

La previsione del comportamento in mare di un'imbarcazione

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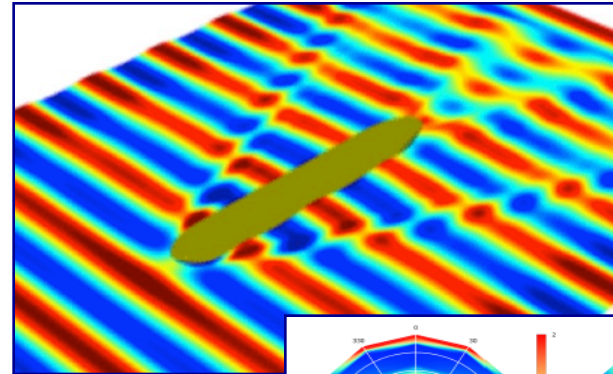
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Possibili approcci al problema del seakeeping

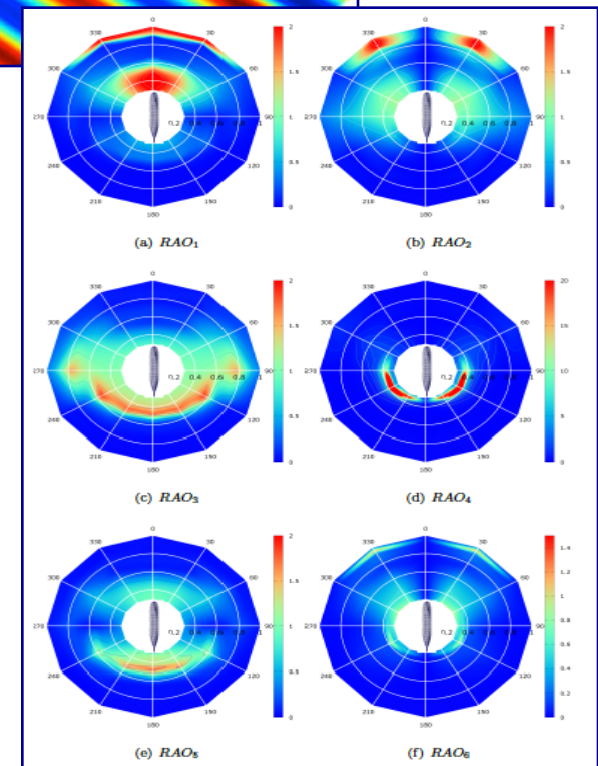
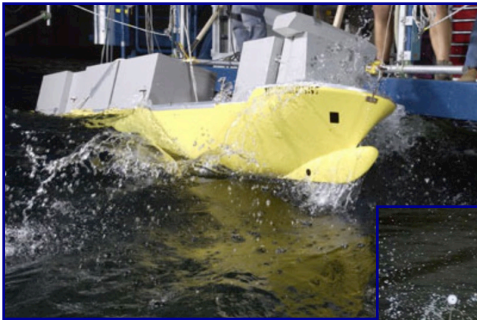
Prove in mare (Sea trials)



Simulazioni numeriche Computational Fluid Dynamics (CFD)



Prove su modello (Towing Tank Tests)



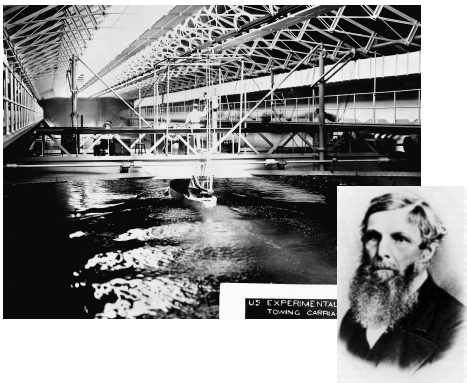
Timeline

HMS Cobra - Destroyer della Royal Navy affondata nel 1901 per una rottura dello scafo a seguito di un evento di *slamming*.



1901

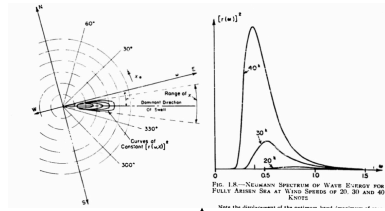
Prima vasca navale costruita da **William Froude** a Torquay (UK) per studiare resistenza e rollio delle navi.



US EXPERIMENTAL TOWING TANK



Pierson, W. J., & St Denis, M. (1953). "On the motion of ships in confused seas". Transactions SNAME, 61, 280-354.



1937

Havelock, T.H. (1937) "The resistance of a ship among waves". Proceedings of the Royal Society (A), Mathematical, Physical and Engineering Science.

1953

1957

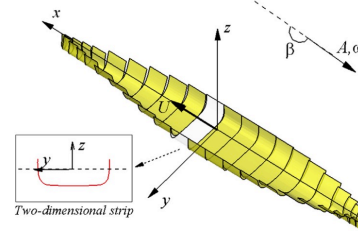
Korvin-Kroukovsky, B. V., & Jacobs, W. R. (1957). Pitching and heaving motions of a ship in regular waves (Vol. 659). Stevens Inst. of Tech Hoboken NJ Experimental Towing TANK.

Frank, W. (1967). "Oscillation of cylinders in or below the free surface of deep fluids". David Taylor Naval Research and Development Center, Bethesda, USA.

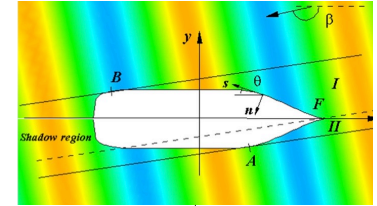
1967

1970

Salvesen, N., Tuck, E. O., & Faltinsen, O. (1970). Ship motions and sea loads. Trans. Sname, 78(8), 250-287.



Nakos, D. E. (1990). Ship wave patterns and motions by a three dimensional Rankine panel method. PhD, Massachusetts Institute of Technology, MIT, MA, USA.

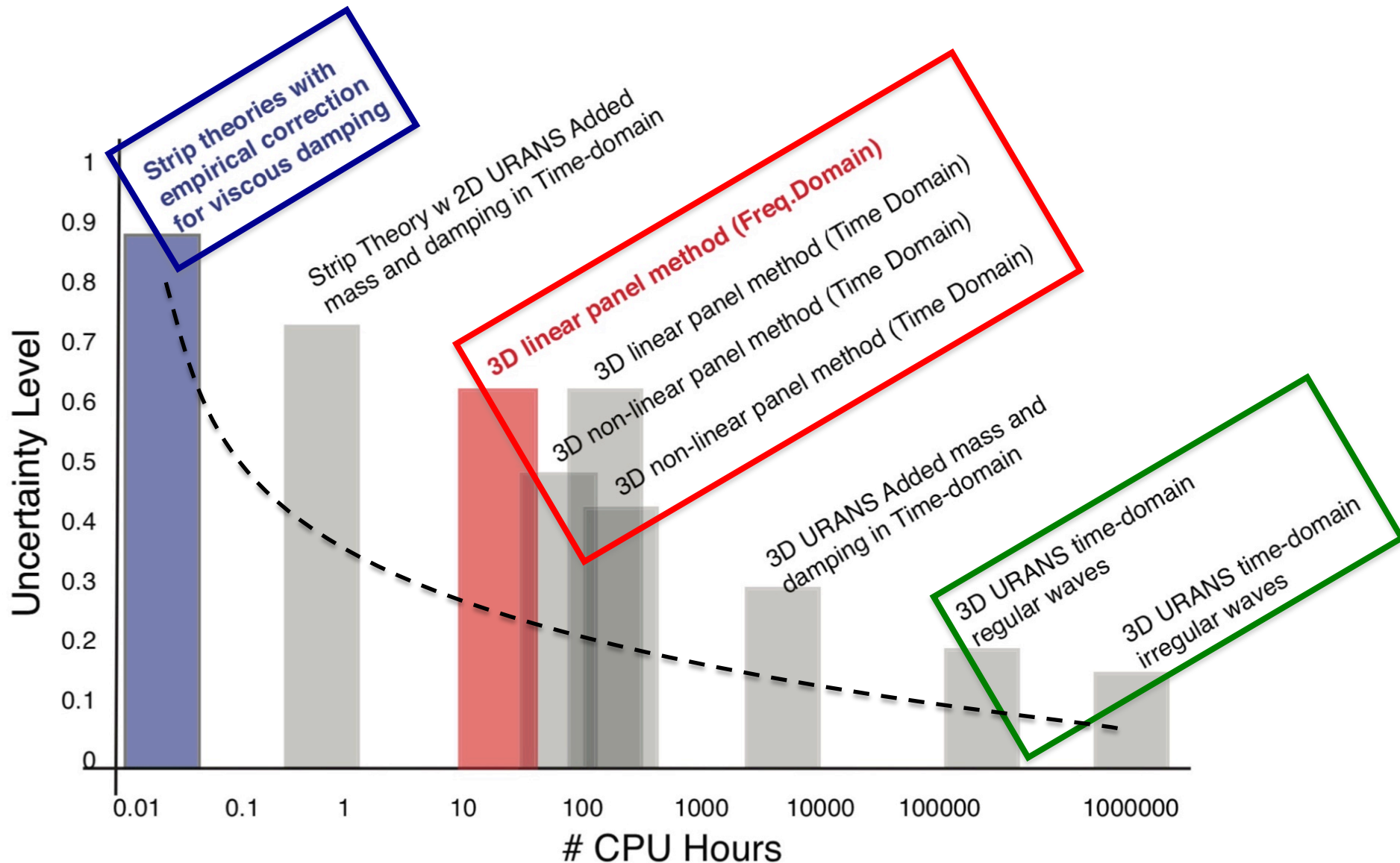


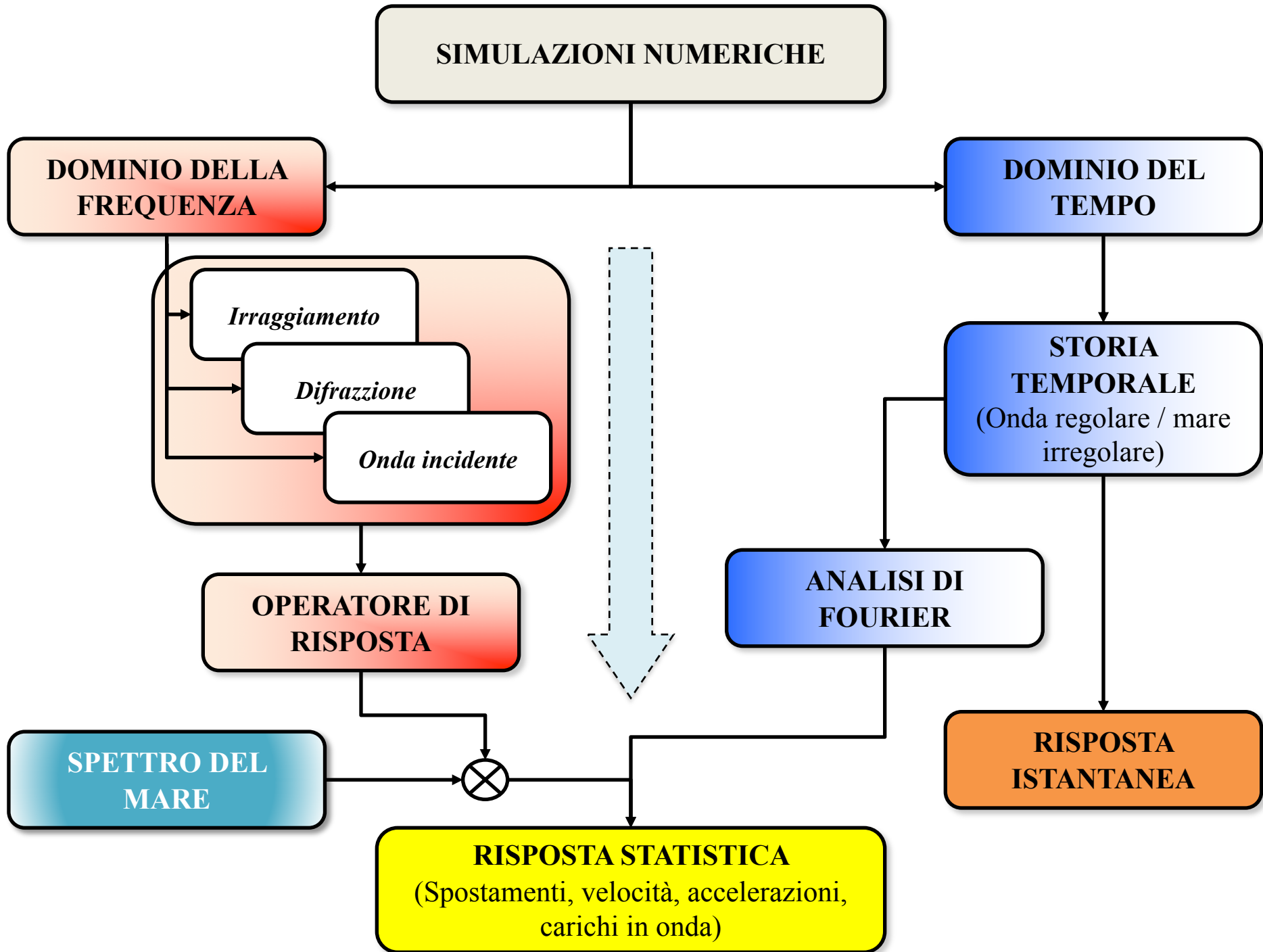
1990

1997

Kim, Y., Kring, D. C., & Slavounos, P. D. (1997). Linear and nonlinear interactions of surface waves with bodies by a three-dimensional Rankine panel method. Applied Ocean Research, 19(5-6), 235-249.

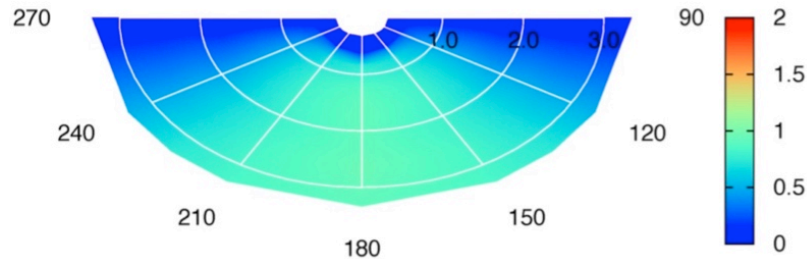
Sviluppo dei metodi computazionali per analisi di *seakeeping*



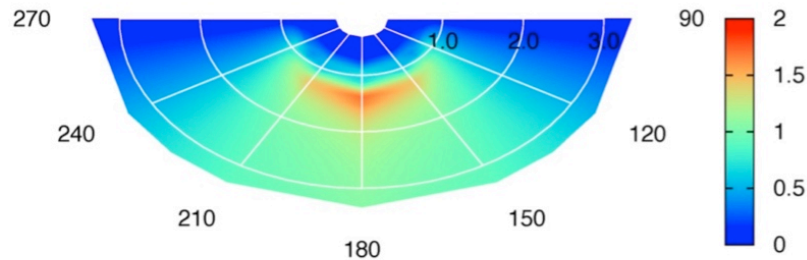


Esempi di risultati di simulazioni

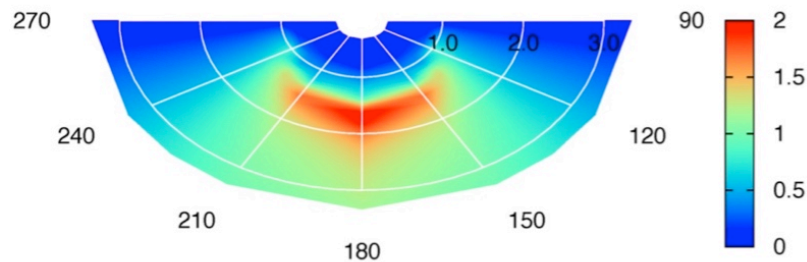
Diagrammi polari dei RAO (Sussulto) al variare della velocità e dell'angolo di incontro nave-mare



(a) $Fn = 0.2$

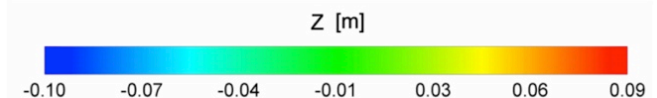
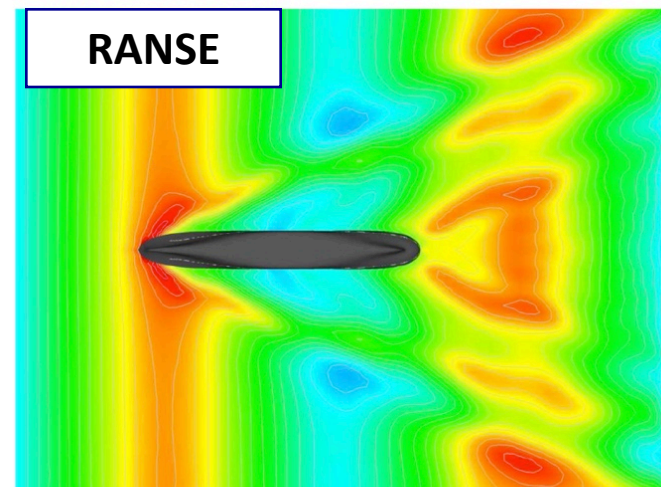
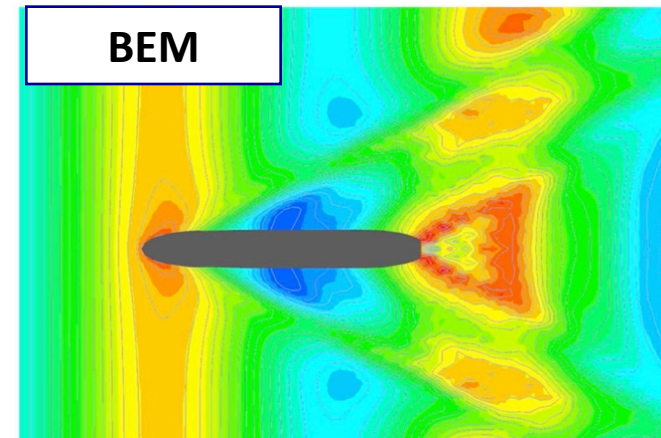


(b) $Fn = 0.4$

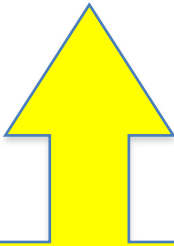


(c) $Fn = 0.6$

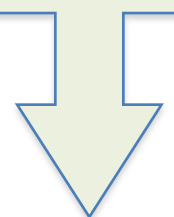
Sopra-elevazione ondosa (*wave pattern*) per nave che avanza con mare in prua.



Pros & Cons

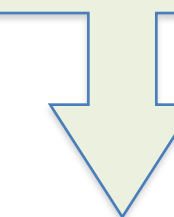
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- Forniscono direttamente gli operatori di risposta (RAO)
 - Forniscono una risposta statistica (valori significativi delle risposte)
 - Utili ai fini del progetto per avere una caratterizzazione della risposta
 - Tempi di calcolo contenuti

DOMINIO FREQUENZA

- Utilizzano la teoria lineare (scomposizione dei problemi e sovrapposizione degli effetti)
 - Alcune non-linearità possono essere introdotte mediante tecniche specifiche
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- Forniscono la storia temporale della risposta
 - Utili per verificare fenomeni fortemente non-lineari e/o particolari
 - Utili per verificare il transitorio

DOMINIO TEMPO

- Tempi di calcolo tipicamente elevati
 - Occorre processare ulteriormente i risultati per ritrovare la caratterizzazione statistica delle risposte (utilizzando una durata opportuna delle serie temporali)
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