Previous sailing yachts seakeeping investigation in view of a new set of rules

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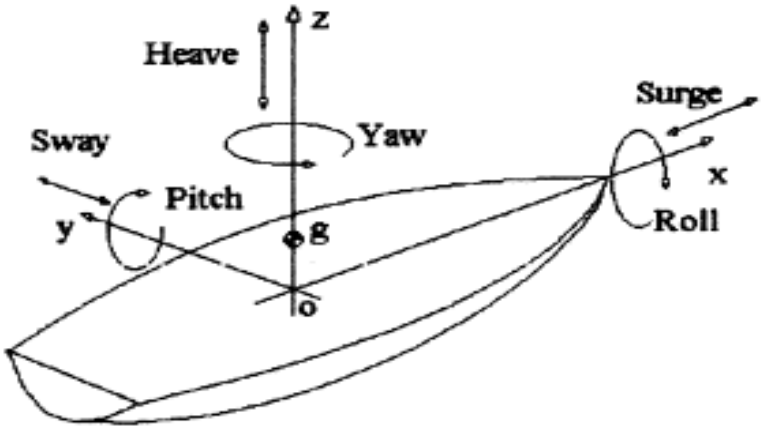
Introduction - Objectives

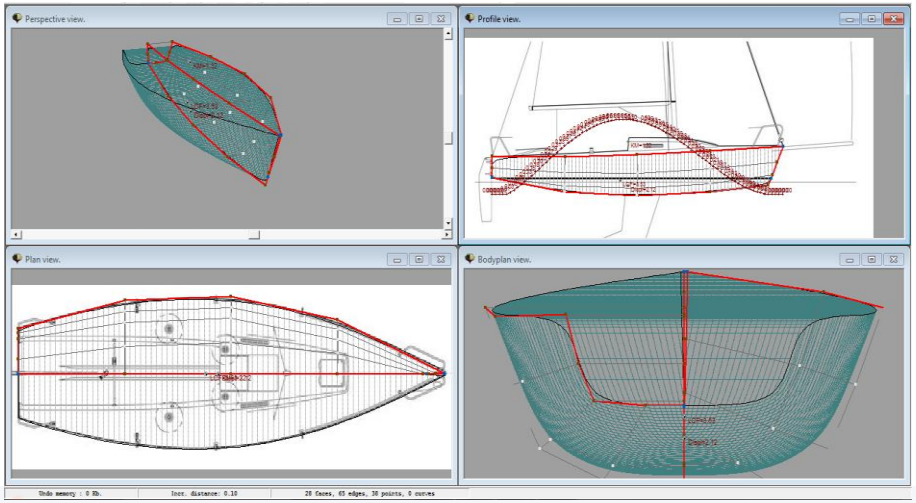


- Yacht dismasting investigation
- Seakeeping => inertial loads
- Acceleration mainly due to pitch
- Hydrostar: potential seakeeping code in frequency domain (BV)
- Classification society => quick method
- Key parameters?

Introduction – Database

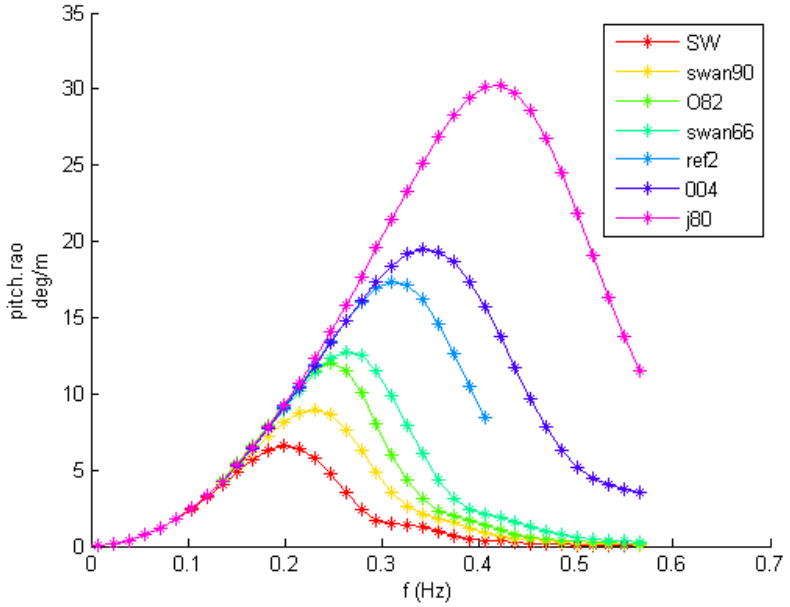
- 7 modern sailing boat hulls

name	LOA (m)	Lwl (m)	B (m)	T canoe (m)	Displacement (kg)	ballast mass (kg)	kyy (m)
SW	31.3	30.4	6.8	1.08	83856	18700	8.70
swan 90	26.8	24.9	6.6	0.95	56726	18400	7.08
oyster 82	24.8	20.9	6.3	1.29	61085	20243	6.33
swan 66	20.3	17.8	5.4	0.90	31030	9400	5.37
ref2	14.5	12.8	4.3	0.66	12877	4507	3.63
AME004	11.3	10.3	3.1	0.44	5381	1883	2.79
J80	8.0	7.0	2.5	0.34	1825	635	2.11



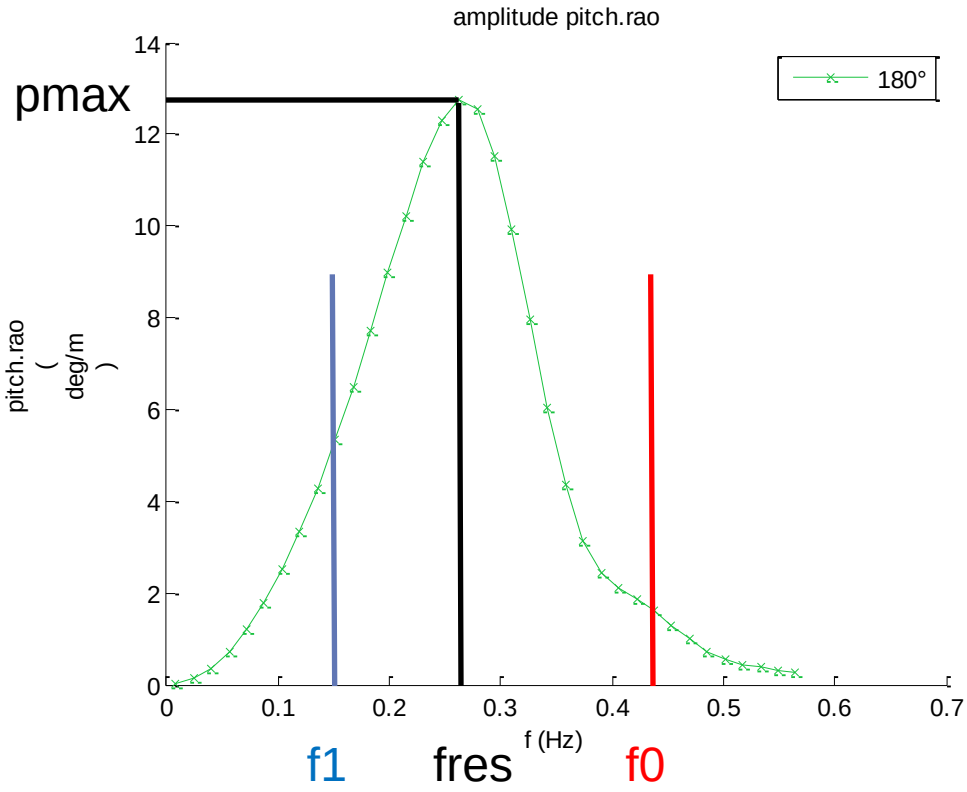
Method for quick pitch RAO estimation

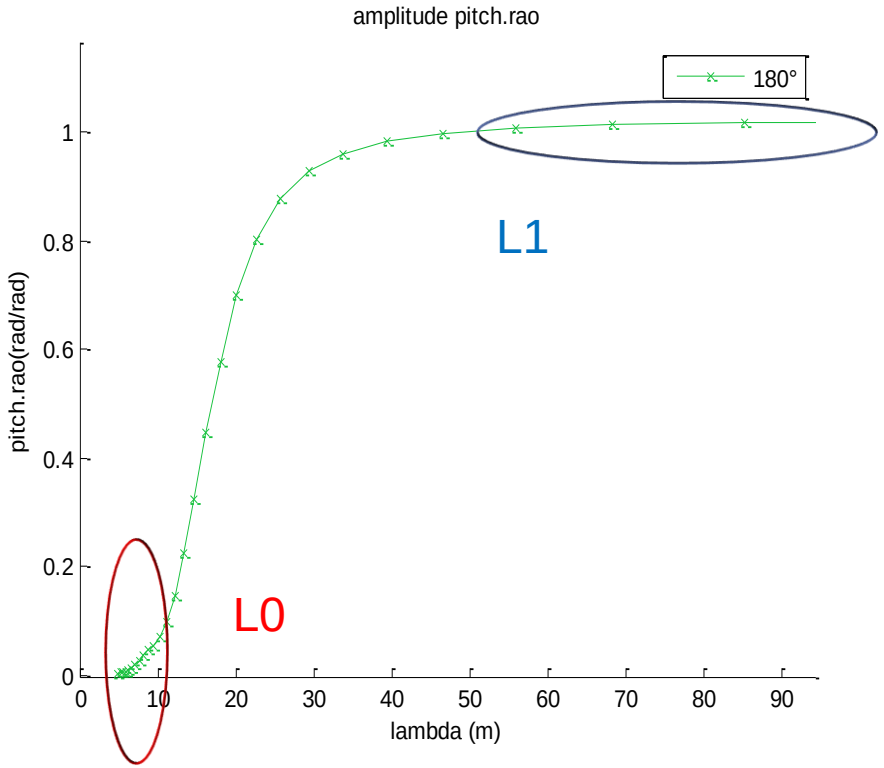
- Waterline length Lwl



Method for quick pitch RAO estimation

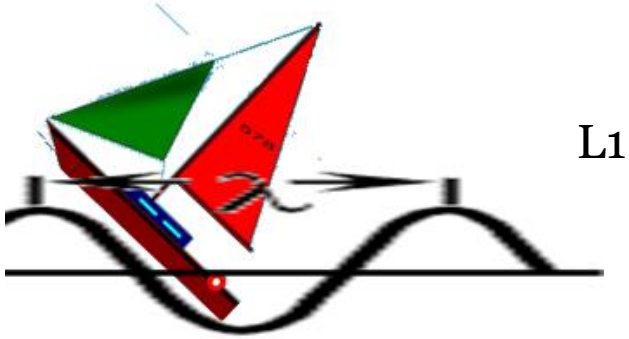
- RAO: 2 representations





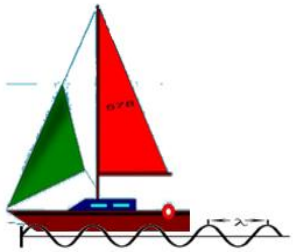
Method for quick pitch RAO estimation

λ>L1



L1≈2*Lwl

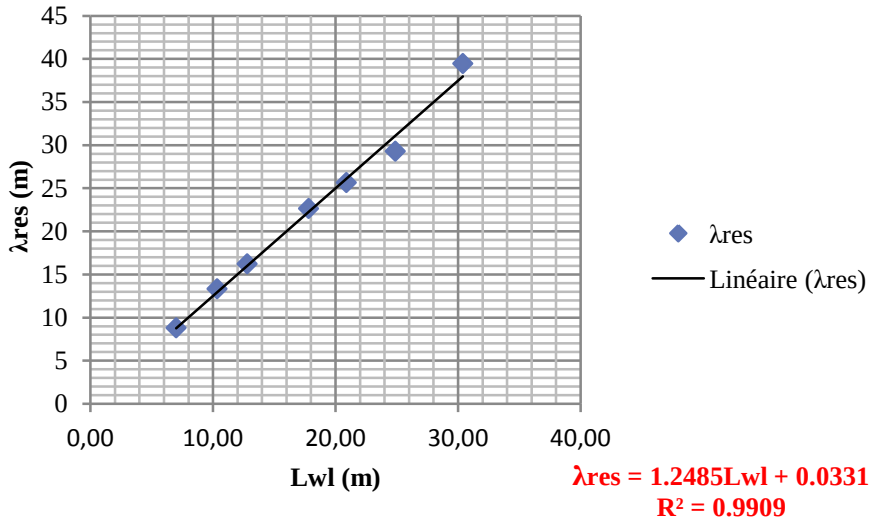
λ<Lo



Lo≈0.5*Lwl

Method for quick pitch RAO estimation

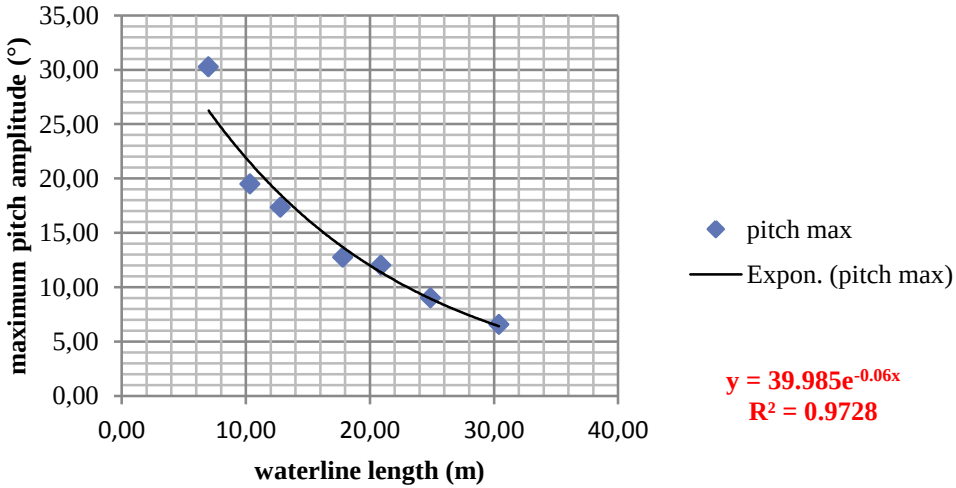
- Regression on 7 hulls



fres = 1.118/sqrt(Lwl)

Method for quick pitch RAO estimation

- Regression on 7 hulls

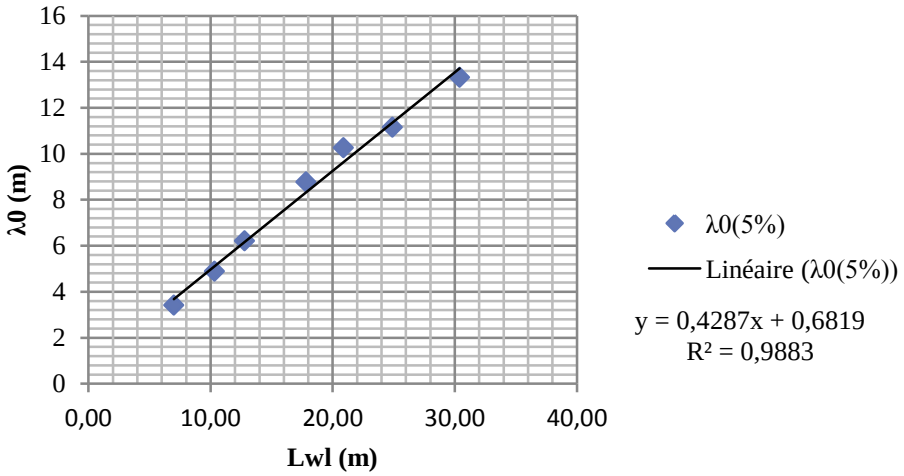


$fres = 1.118/\sqrt{Lwl}$

$pmax = 39.985e^{-0.06Lwl}$

Method for quick pitch RAO estimation

- Regression on 7 hulls



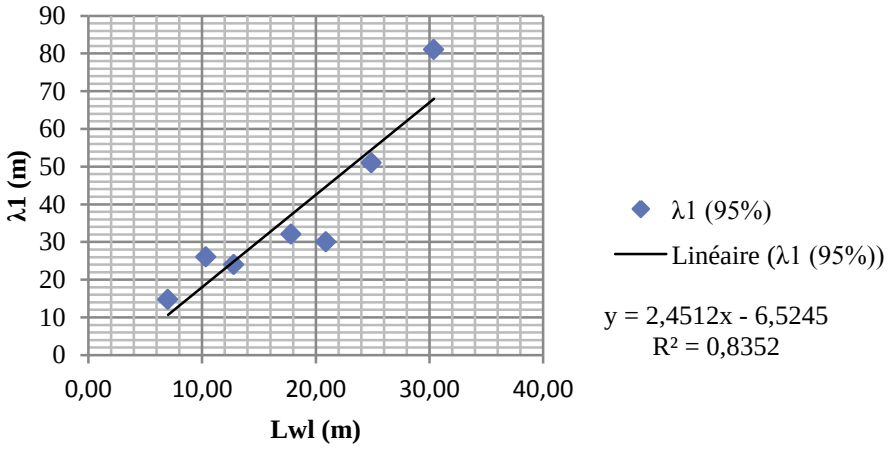
fres = 1.118/sqrt(Lwl)

pmax = $39.985e^{-0.06Lwl}$

L0 = 0.429Lwl

Method for quick pitch RAO estimation

- Regression on 7 hulls



fres = 1.118/sqrt(Lwl)

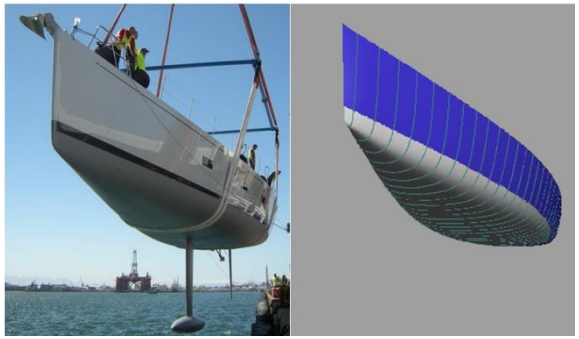
pmax = $39.985e^{-0.06Lwl}$

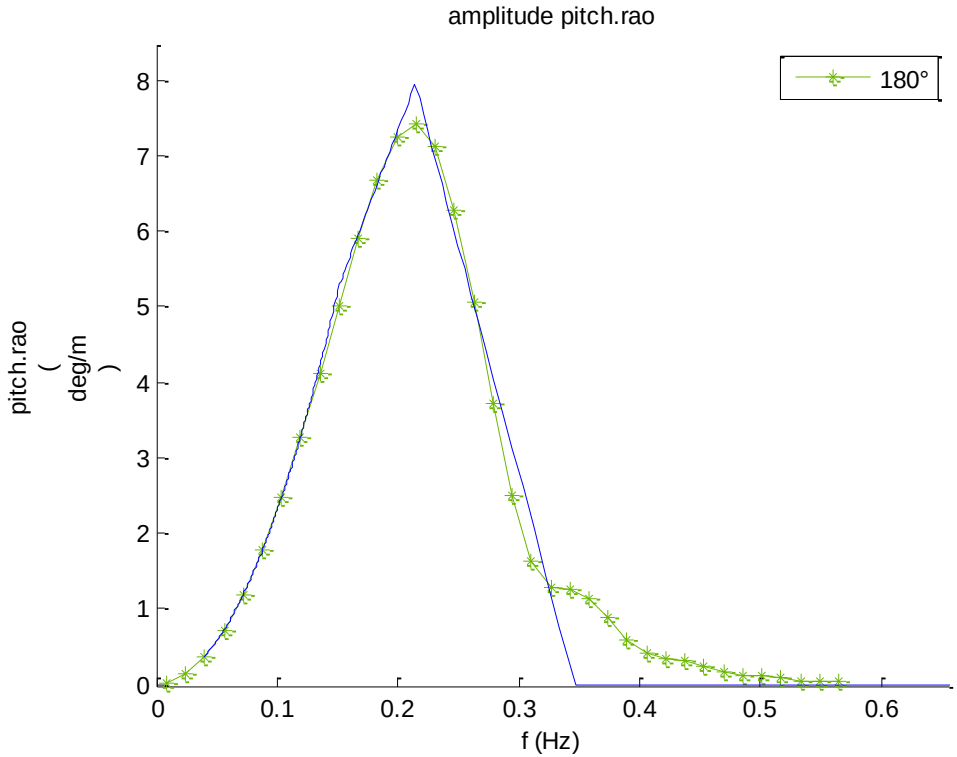
L0 = 0.429Lwl

L1 = 2.5Lwl

Method for quick pitch RAO estimation

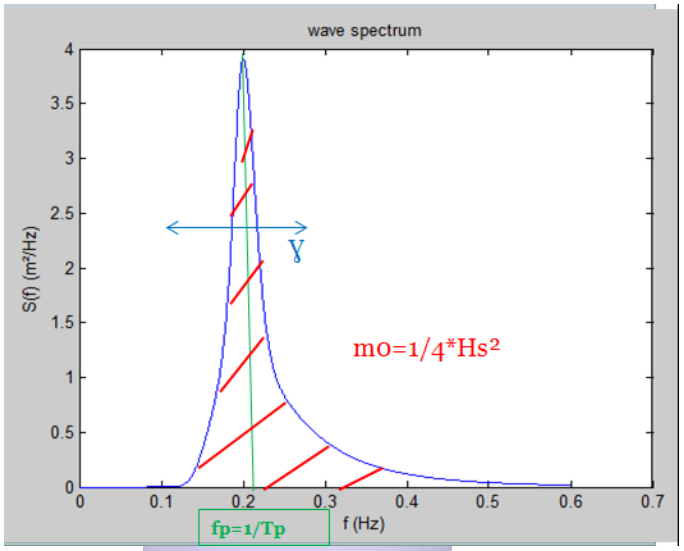
- Results on *Kiboko*



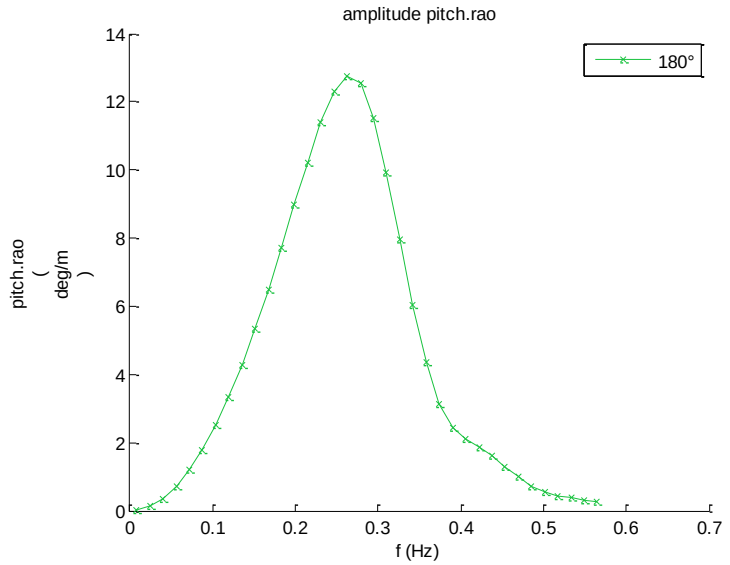


Pitch in irregular sea

- Frequency domain



X



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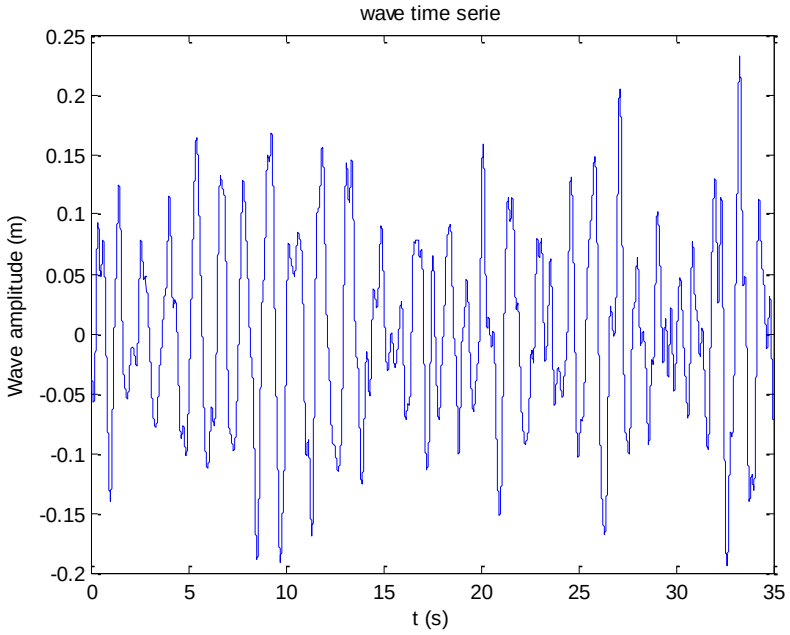
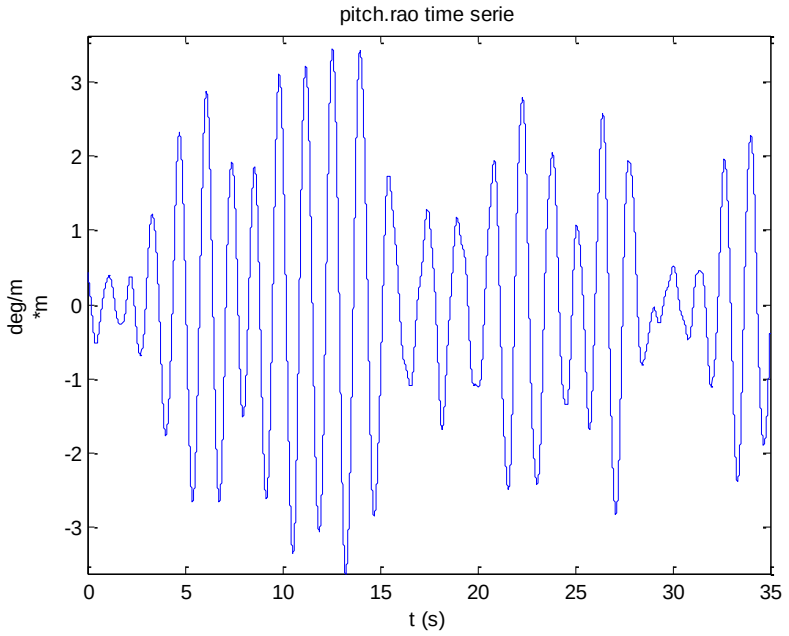
Pitch in irregular sea

- Time domain

$$\eta(t) = \sum_{i=1}^{\infty} (a_i \cos(2\pi f_i t + \varphi_i))$$



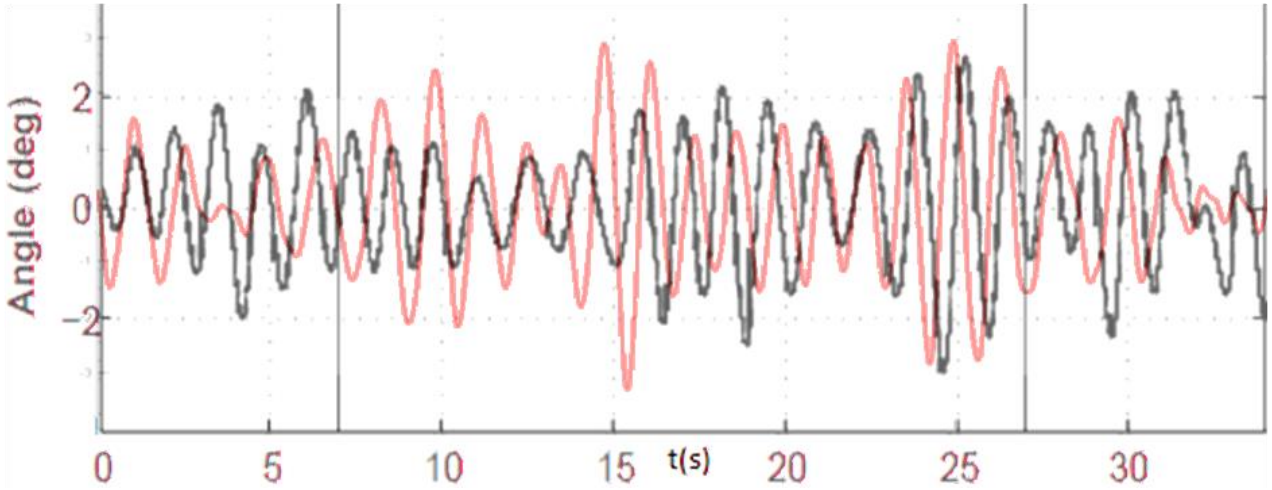
$$x_i(t) = \sum_{i=1}^{N} (b_i * \cos(2\pi f_{e,i} t + \varphi_i + \mathrm{RAO}_{\varphi}(f_i)))$$



Pitch in irregular sea

- Comparison with experimental results for J80

•In pure front waves
•speed = 5 knots.
•Hs=0.3m
•Tp = 2.251s
•ɣ=3.3 (closed basin)
•No heel angle

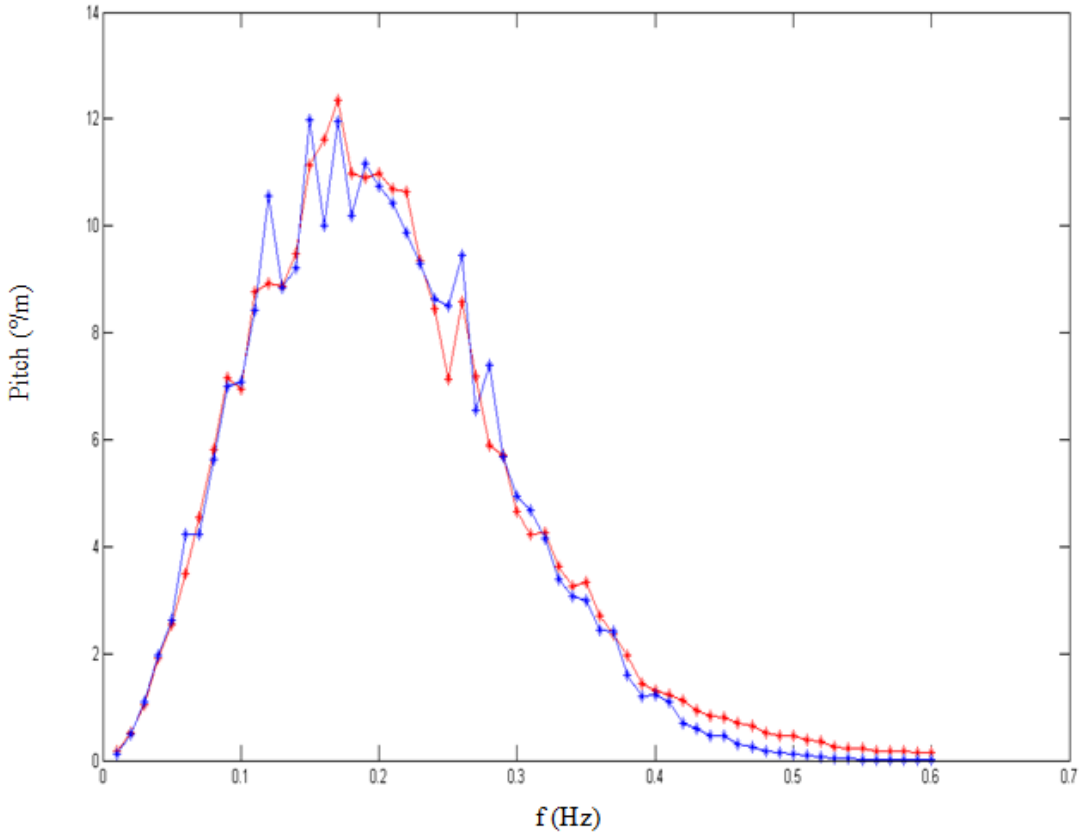


Experimental
Numerical

Augier, B., Bot, P., Hauville, F., Durand, M., (2012), "Experimental validation of unsteady models for fluid structure interaction: Application to yacht sails and rigs". *Journal of Wind Engineering and Industrial Aerodynamics, 101 (2012), pp 53–66*

Pitch in irregular sea

- Results for *kiboko* in irregular head sea without speed



Numerical
Empirical

Conclusion

- Critical parameters: Lwl, kyy, V, stern (bow) shape, heading
- Simplified method for head sea without forward speed using only Lwl. To be improved taking into account more parameters.
- Regression on bigger database
- Method for pitch prediction in function of wind speed to be compared with experimental results

Thank you for your attention

Questions ?