Videos of coupling between shallow water sloshing and horizontal vehicle motion

— details of parameters and input data —

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The videos are labelled `FluidVehicle`$\oplus$`.mpg` with $\oplus = 1, \ldots, 7$.

The initial conditions for videos 1,2,3,4,7 are

$$\begin{aligned} h(x,0) &= h_0\,, \\ u(x,0) &= A_2 \tfrac{\omega}{\alpha h_0} \left(\cos \alpha x - 1 + \tan \tfrac{1}{2}\alpha L \sin \alpha x\right)\,, \\ q(0) &= 0\,, \\ \dot{q}(0) &= \widehat{q}\omega = \tfrac{1}{\alpha h_0} A_2 \omega\,, \\ \ddot{q}(0) &= 0\,, \end{aligned}$$

where

$$\alpha = \frac{\omega}{\sqrt{g h_0}}\,.$$

Initial conditions for `FluidVehicle5.mpg` and `FluidVehicle6.mpg` are:

$$\begin{aligned} h(x,0) &= h_0\,, \\ u(x,0) &= 0\,, \\ q(0) &\neq 0\,, \\ \dot{q}(0) &= 0\,, \\ \ddot{q}(0) &= 0\,. \end{aligned}$$

Table 1: Input data for the coupling of shallow-water sloshing with horizontal vehicle motion videos. The fluid density $\rho = 1000\, kg/m^3$ and the gravitational constant is set at $g = 9.81\, m/s^2$.

Video	`... 1.mpg`	`... 2.mpg`	`... 3.mpg`
$L\ (m)$	0.525	0.525	0.525
$h_0\ (m)$	0.08	0.03	0.03
$\nu\ (kg/sec^2)$	110.0	290.0	290.0
$\Delta t\ (sec)$	0.01	0.01	0.01
$\Delta x\ (m)$	$\frac{0.525}{100}$	$\frac{0.525}{100}$	$\frac{0.525}{100}$
$\omega\ (rad/sec)$	1.2988 $= \omega_1^{coupled}$	2.5737 $= \omega_1^{coupled}$	6.6231 $= \omega_2^{coupled}$
R	0.50	0.40	0.40
G	0.2299 < 4.9348 $= \pi^2 R$	4.3110 > 3.9478 $= \pi^2 R$	4.3110 > 3.9478 $= \pi^2 R$
elapsed time (sec)	904.24	915.88	345.79
number of time steps	2500	2500	1000
$m_f\ (kg)$	42	15.75	15.75
$m_v\ (kg)$	21	6.30	6.30
$\omega_1^{coupled}$ (rad/sec)	1.2988	2.5737	2.5737
$\omega_1^f\ (rad/sec)$	5.3011	3.2462	3.2462
$\omega_1^v\ (rad/sec)$	2.2886	6.7846	6.7846
$\omega_1^{fv}\ (rad/sec)$	1.3213	3.6265	3.6265
$A_2\ (m)$	-0.01	0.005	-0.028
$q(0)\ (m)$	0	0	0

Table 2: Input data for the coupling of shallow-water sloshing with horizontal vehicle motion videos. The fluid density $\rho = 1000\, kg/m^3$ and the gravitational constant is set at $g = 9.81\, m/s^2$.

Video	FluidVehicle4.mpg	FluidVehicle7.mpg
$L\ (m)$	0.525	0.525
$h_0\ (m)$	0.03	0.05
$\nu\ (kg/sec^2)$	240.0	1500
$\Delta t\ (sec)$	0.01	0.01
$\Delta x\ (m)$	$\frac{0.525}{100}$	$\frac{0.525}{100}$
$\omega\ (rad/sec)$	2.4642 $= \omega_1^{coupled}$	3.6660 $= \omega_1^{coupled}$
R	0.40	0.60
G	3.5677 < 3.9478 $= \pi^2 R$	8.0275 > 5.9217 $= \pi^2 R$
elapsed time (sec)	434.77	742.8168
number of time steps	1200	2000
$m_f\ (kg)$	15.75	26.25
$m_v\ (kg)$	6.30	15.75
$\omega_1^{coupled}$ (rad/sec)	2.4642	3.6660
$\omega_1^f\ (rad/sec)$	3.2462	4.1909
$\omega_1^v\ (rad/sec)$	6.1721	9.7590
$\omega_1^{fv}\ (rad/sec)$	3.2991	5.9761
$A_2\ (m)$	0.007	-0.007
$q(0)\ (m)$	0	0

Table 3: Input data for the coupling of shallow-water sloshing with horizontal vehicle motion videos. The fluid density $\rho = 1000\, kg/m^3$ and the gravitational constant is set at $g = 9.81\, m/s^2$.

Video	FluidVehicle5.mpg	FluidVehicle6.mpg
$L\ (m)$	0.525	0.525
$h_0\ (m)$	0.03	0.03
$\nu\ (kg/sec^2)$	240.0	500
$\Delta t\ (sec)$	0.01	0.01
$\Delta x\ (m)$	$\frac{0.525}{100}$	$\frac{0.525}{100}$
R	0.40	0.40
G	3.5677	7.4328
elapsed time (sec)	728.1473	739.5327
number of time steps	2000	2000
$m_f\ (kg)$	15.75	15.75
$m_v\ (kg)$	6.30	6.30
$\omega_1^{coupled}$ (rad/sec)	2.4642	2.8287
$\omega_1^f\ (rad/sec)$	3.2462	3.2462
$\omega_1^v\ (rad/sec)$	6.1721	8.9087
$\omega_1^{fv}\ (rad/sec)$	3.2991	4.7619
$q(0)\ (m)$	-0.06	-0.06