Dynamic Positioning Committee
Marine Technology Society

Thrusters

Dynamics of Propeller Blade and Duct Loading on Ventilated Thrusters in Dynamic Positioning Mode

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(Presentation is not yet available)

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DYNAMIC POSITIONING CONFERENCE 2007

Dynamics of Propeller Blade and Duct Loadings on Ventilated Thrusters in Dynamic Positioning Mode

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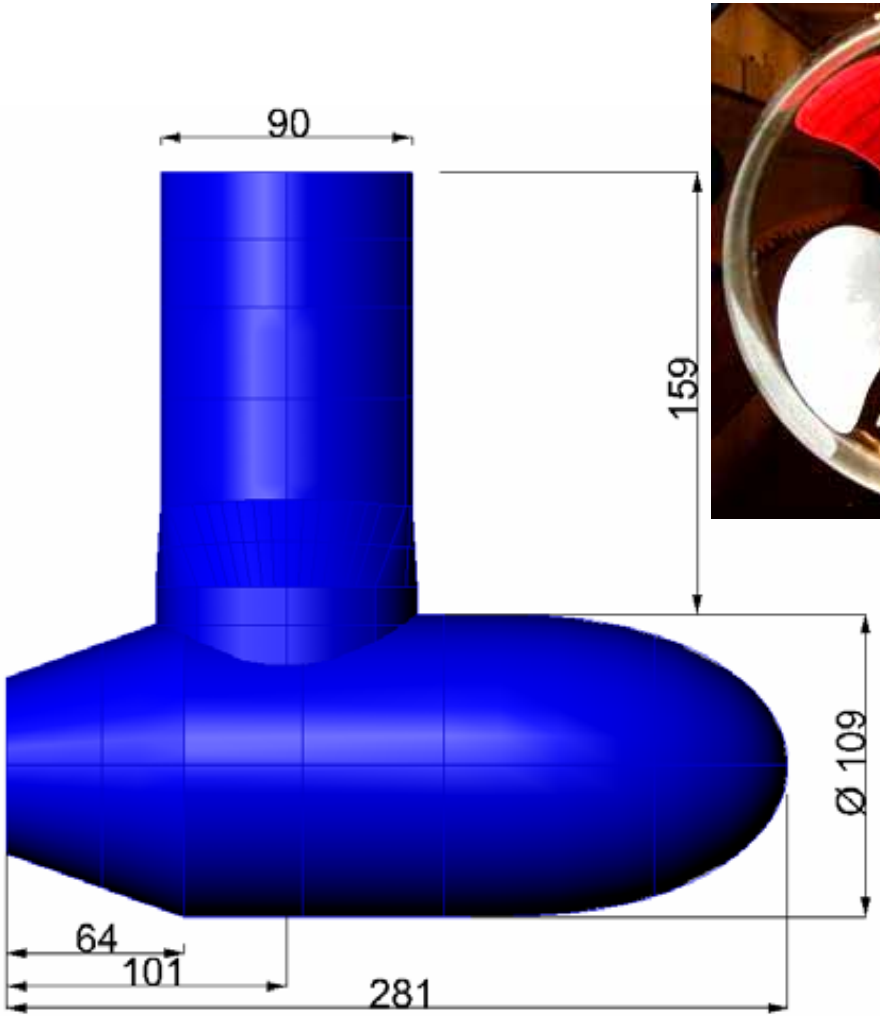
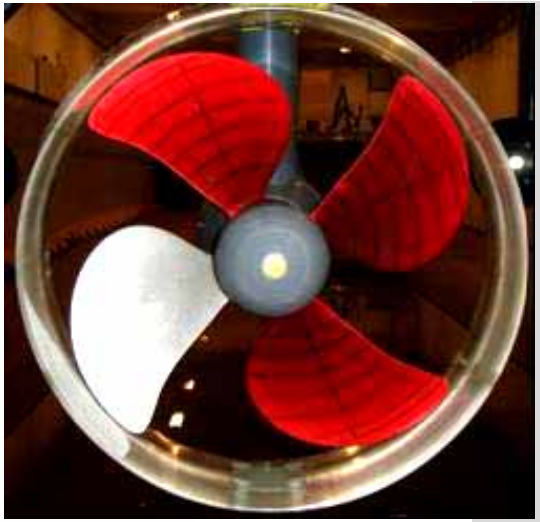
Propeller and thruster models

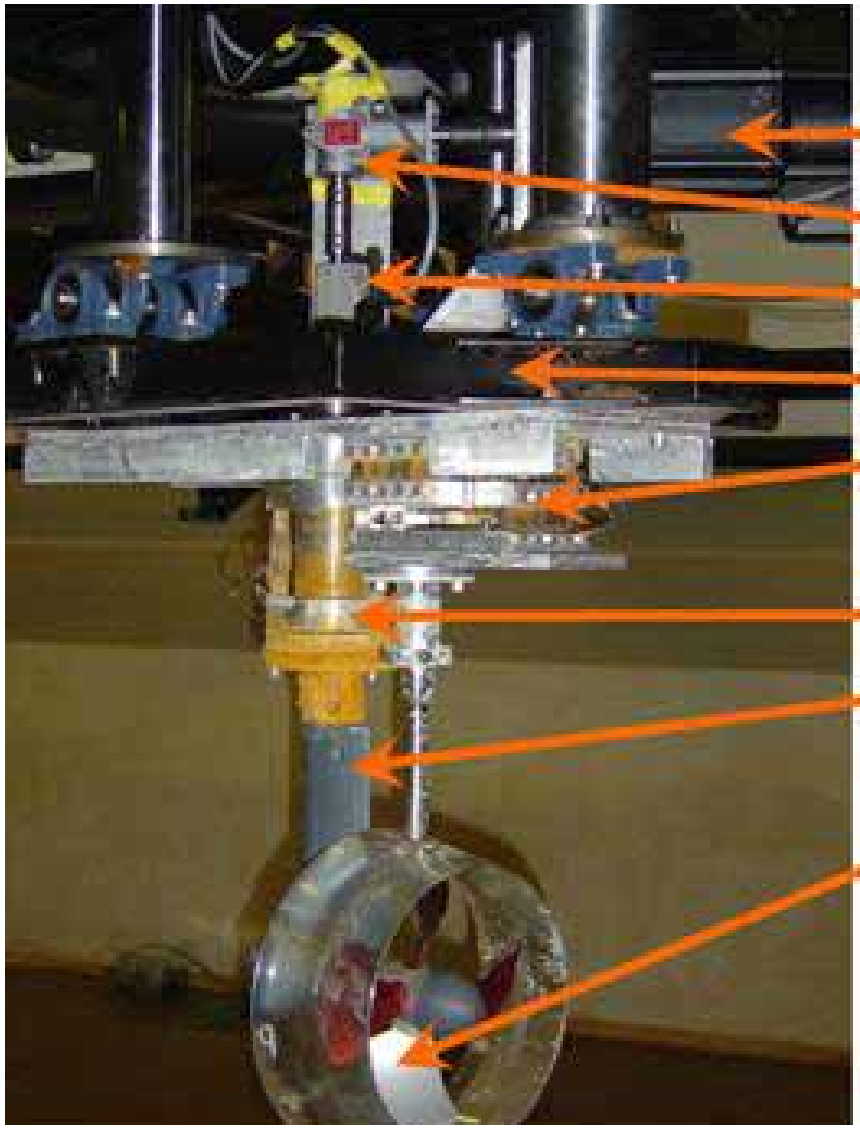




Open thruster

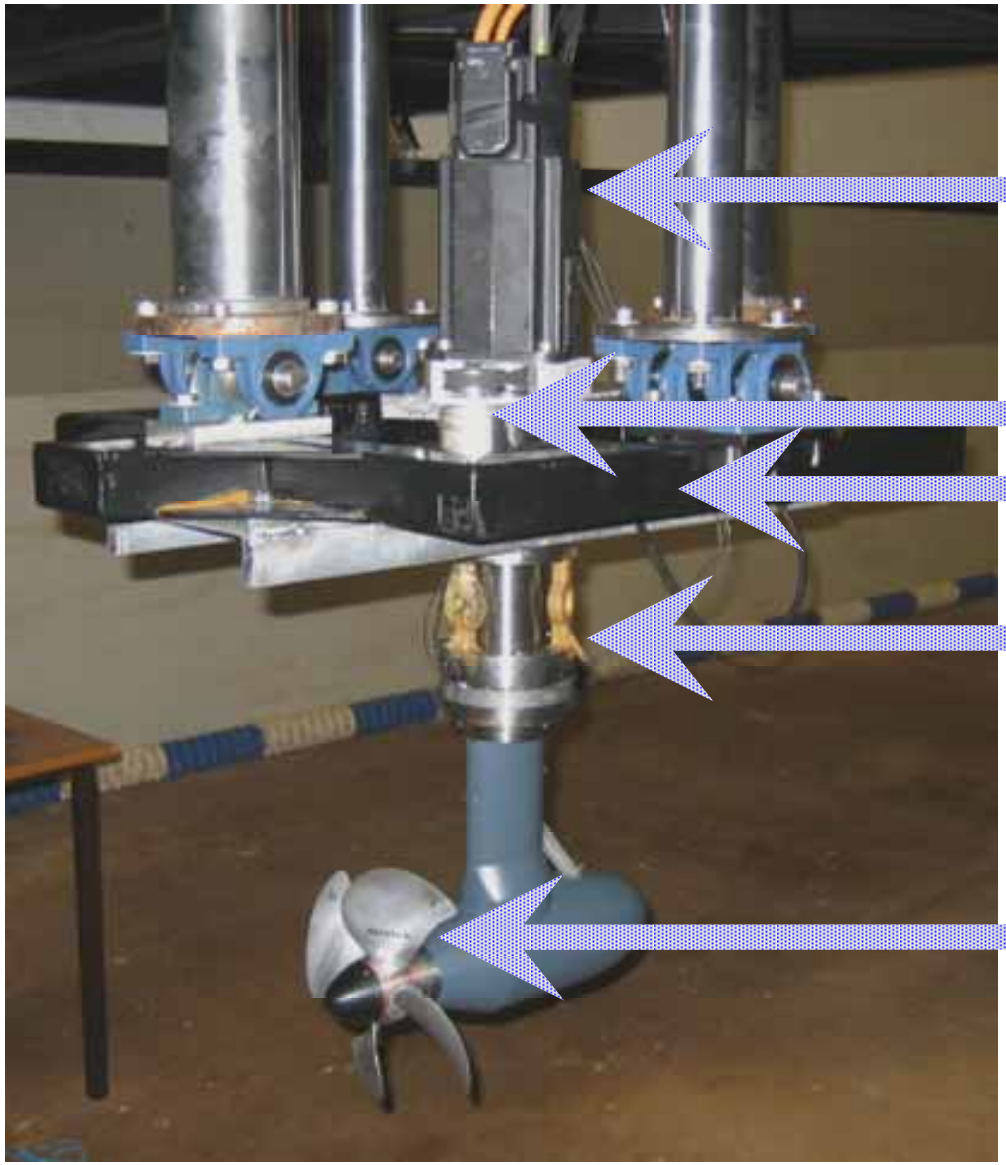
Ducted thruster

Test set-up for ducted thruster tests



- Electric motor
- Gear
- Torque-meter
- MClab-rig
- X & Y force transducer for duct
- Six component balance
- Thruster body including wireless transmission
- Blade attached to six component blade dynamometer

Test set-up for open thruster tests

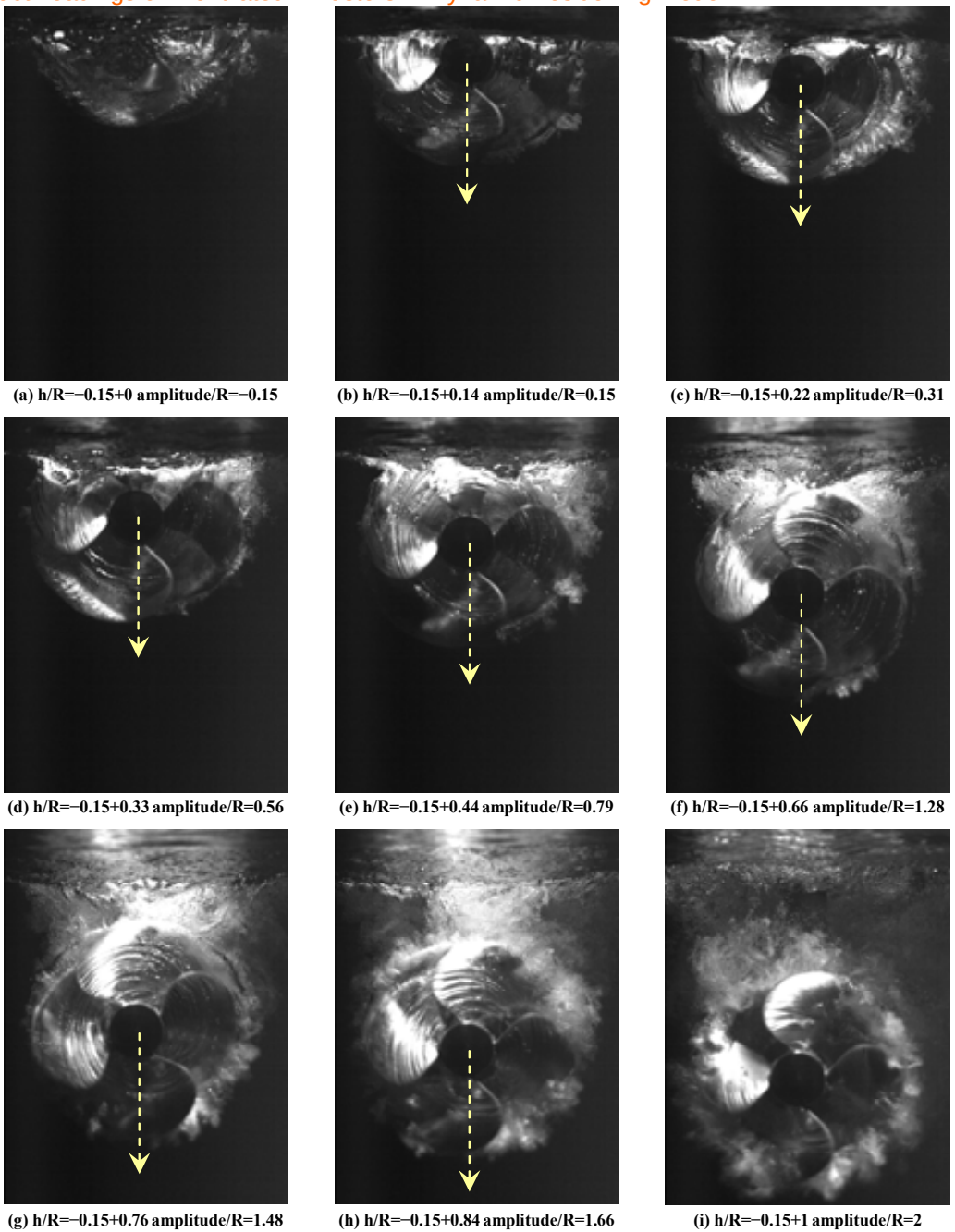


Tested parameters

- All tests
  - Different propeller rate of revolutions
  - Speed (negative, zero and positive)
- Constant immersion tests
  - Different immersion ratios
  - Different azimuth angles
- Dynamic azimuthing tests
  - Different immersion ratios
- Dynamic vertical motion tests
  - Different starting immersion ratios
  - Different amplitudes
  - Different periods

Open thruster; funnel centre on water surface h/R = 2.6 (constant immersion)

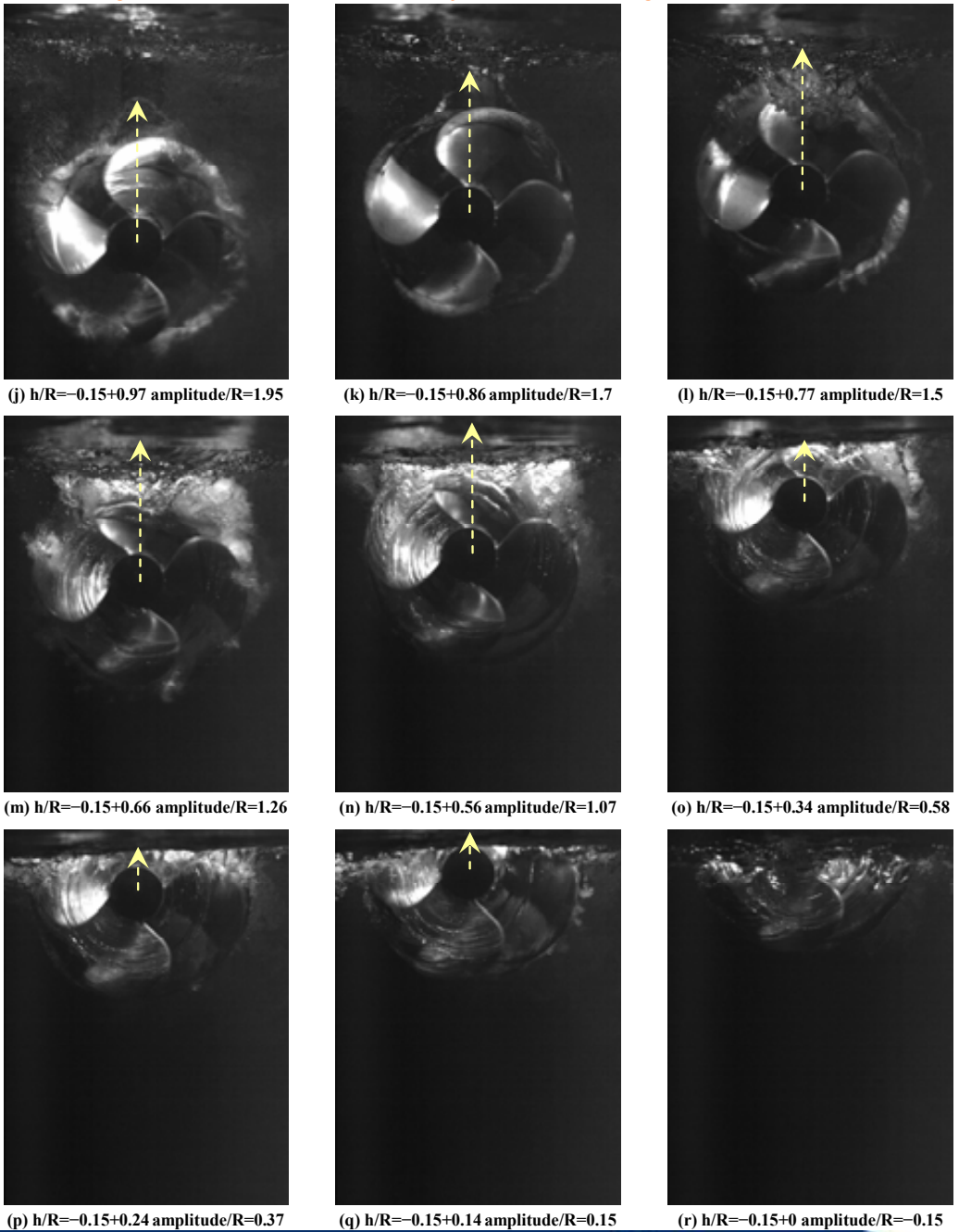
Open thruster; shaft immersion ratio at highest position h/R=−0.15, amplitude/R=2.15, period=2s



(a) h/R=−0.15+0 amplitude/R=−0.15
(b) h/R=−0.15+0.14 amplitude/R=0.15
(c) h/R=−0.15+0.22 amplitude/R=0.31
(d) h/R=−0.15+0.33 amplitude/R=0.56
(e) h/R=−0.15+0.44 amplitude/R=0.79
(f) h/R=−0.15+0.66 amplitude/R=1.28
(g) h/R=−0.15+0.76 amplitude/R=1.48
(h) h/R=−0.15+0.84 amplitude/R=1.66
(i) h/R=−0.15+1 amplitude/R=2

Continued…

Open thruster; shaft immersion ratio at highest position h/R=−0.15, amplitude/R=2.15, period=2s

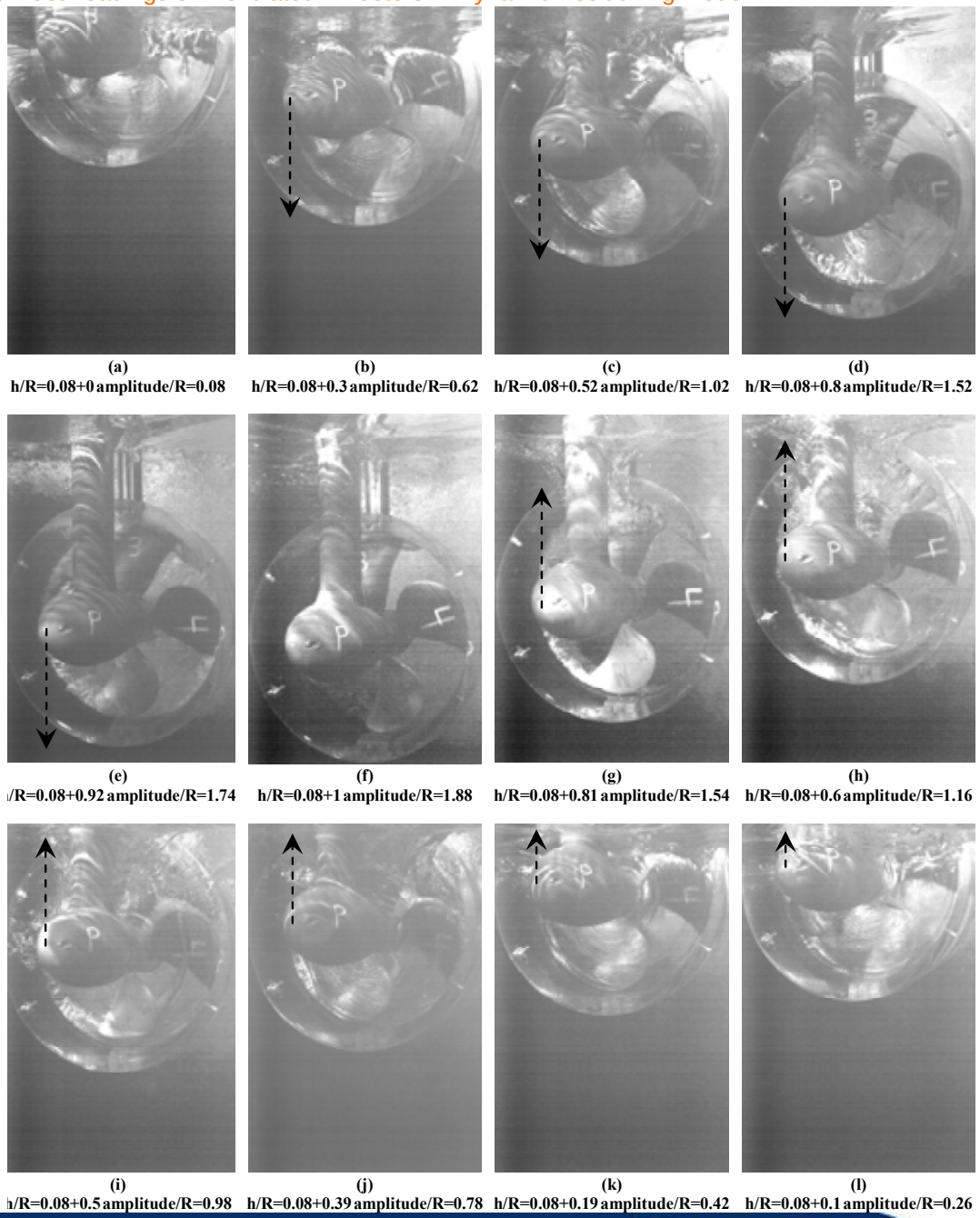


(j) h/R=−0.15+0.97 amplitude/R=1.95 (k) h/R=−0.15+0.86 amplitude/R=1.7 (l) h/R=−0.15+0.77 amplitude/R=1.5

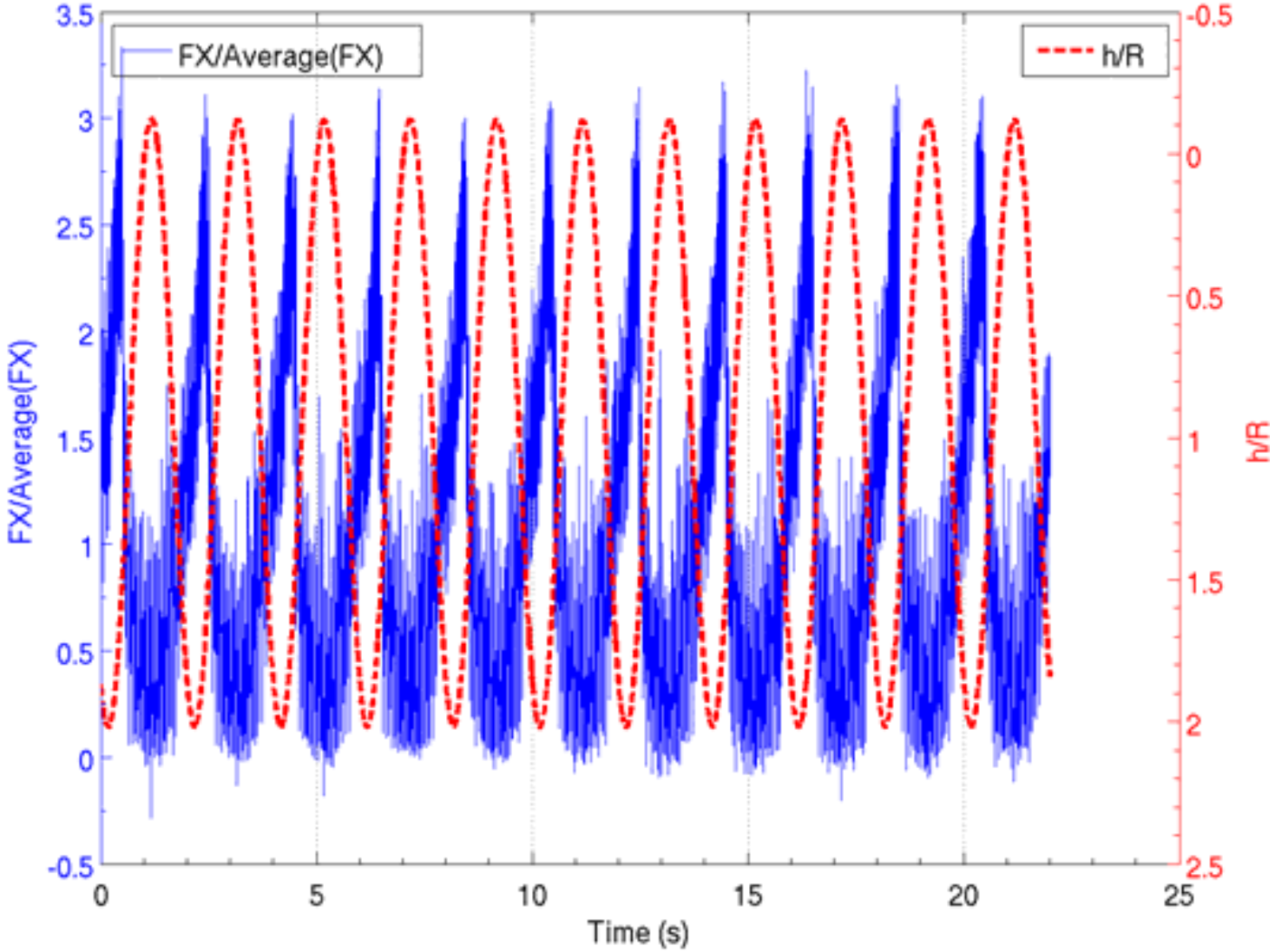
(m) h/R=−0.15+0.66 amplitude/R=1.26 (n) h/R=−0.15+0.56 amplitude/R=1.07 (o) h/R=−0.15+0.34 amplitude/R=0.58

(p) h/R=−0.15+0.24 amplitude/R=0.37 (q) h/R=−0.15+0.14 amplitude/R=0.15 (r) h/R=−0.15+0 amplitude/R=−0.15

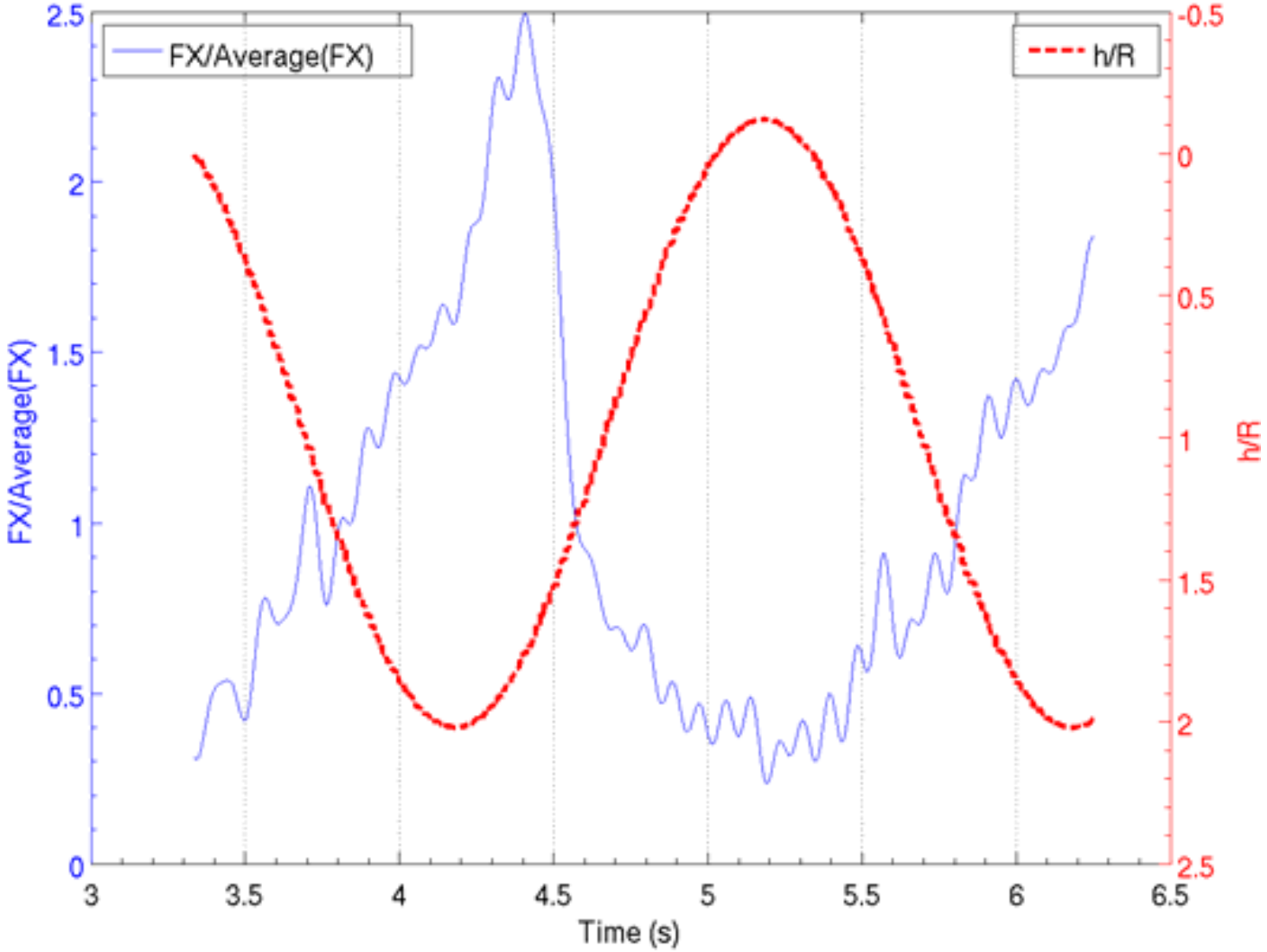
Ducted thruster; shaft immersion ratio at highest position h/R=−0.08, amplitude/R=1.8, period=4s



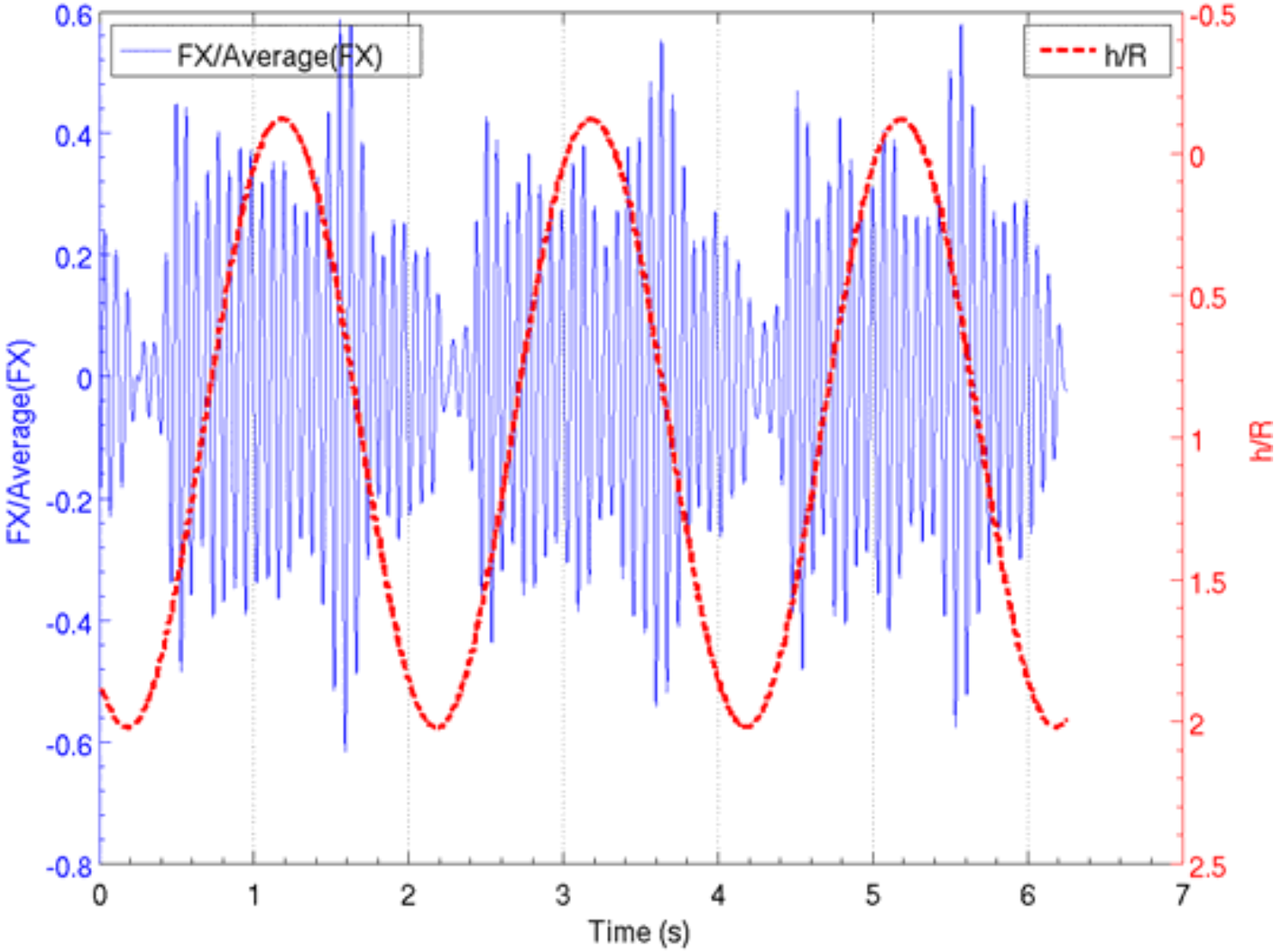
Open thruster; Relative blade thrust min. h/R=-0.15; amplitude/R=2.15; T=2 s



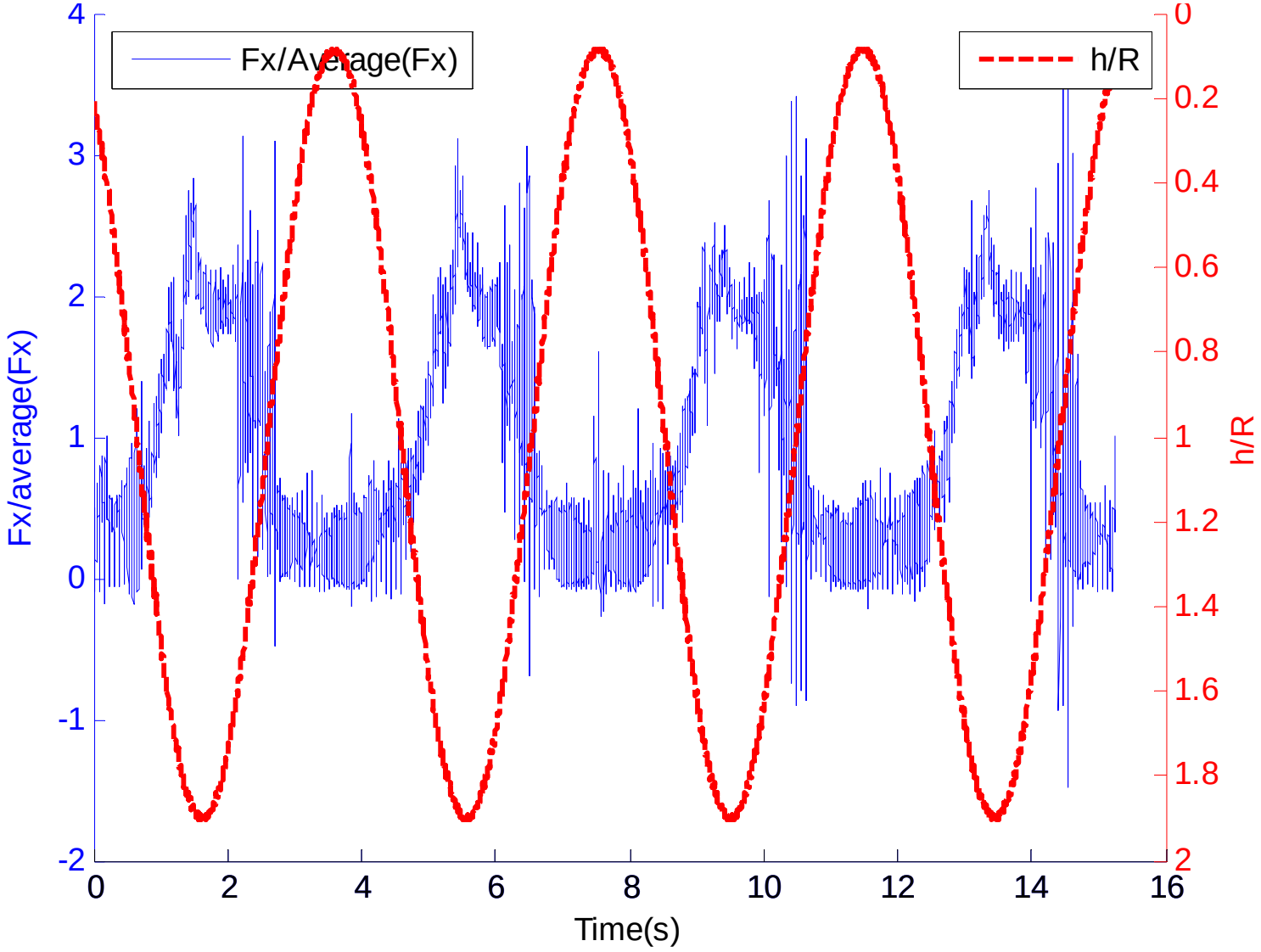
Open thruster; Low pass filtered blade thrust; min. h/R=-0.15; amplitude/R=2.15; T=2 s



Open thruster; Shaft freq. fluctuations in blade thrust; min. h/R=-0.15; amplitude/R=2.15; T=2s



Ducted thruster; Relative blade thrust min. h/R=0.08; amplitude/R=1.8; T=4 s



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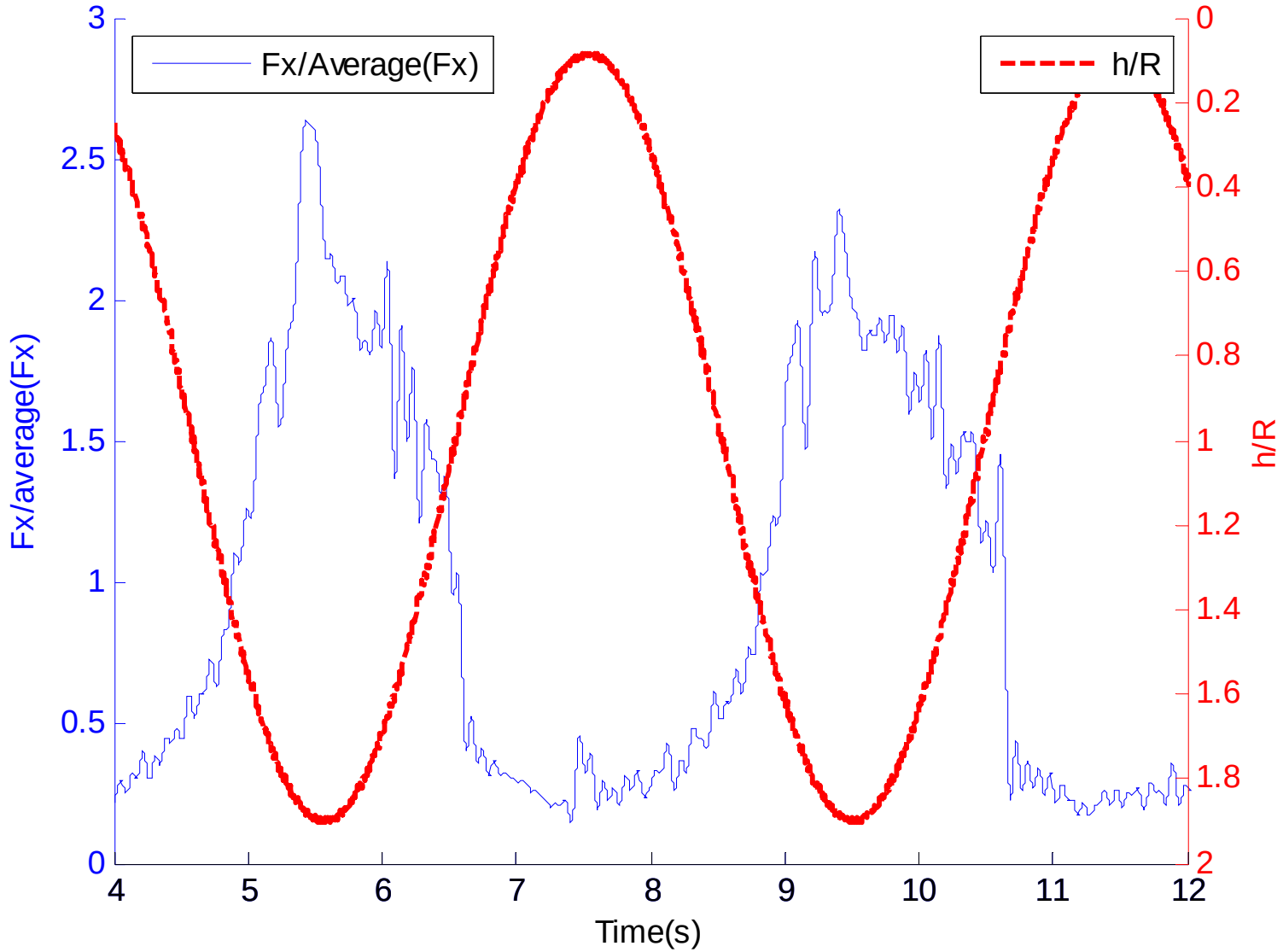
Ducted thruster; Low pass filtered blade thrust; min. h/R=0.08; amplitude/R=1.8; T=4 s



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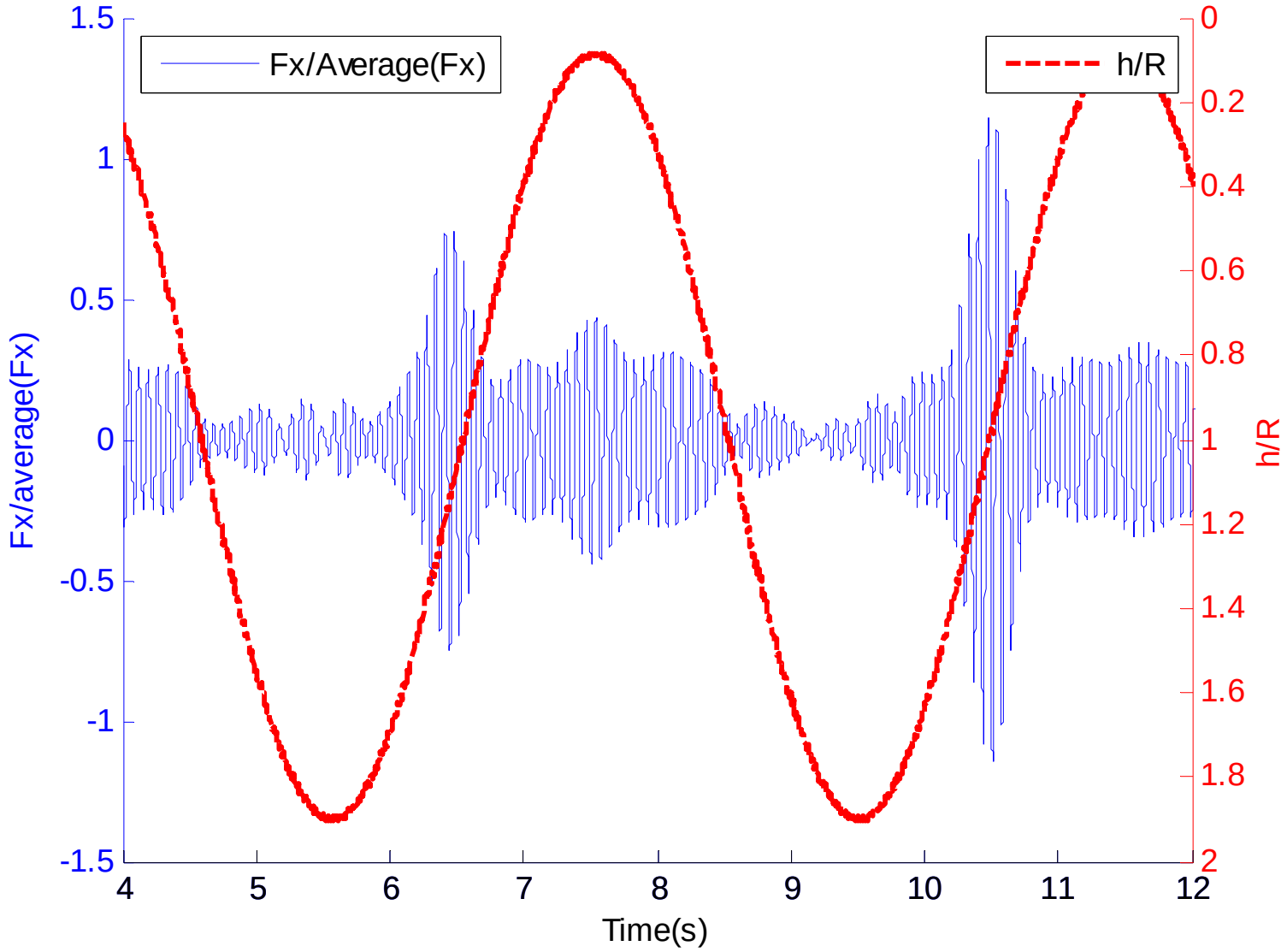
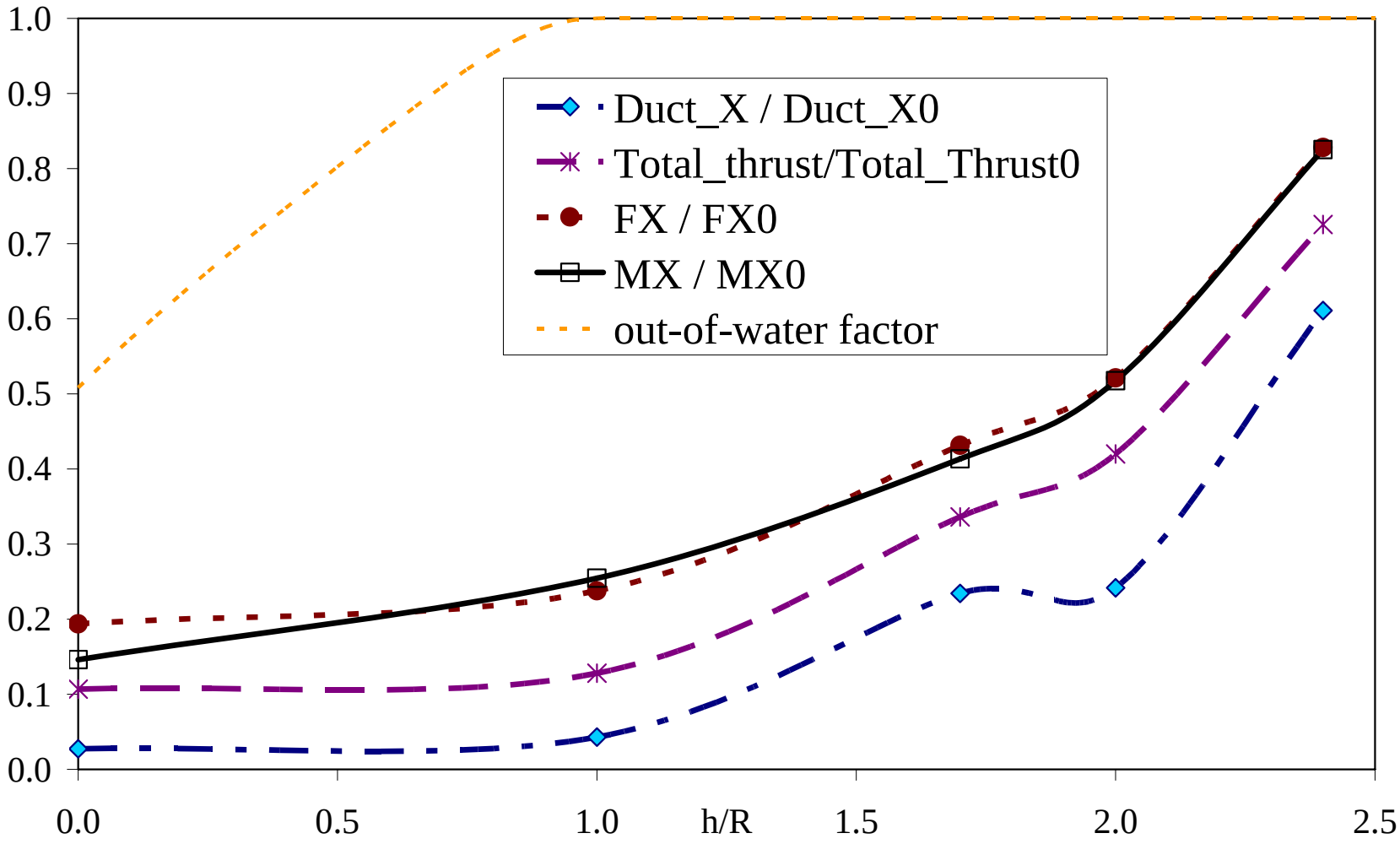
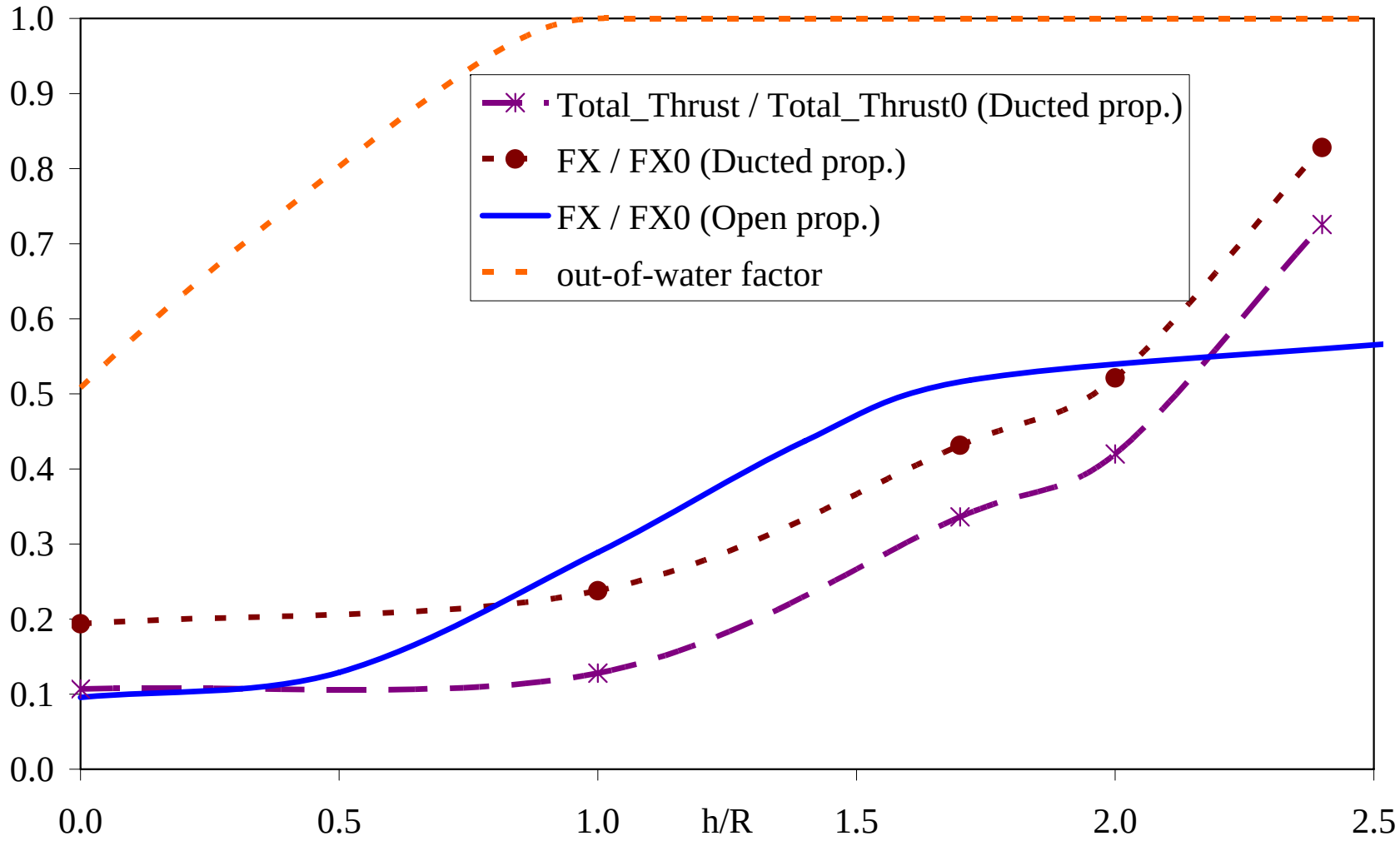
Ducted thruster; Shaft freq. fluctuations in blade thrust; min. h/R=0.08; amplitude/R=1.8; T=4 s



Time-averaged ducted thruster loadings under constant immersion



Comparison of time-averaged loadings of ducted & open thrusters under constant immersion



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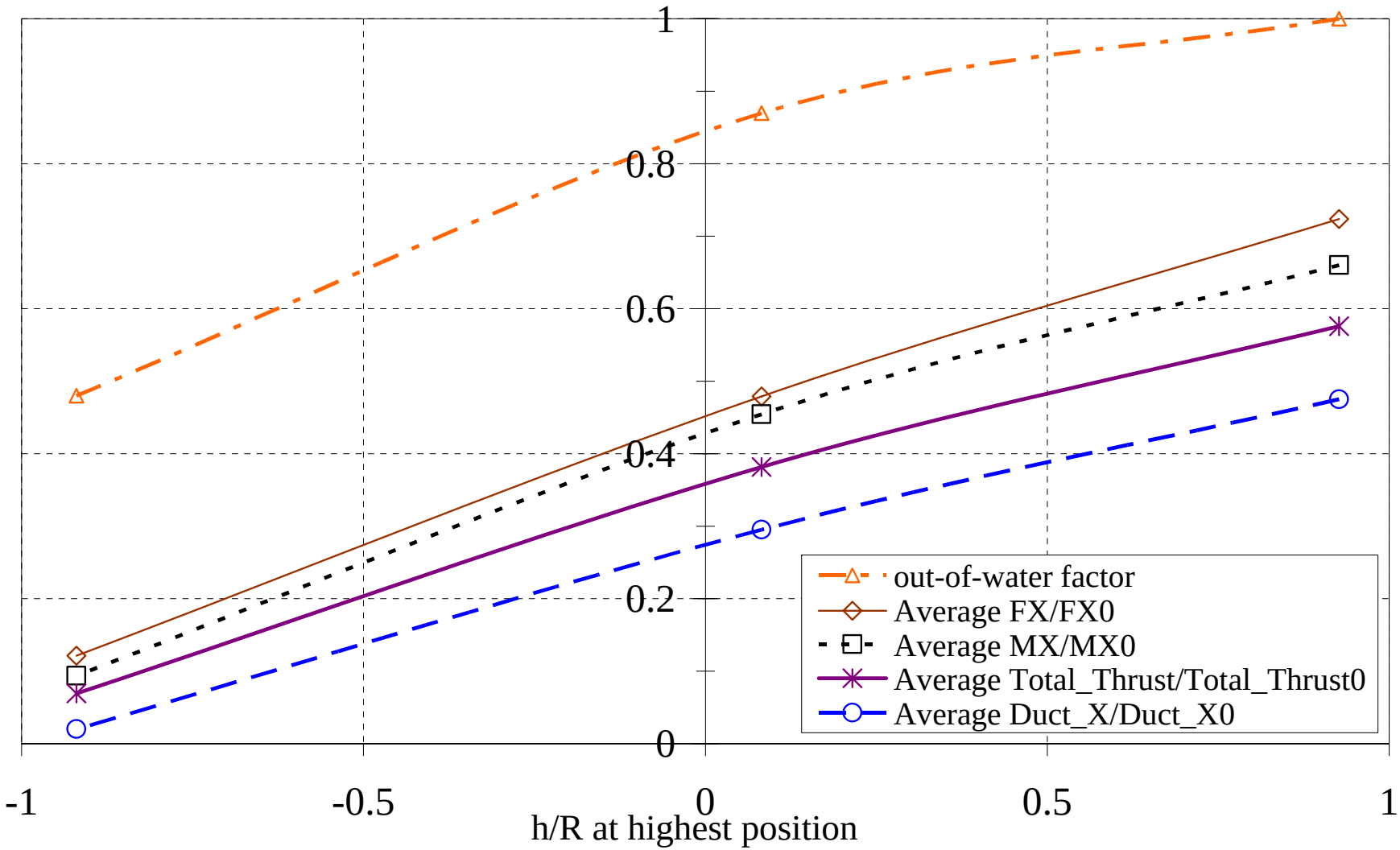
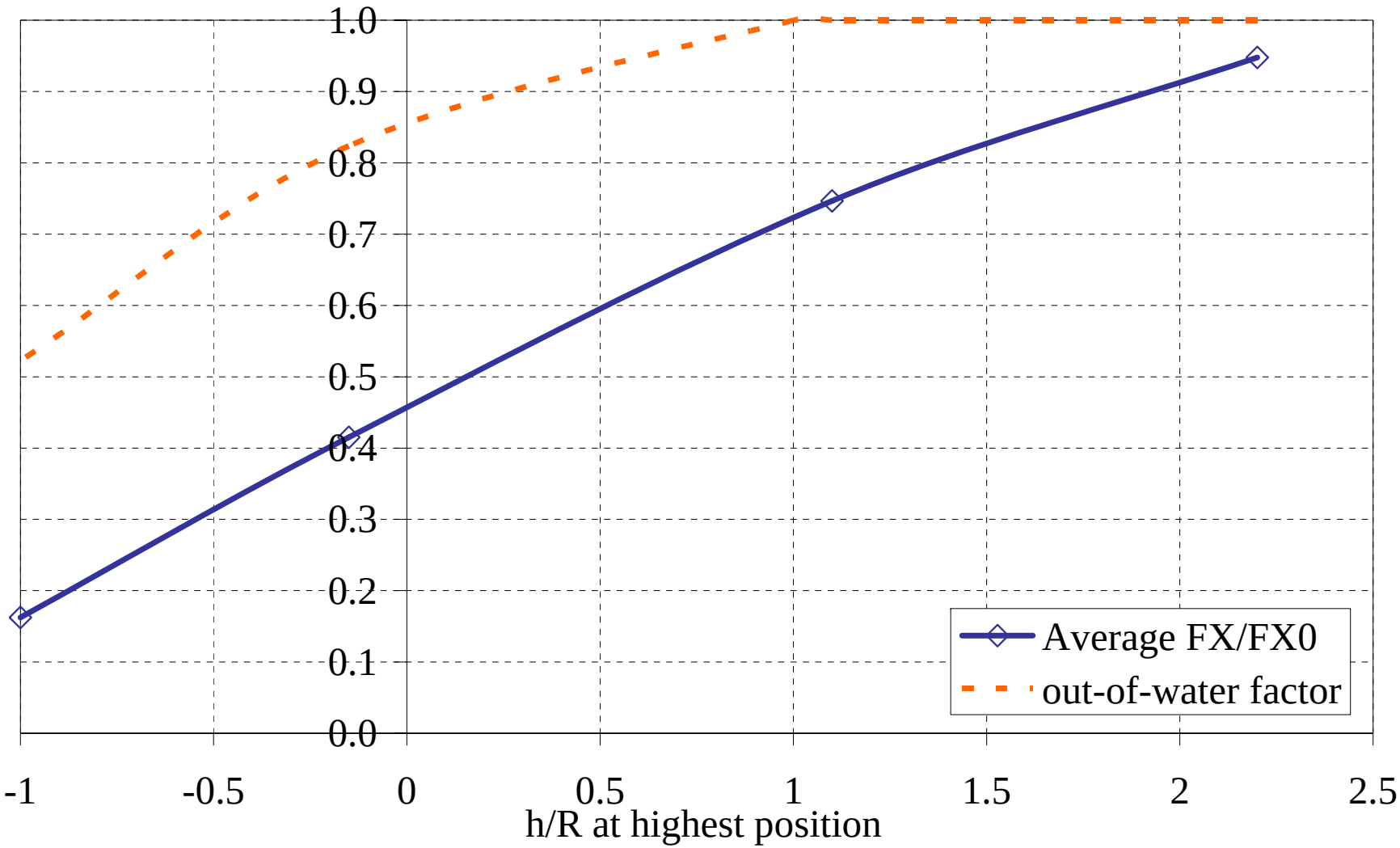
Time-averaged ducted thruster loadings under forced heave motion



Time-averaged relative blade thrust of open thruster under forced heave motion



Concluding remarks

- Fluctuations in blade thrust and blade torque are quite significant when a thruster is ventilated.
- Ventilation influences both the dynamic and static loadings.
- More ventilation leads to less available blade thrust, blade torque, duct thrust and consequently total thrust.
- Under ventilated conditions, fluctuations in blade torque are almost identical to fluctuations in blade thrust.
- Loading fluctuations due to ventilation must be taken into account at the design stage.