

RITMARE: la ricerca italiana sul mare

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Sostenibilità ambientale

- Riduzione delle emissioni e dell'inquinamento acustico aria e in mare
- Transizione da combustibili tradizionali a gas liquefatto
- Produzione di energia a bordo

Comfort

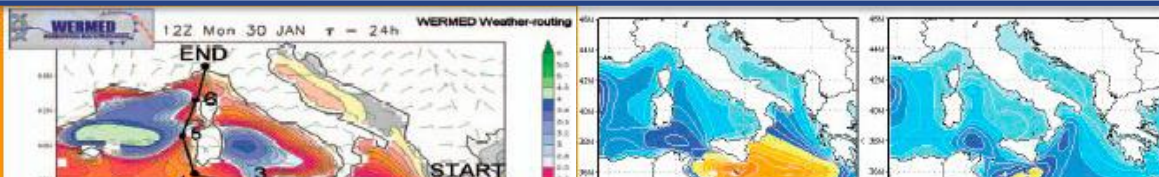
- Stabilizzazione integrata della nave e controllo del moto
- Controllo attivo/passivo delle vibrazioni e del rumore
- Qualità dell'aria a bordo

Sicurezza

- Valutazione dell'integrità strutturale
- Weatherrouting e assistenza in condizioni meteo pericolose
- Emergenza ed abbandono nave

Materiali innovativi

- Materiali super-idrofobici
- Materiali anti-fouling
- Materiali ad elevata resistenza termomeccanica



WERMED
Weatherrouting dans la Méditerranée.
Results of the Project

Editors: A. Delitala, A. Speranza



GENOVA/ PORTO TORRES

CAGRIARI/LARNACA

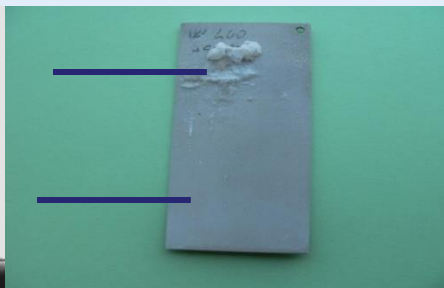
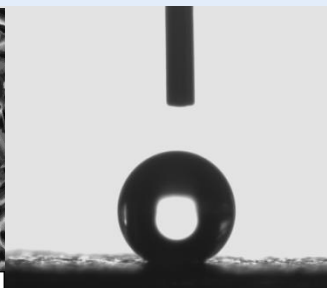
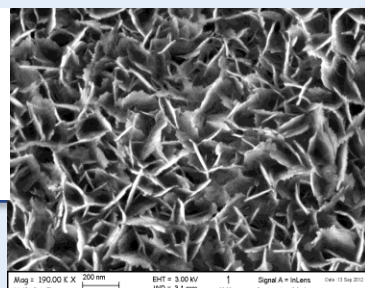
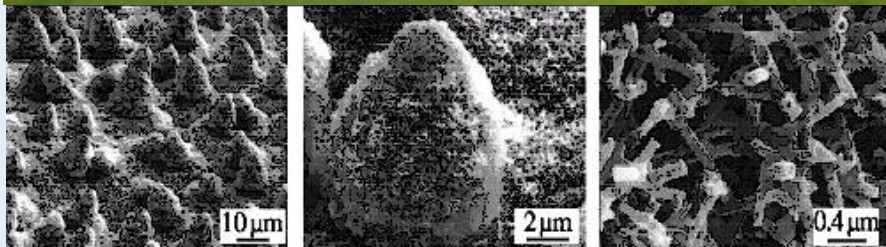
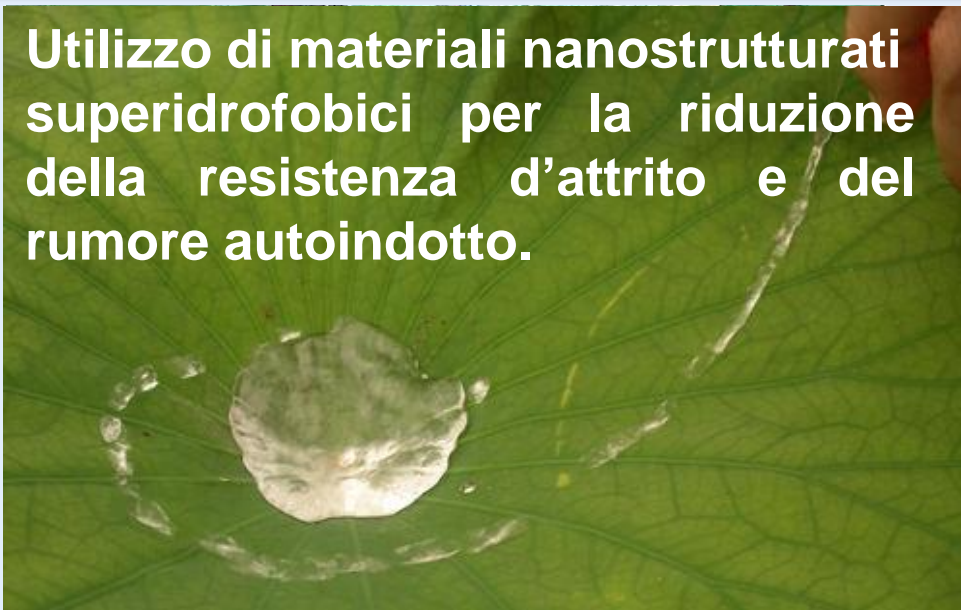
GENOVA/TUNIS/MALTA/GENOVA

PEIRAEUS/GENOVA

PATRAS/ANCONA

Utilizzo di materiali nanostrutturati superidrofobici per la riduzione della resistenza d'attrito e del rumore autoindotto.

Materiali super-idrofobici



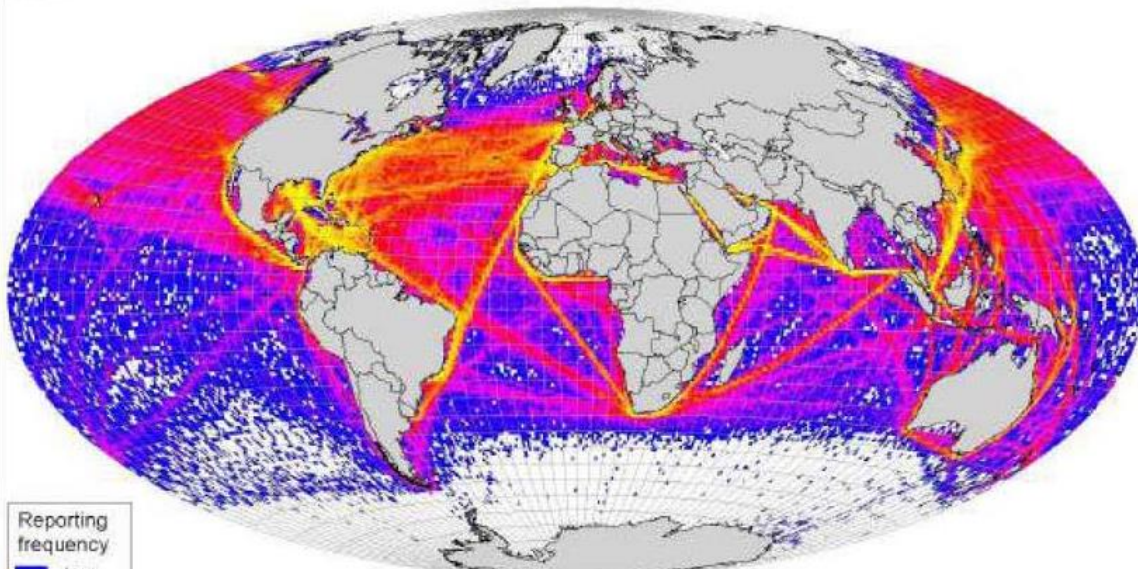
Caratteristiche richieste ai nuovi materiali

- *Riduzione dei consumi*
- *Riduzione del rumore*
- *Anti-fouling, autopulenti*
- *Proprietà anticorrosive*
- *Comfort, sicurezza, ecc.*



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Reduce underwater noise

A map of the ship generated underwater noise
source: U.S. Coast Guard

Estimated reduction in whale communication range:
prior to the advent of commercial shipping (left) and today
(right). Source :C.W. Clarke, Cornell Univ.



Newfoundland

Florida



L'Italia ha aderito con la legge 163/2012
alla Convenzione IMO (Londra 2001)
sui sistemi antivegetativi



CORROSIONE E BIODETERIORAMENTO RAPPRESENTANO UN SERIO PROBLEMA TECNOLOGICO

Costo imputabile a questi fenomeni: 3-4 % PIL dei paesi industrializzati

**Mentre voi state leggendo queste
parole...10.000 kg di ferro si stanno
corrodendo nel mondo**

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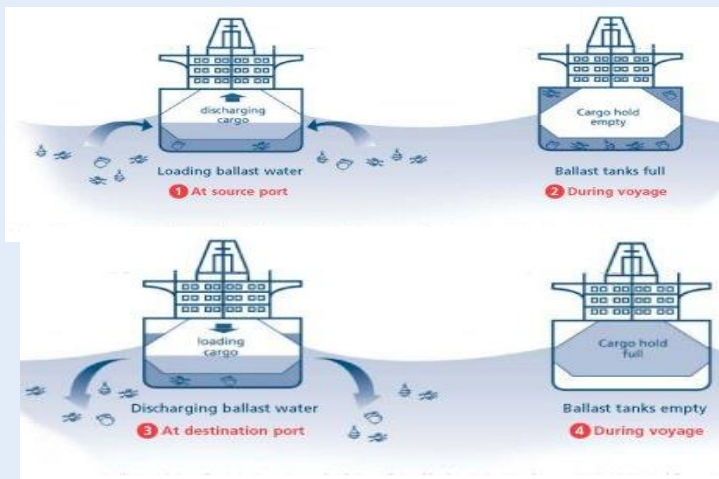


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Trattamenti per acque di zavorra (Ballast Water)

Sono la principale causa della diffusione delle specie aliene (inquinamento biologico) che l'IMO ha recentemente regolamentato



Azienda Chimica Genovese (ACG)
Genova, Italy



Innovativo sistema di Elettroclorazione Ecompatibile

MARZO 2014



IMO - BASIC APPROVAL

Elaborazione e validazione mediante un percorso di **certificazione (ISO 17025)** delle metodiche di **testing** per la verifica dell' **eco compatibilità** ed **efficacia** di **impianti** per il trattamento delle acque di zavorra (**BWTs**), in accordo con gli **standard IMO** del nuovo regolamento internazionale.

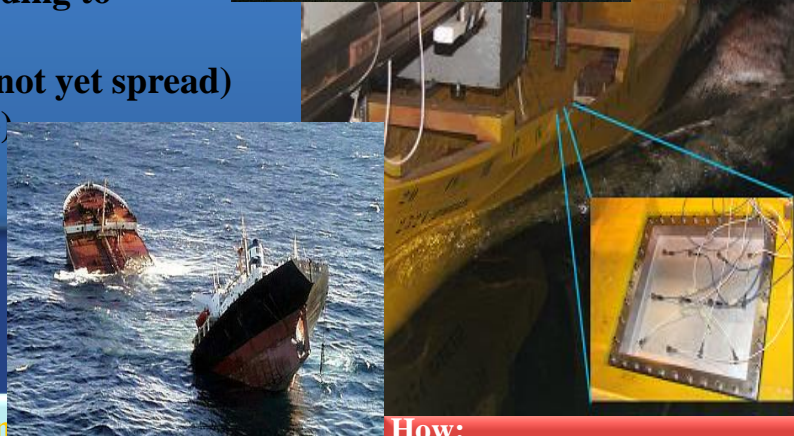
Prima e unica Azienda in Italia ad aver ottenuto il "Basic Approval" dall'IMO

Structural health monitoring

(via system identification)

Short-term eng. applications:

- real-time identification of marine structure response and “running” system;
- **model updating**
- sensing of occurred damage or intermediate failures leading to collapse
- evaluation of potential (not yet spread) damage (e.g., fatigue life)

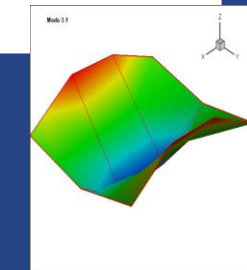
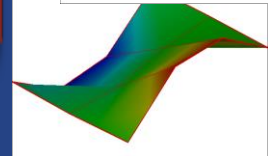
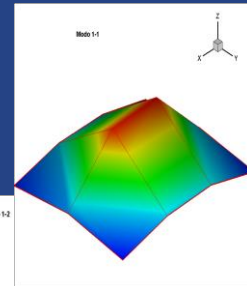
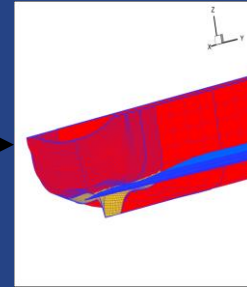


Model updating for healthy reference condition identification

Numerical simulation for diagnosis calibration

Experimental tests

Multivariate analysis



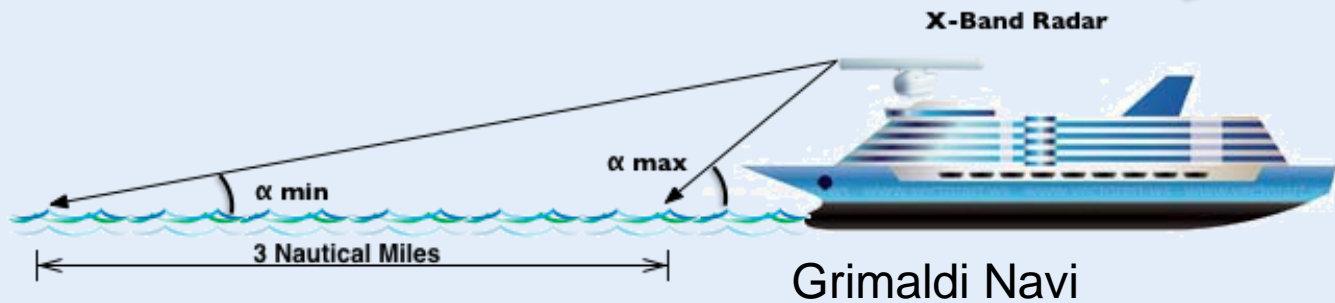
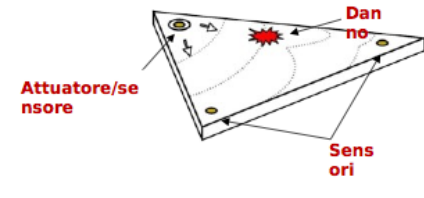
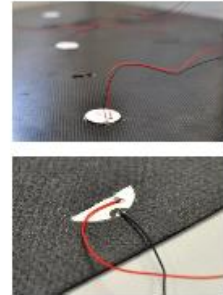
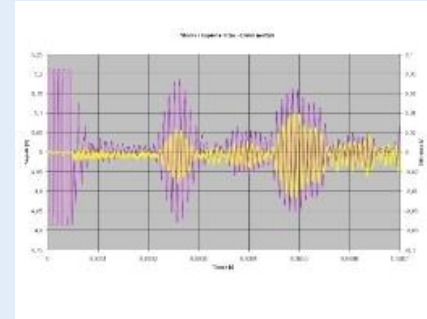
Long-term eng. application

- increase of safety level,
- relaxation of safety constraints with enhancement of optimization targets,
- reduction of fleet or plant maintenance costs

How:

- Monitoring / Diagnosis via syst. identification techniques
- Prognostics (from damage to failure and collapse)
- Decision scheme (fix levels and damage tolerance)
- Confidence (false warnings and resolution capabilities)

Monitoraggio delle strutture

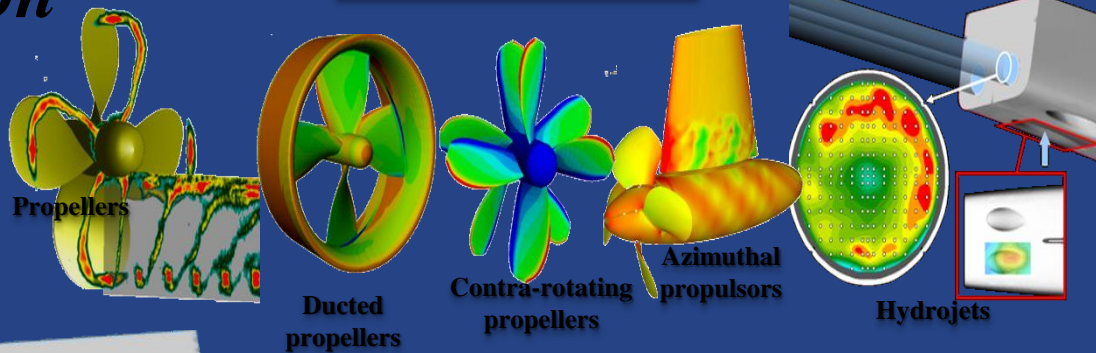


- Prevedere cicli di manutenzione
- Monitoraggio abbinato a conoscenza stato del mare
- → “addestramento”

Marine propulsion

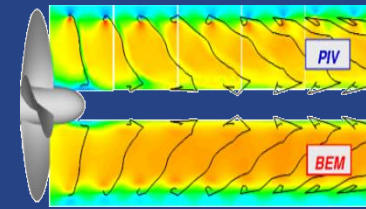
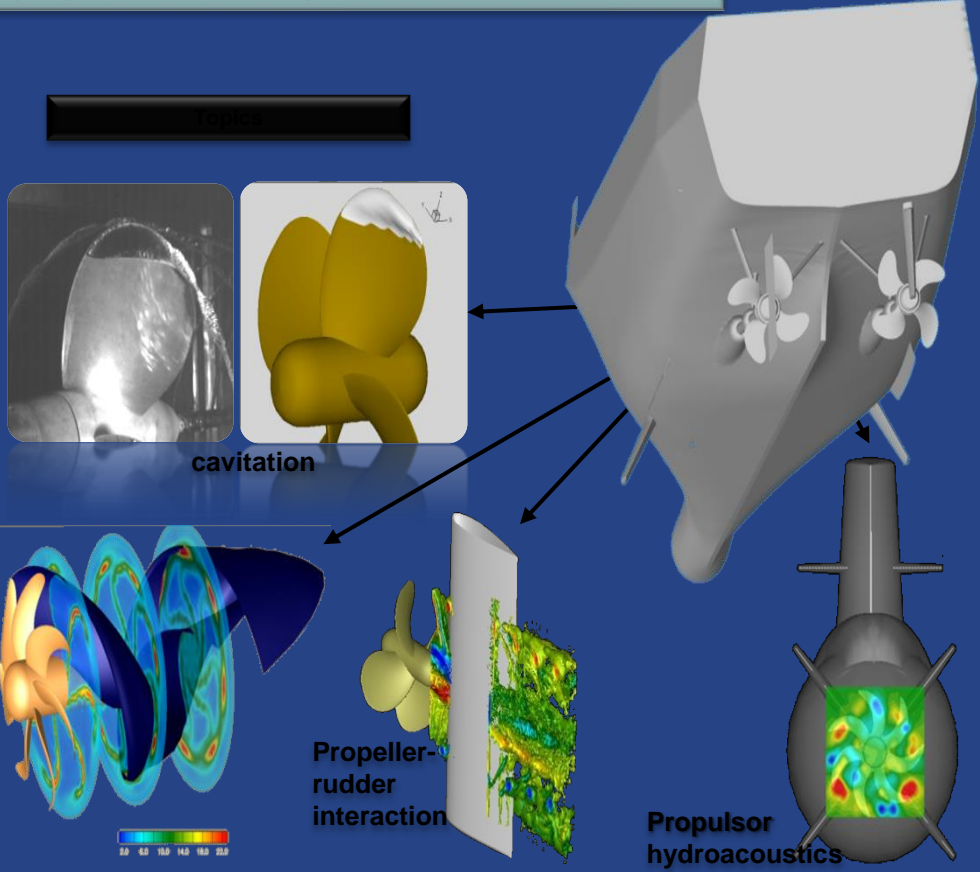
Research aims:
 Performance improvement of propulsive systems (e.g. better efficiency, on-board comfort), environmental sustainability (e.g. pollutants, wild-life, ...), safety, understanding of propulsion-related phenomena ...

Propulsors



Investigation Techniques

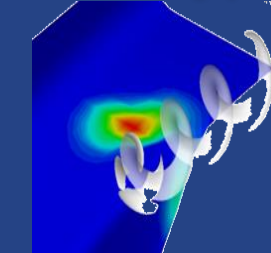
Computational Fluid Dynamic Experimental Fluid Dynamic



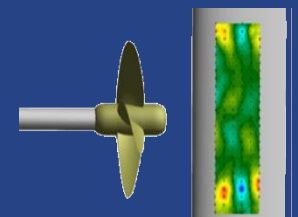
Marine propeller hydrodynamic modeling by BEM



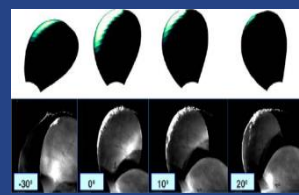
Optical techniques (LDV, 2D-PIV, Stereo-PIV, DD-PIV)



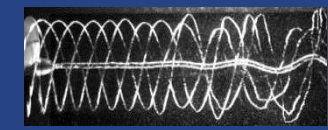
Hydroacoustic scattering models



Pressure mapping techniques



Cavitation modeling by BEM



Qualitative and quantitative (LIF) visualization techniques

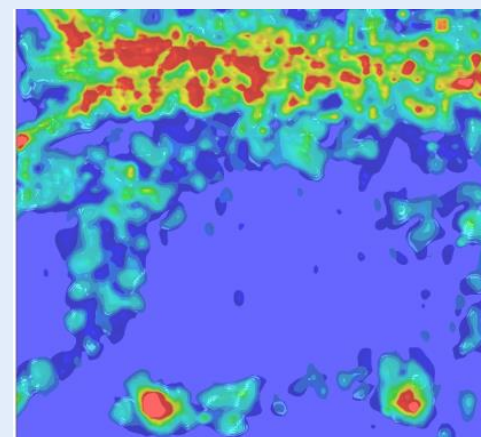
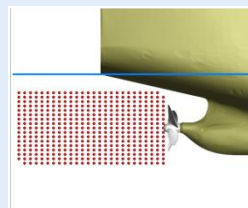
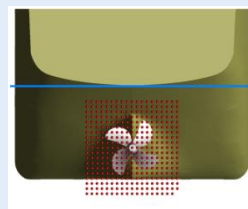
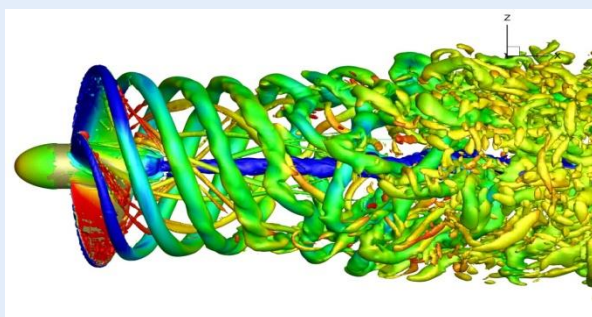
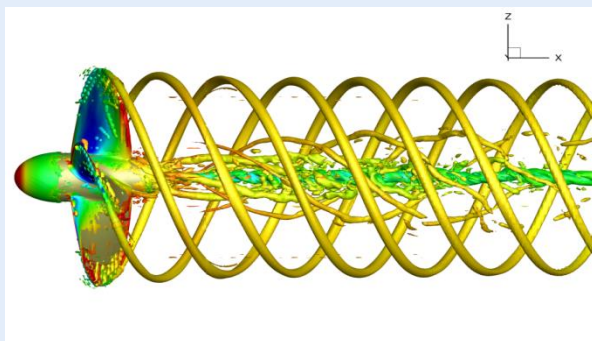
Sviluppo di tecniche sperimentali (dirette ed indirette) per la caratterizzazione del campo acustico e l'individuazione delle sorgenti, tese a realizzare un tool progettuale e diagnostico per la mitigazione della segnatura acustica a partire da misure su scala modello.

Tecniche Dirette:

caratterizzazione delle perturbazioni idrodinamiche e acustiche a partire da misure di pressione nel nearfield

Tecniche Indirette:

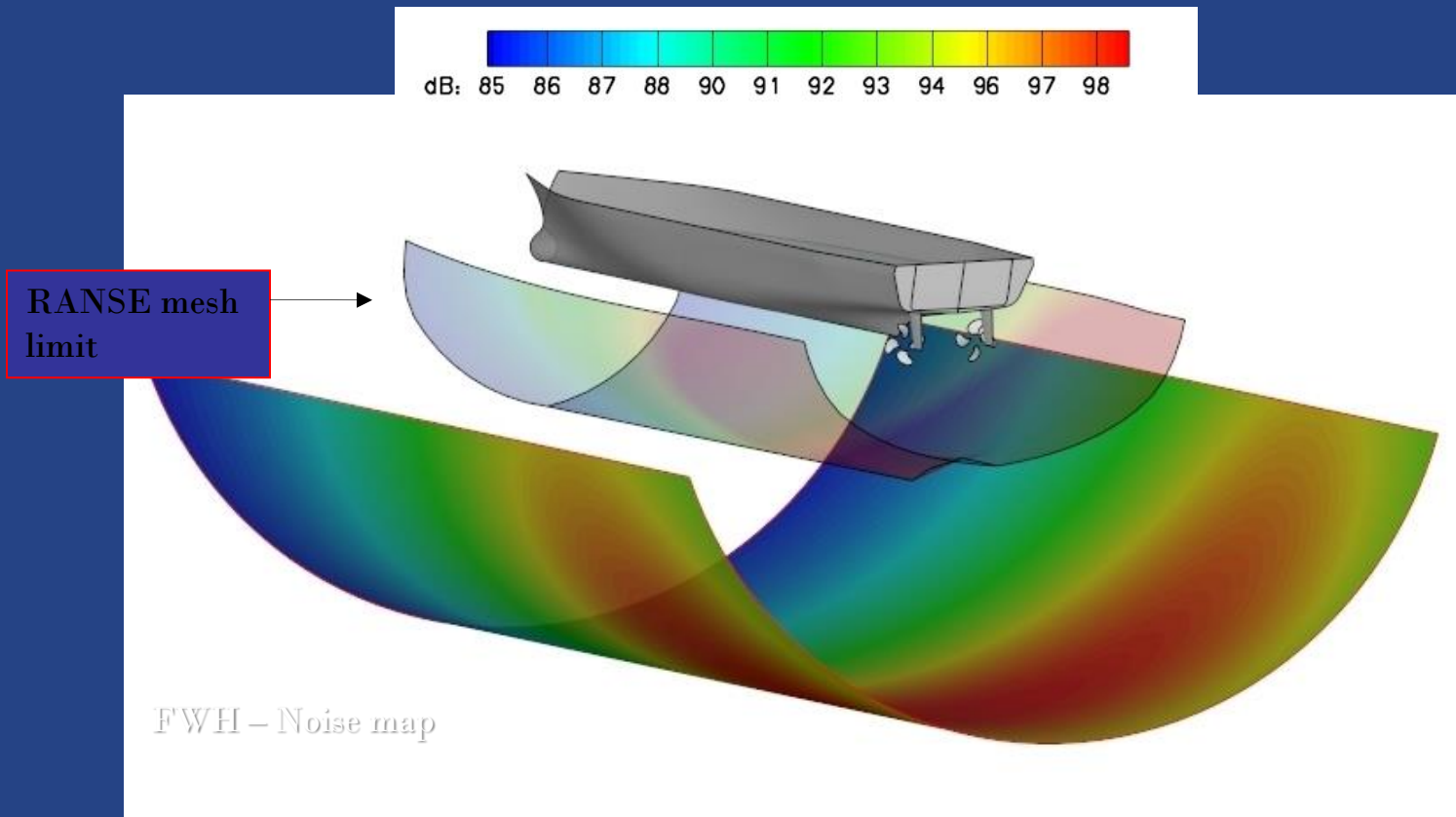
caratterizzazione del campo acustico indotto dalla scia attraverso tecniche volumetriche e analogie acustiche



TOMOPIV measurements in the wake of an isolated marine propeller. Topology of the vorticity field (left), second time derivative of the Lamb Vector representing the instantaneous spatial distribution of the acoustic source term in the Powell's Analogy (right).

Numerical prediction of underwater noise

Noise map (traced by 2500 hydrophones) of the *actual acoustic pressure far field* and the analogous footprint determined on the most external layer of the RANSE mesh. This result represents a reasonable *hydroacoustic characterization* of the ship.



The FWH equation represents a very effective approach to investigate on the ship generating noise mechanisms taking place underwater. We believe it could be adopted as a *standard technique* to characterize the hydroacoustic behavior of a ship and/or its sub-components, even at a *design stage*.

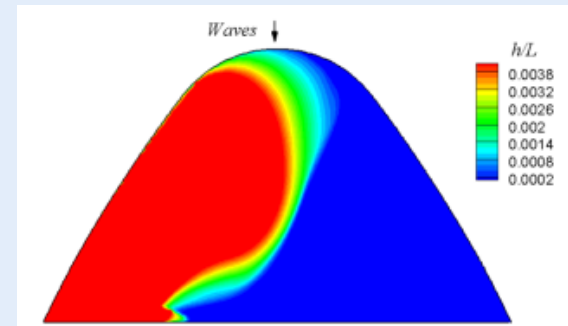
Modelli di interazione correnti-onda-scafo

- Instabilità parametrica da rollio anche con mare da prua
- Perdita stabilità direzionale



**Comfort
& Sicurezza**

- ottimizzazione dedicata alla gestione del trasporto marittimo in condizioni meteo-marine avverse.

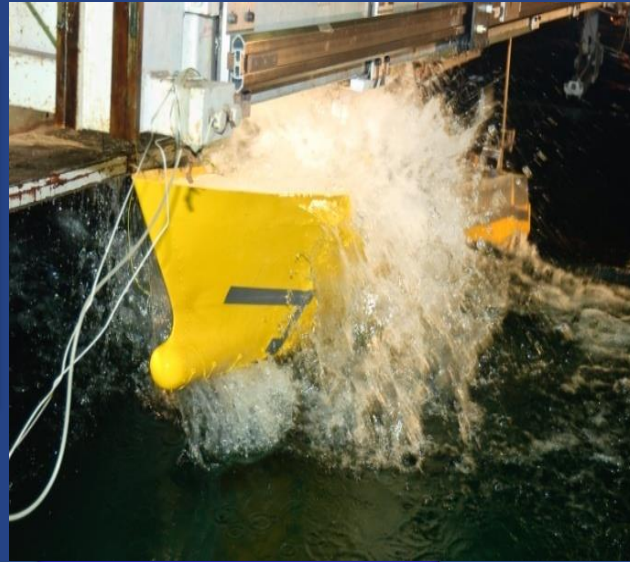


Infrastructures for maritime design and testing

Two towing tanks

#1) Among the largest worldwide (470 x 13.5 x 6.5m, carriage max. speed 15 m/s);

#2) Half of #1, but equipped with a wavemaker for rough sea experiments



Water flume
(with inclined floor)



Two circulating channels

Laser facilities (Doppler or Particle Image Velocimeters), acoustic probes etc.



Prototype/model factory

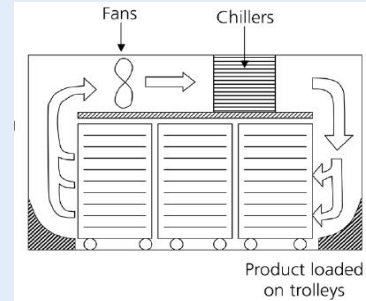
Sloshing lab



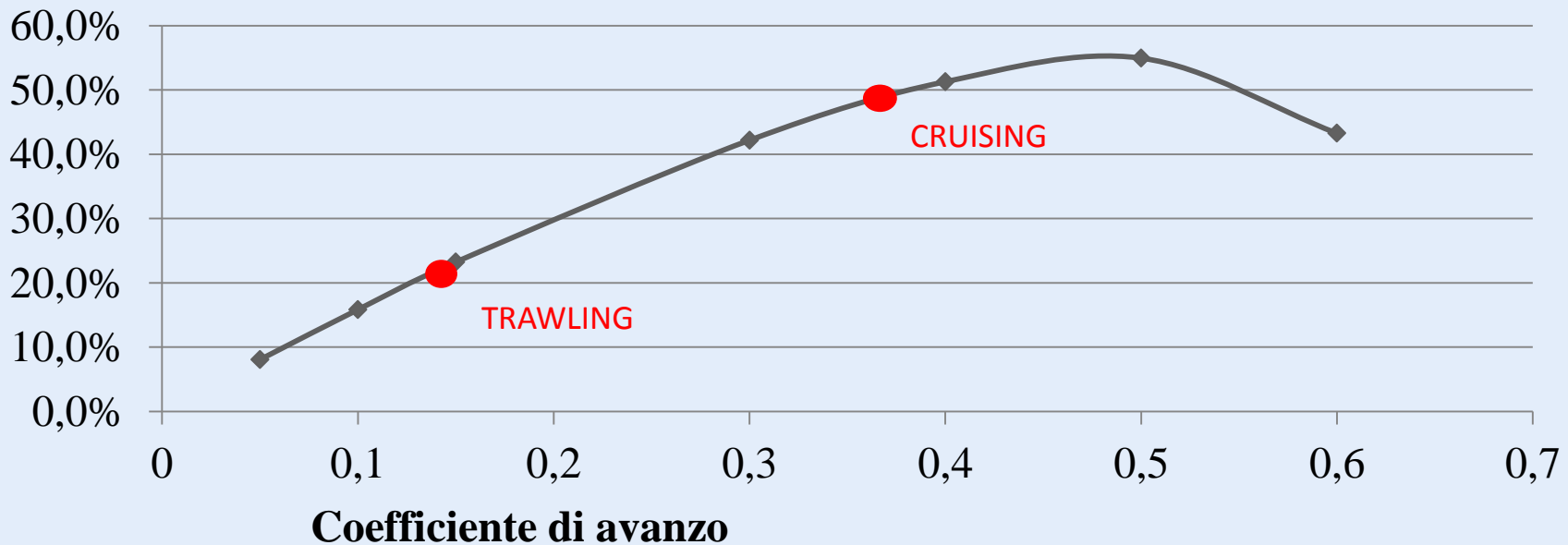
Peschiereccio sostenibile



Tecnologie per la Valorizzazione del Pescato



Rendimento elica isolata



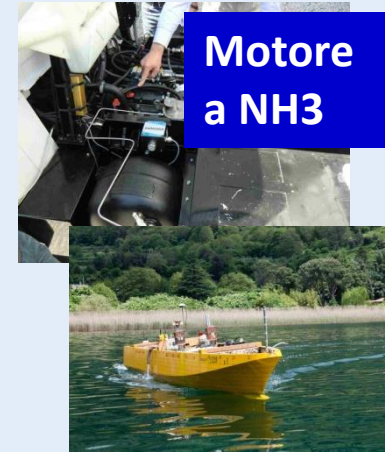
Passaggio da combustibili liquidi a gas liquefatto

Carburanti alternativi:

Analisi delle tecnologie più promettenti per motori marini

- *Metano, gas di petrolio liquefatto*
- *Idrogeno*
- *Ammoniaca*

Analisi dell'impatto su impianto motore Diesel e sviluppo di un kit di conversione



Motore a NH3

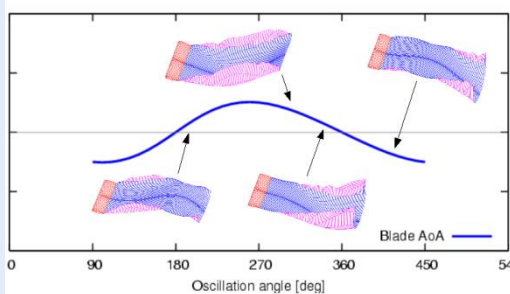
Propulsori ibridi convenzionale/emissione-zero:

Analisi delle tecnologie più promettenti per lo sviluppo di sistemi di propulsione ausiliare ad emissioni (quasi) zero:

- Propulsione dal vento: **rotori Flettner vele rigide**
- Propulsione dalle onde: **systemi bio-mimetici (pinne)**



Vele rigide



Rotori Flettner

