate the longitudinal (surge) force, lateral (sway) force and turning moment (yaw), based on Wang's paper. Below please input the ship particulars as required:

Length of Moored vessel (LBP), in feet:	$L \equiv 950$
Midship cross-sectional area of moored ship, in ft^2:	$A1 \equiv 3192$
Length of passing vessel (LBP), in feet:	$L_2 \equiv .5 \cdot L$
Midship cross-sectional area of passing ship, in ft^2:	$A2 \equiv 6413$
Water density, in slug/ft^3:	$\rho \equiv 1.9905$
Passing ship velocity (incl. current), in feet/second:	$U \equiv 11.2$
Separation distance (from centerline to centerline), in feet:	$SEP\_DIST \equiv .2 \cdot L$
Stagger distance (negative when passing ship behing moored ship), in feet:	$STA\_DIST \equiv 0 \cdot L$
Water depth, in feet	$D \equiv .1 \cdot L$

Results:

$SurgeForce = 1.016 \times 10^{-11}$ in lbf

$SwayForce = 7.644 \times 10^{4}$ in lbf

$YawMoment = 7.851 \times 10^{-9}$ in ft-lbf

Sectional area curves as functions of length, for both moored and passing ship (from Wang's paper):

$$S_1(x1) \equiv \left(1 - \frac{4 \cdot x1^2}{L^2}\right) \cdot A1 \qquad dS_1(x1) \equiv \frac{d}{dx1} S_1(x1) \qquad S_2(x2) \equiv \left(1 - \frac{4 \cdot x2^2}{L_2^{\,2}}\right) \cdot A2 \quad dS_2(x2) \equiv \frac{d}{dx2} S_2(x2)$$

$$F(x1, \xi, \eta) \equiv \int_{-\frac{L_2}{2}}^{\frac{L_2}{2}} \frac{dS_2(x2) \cdot (x2 - x1 + \xi)}{\left[(x2 - x1 + \xi)^2 + \eta^2\right]^{\frac{3}{2}}} \, dx2$$

$$G(x1, \xi, \eta) \equiv \int_{-\frac{L_2}{2}}^{\frac{L_2}{2}} \frac{dS_2(x2)}{\left[(x2 - x1 + \xi)^2 + \eta^2\right]^{\frac{3}{2}}} \, dx2$$

$$Wang\_Surge(\xi, \eta) \equiv \frac{\rho \cdot U^2}{2 \cdot \pi} \cdot \int_{-\frac{L}{2}}^{\frac{L}{2}} dS_1(x1) \cdot F(x1, \xi, \eta) \, dx1$$

surge force formulation for infinite depth

$$Wang\_Sway(\xi, \eta) \equiv \frac{\rho \cdot U^2 \cdot \eta}{\pi} \cdot \int_{-\frac{L}{2}}^{\frac{L}{2}} dS_1(x1) \cdot G(x1, \xi, \eta) \, dx1$$

sway force formulation for infinite depth

$$Wang\_Yaw(\xi, \eta) \equiv \frac{\rho \cdot U^2 \cdot \eta}{\pi} \cdot \int_{-\frac{L}{2}}^{\frac{L}{2}} \left[\left(dS_1(x1) \cdot x1 + S_1(x1)\right) \cdot G(x1, \xi, \eta)\right] dx1$$

yaw moment formulation for infinite depth

$$eta(\eta, h, n) \equiv \sqrt{\eta^2 + 4 \cdot n^2 \cdot h^2}$$

separation distance parameter as a function of finite depth

$$\text{Wang\_Surge\_Depth}(\xi,\eta,h) \equiv \sum_{n=-10}^{10} \text{Wang\_Surge}(\xi,\text{eta}(\eta,h,n))$$

surge force as a function of finite depth

$$\text{Wang\_Sway\_Depth}(\xi,\eta,h) \equiv \eta\cdot \sum_{n=-10}^{10} \frac{\text{Wang\_Sway}(\xi,\text{eta}(\eta,h,n))}{\text{eta}(\eta,h,n)}$$

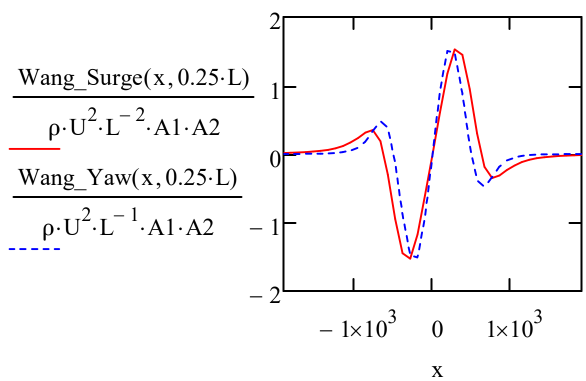
sway force as a function of finite depth

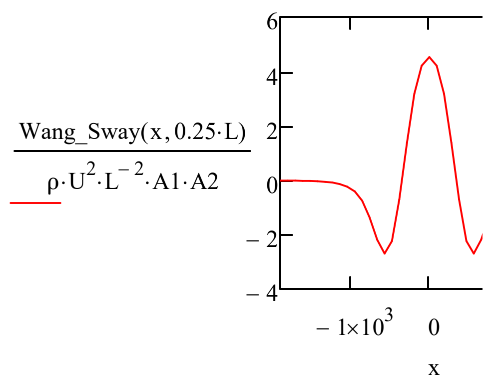
$$\text{Wang\_Yaw\_Depth}(\xi,\eta,h) \equiv \eta\cdot \sum_{n=-10}^{10} \frac{\text{Wang\_Yaw}(\xi,\text{eta}(\eta,h,n))}{\text{eta}(\eta,h,n)}$$

yaw moment as a function of finite depth

Plots of Surge, Sway and Yaw forces and moments for separation distance of 0.25xL for infinite water depth:

$x := -2\cdot L, -1.9\cdot L .. 2\cdot L$



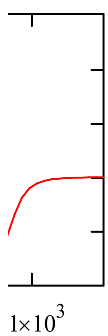


$$\frac{\text{Wang\_Sway}(0,0.25\cdot L)}{\rho\cdot U^{2}\cdot L^{-2}\cdot A1\cdot A2} = 4.534$$

$$\textit{SurgeForce} \equiv \text{Wang\_Surge\_Depth}(\text{STA\_DIST},\text{SEP\_DIST},D)$$

$$\textit{SwayForce} \equiv \text{Wang\_Sway\_Depth}(\text{STA\_DIST},\text{SEP\_DIST},D)$$

$$\textit{YawMoment} \equiv \text{Wang\_Yaw\_Depth}(\text{STA\_DIST},\text{SEP\_DIST},D)$$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