MARIN

BETTER SHIPS, BLUE OCEANS

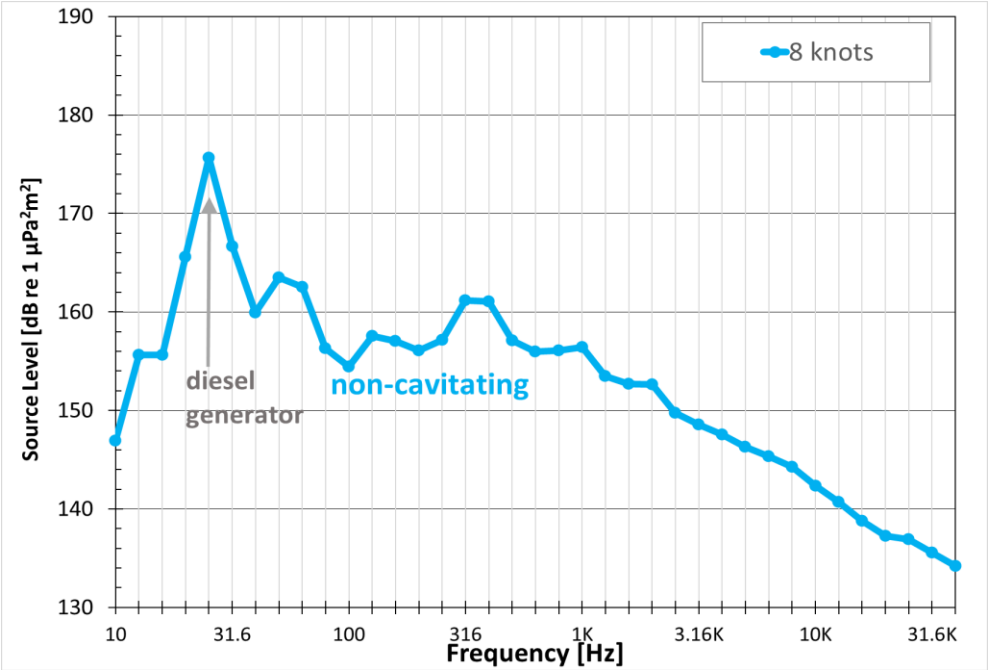
Saturn

Developing Solutions for Underwater Radiated Noise

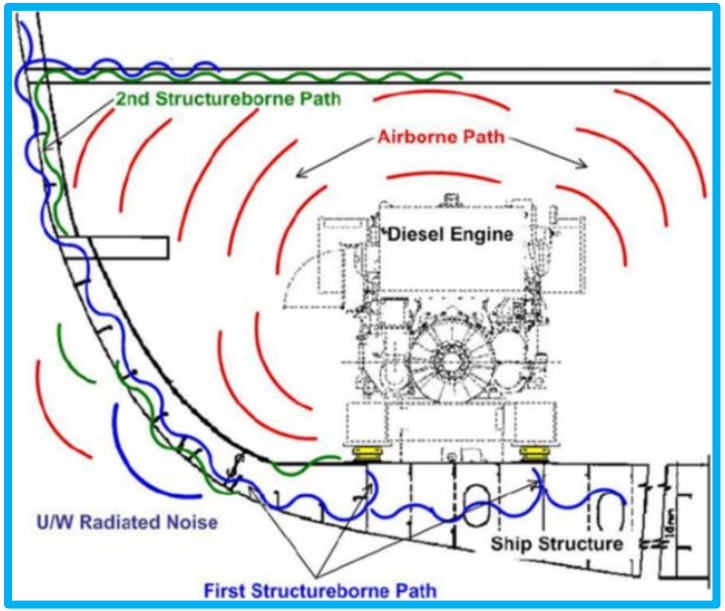
Five solutions for reducing underwater radiated noise and their impact on efficiency

Frans Hendrik Lafeber, Johan Bosschers, Thomas Lloyd, Evert-Jan Foeth, John Huisman

URN from ships: machinery-induced

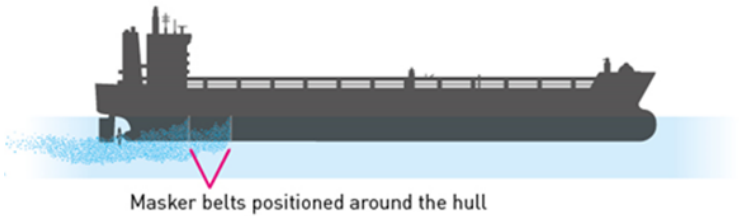


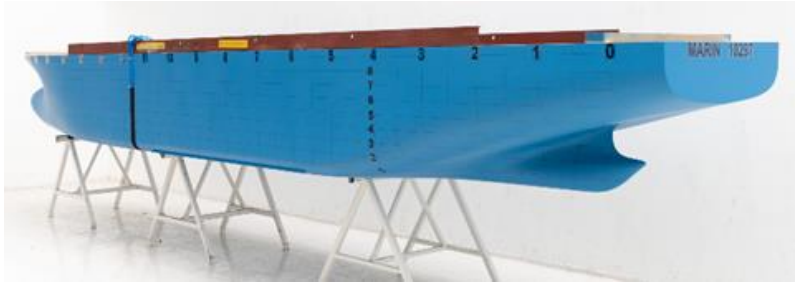
Source: Arveson & Vendittis (2000) 173 m cargo vessel

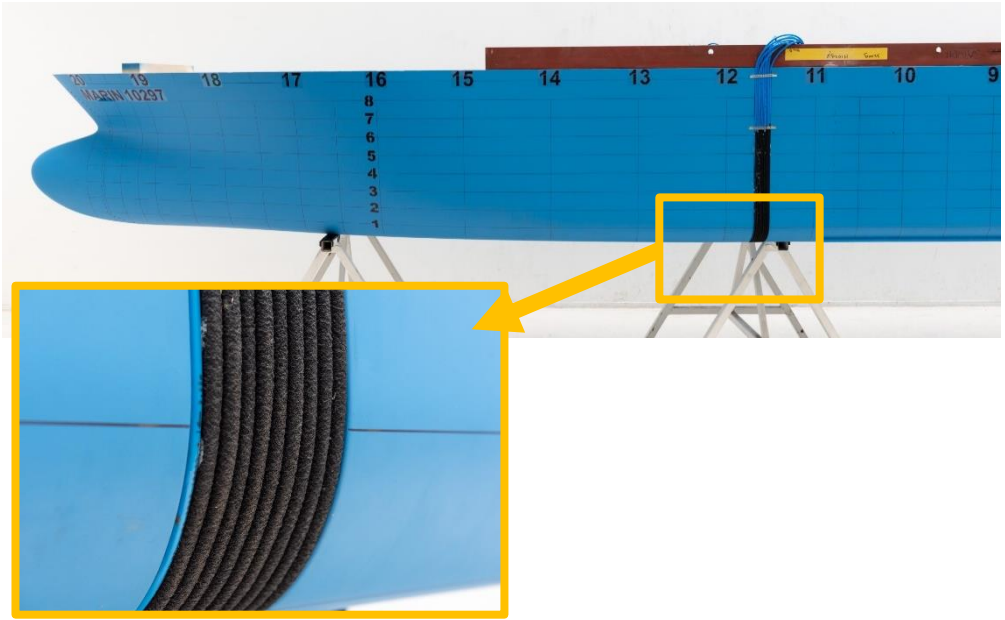


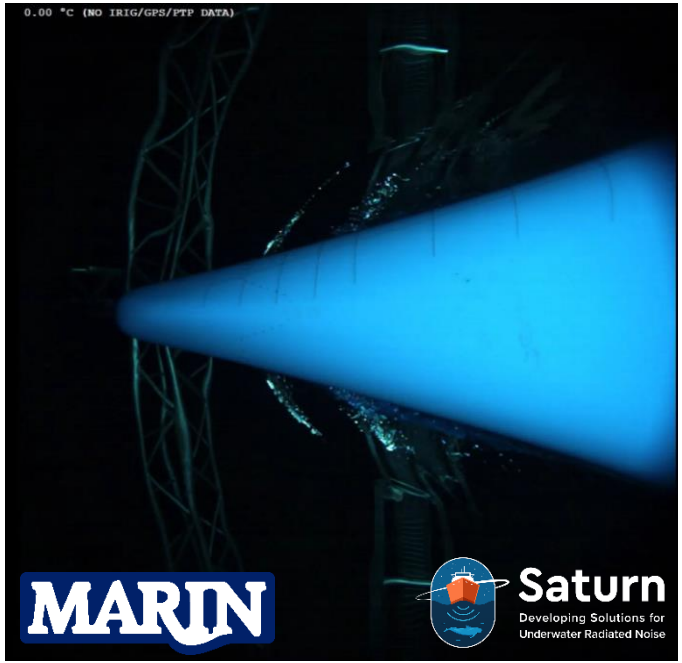
Source: Spence and Fischer, 2017

Solution 1: Masker system (machinery noise)









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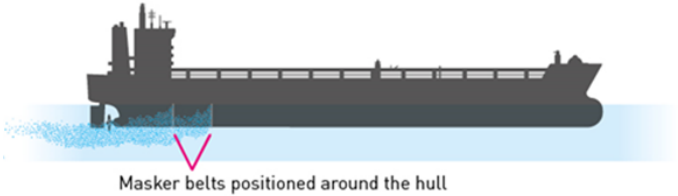
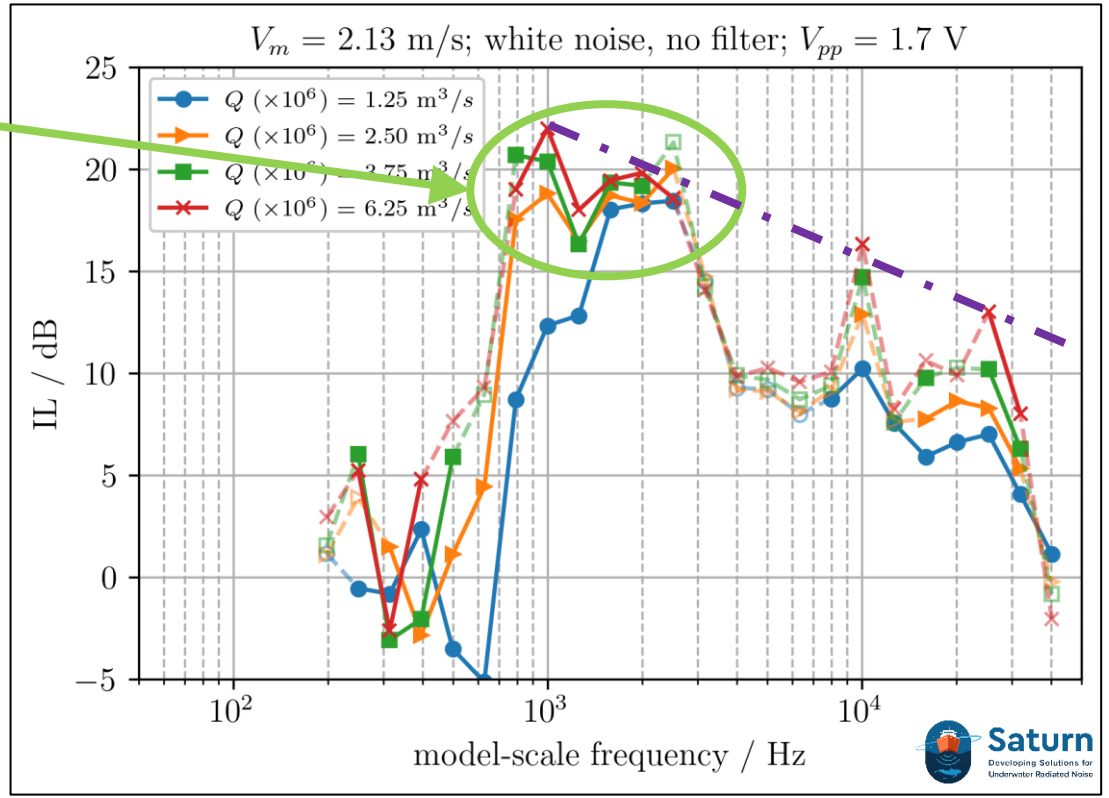
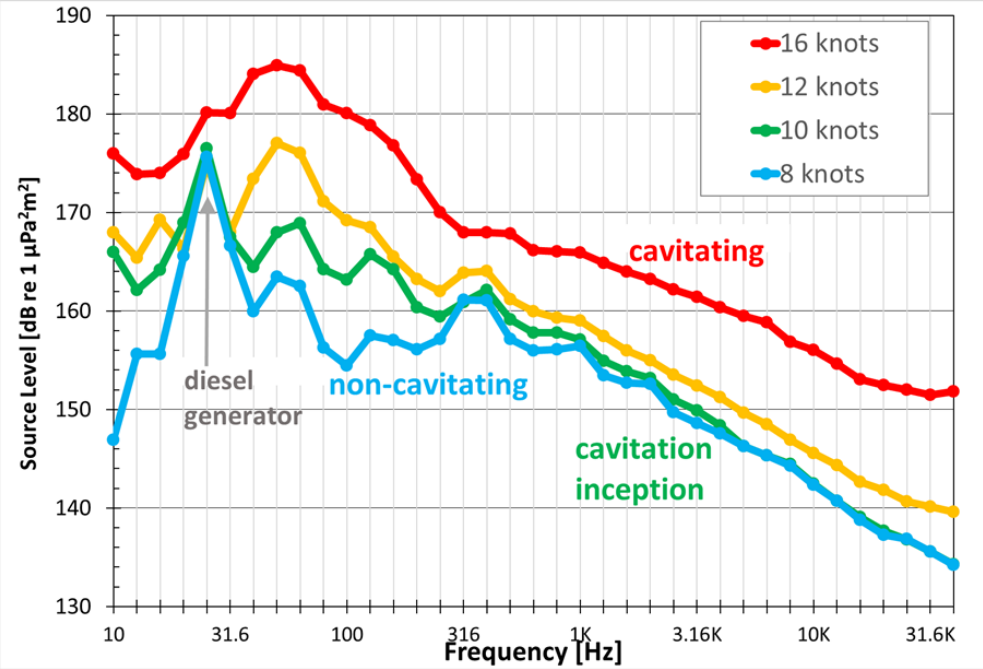


Insertion loss: up to 20 dB above 1 kHz

- Bubbles might be integrated with air lubrication to reduce resistance
  - Not tested in Saturn
  - Gains of 5 % - 10 % have been claimed in literature
  - Bubbles can reduce propeller efficiency

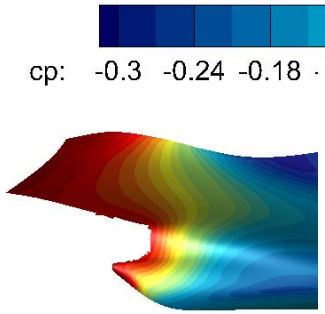


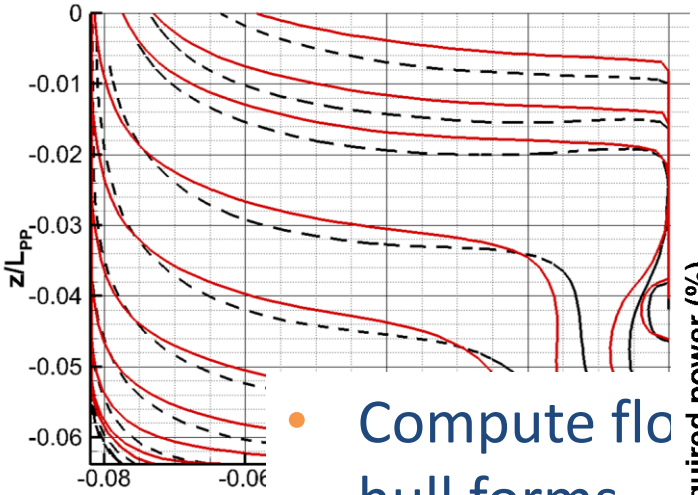
URN from ships: cavitation-induced



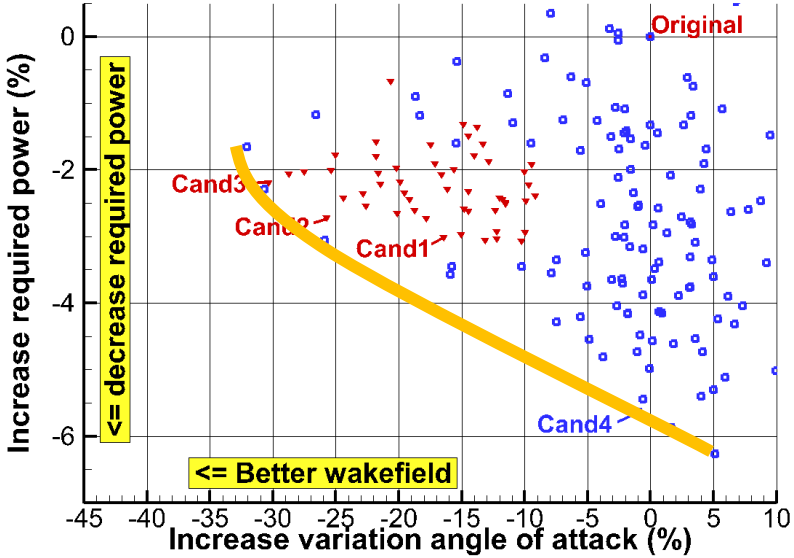
Source: Arveson & Vendittis (2000) 173 m cargo vessel

Solution 2: Hull form optimisation

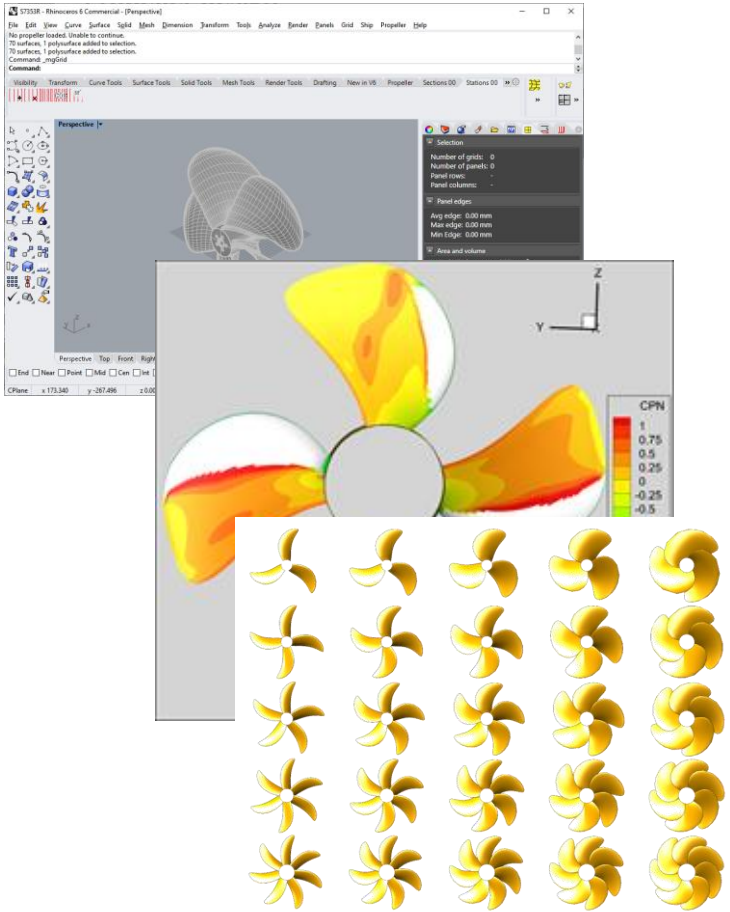


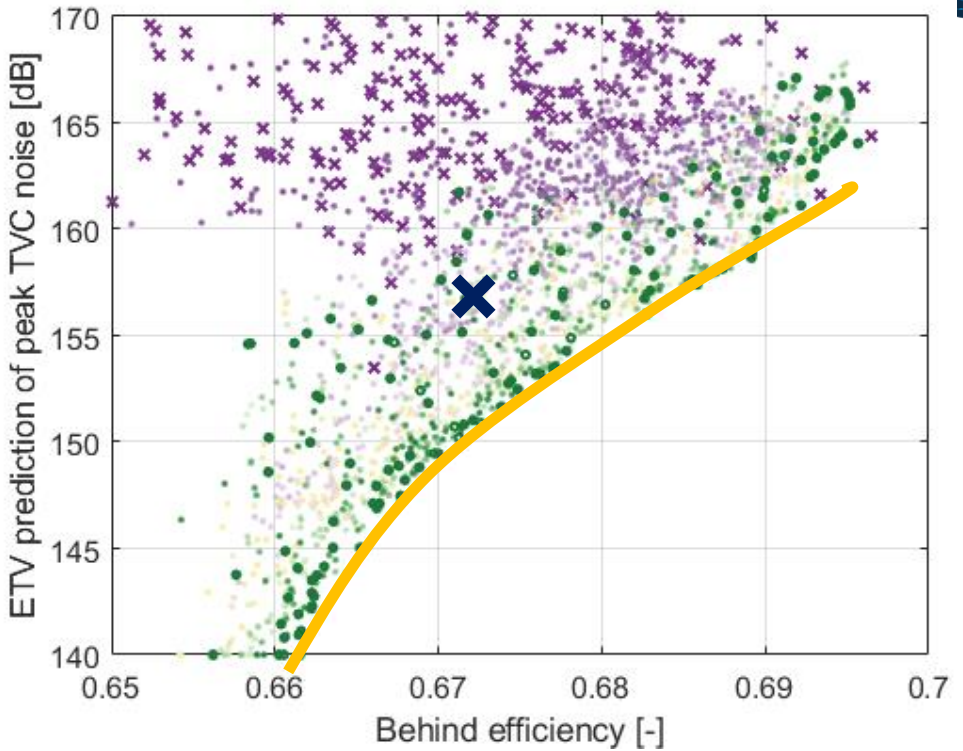


- Compute flo
  hull forms



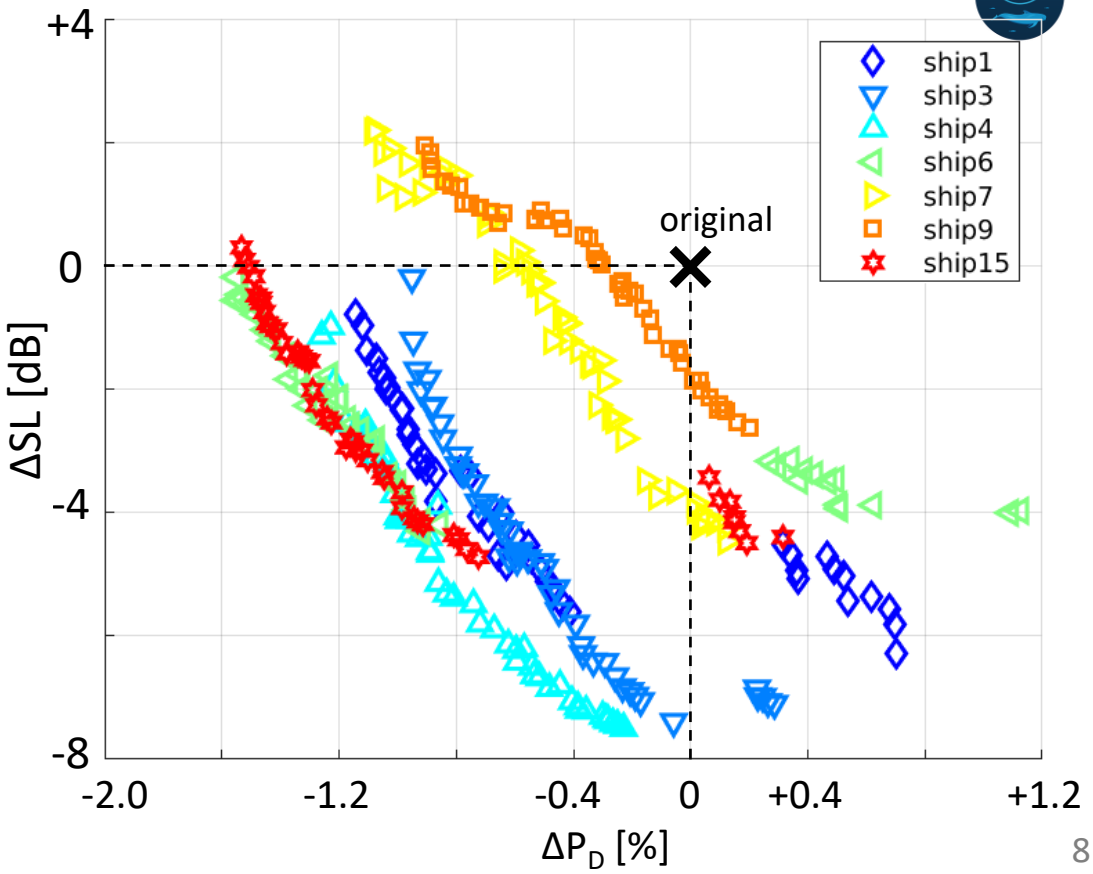
Solution 3: Propeller optimisation



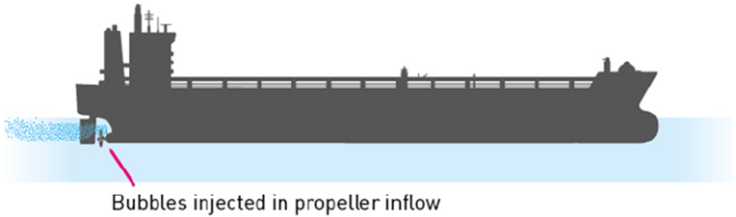


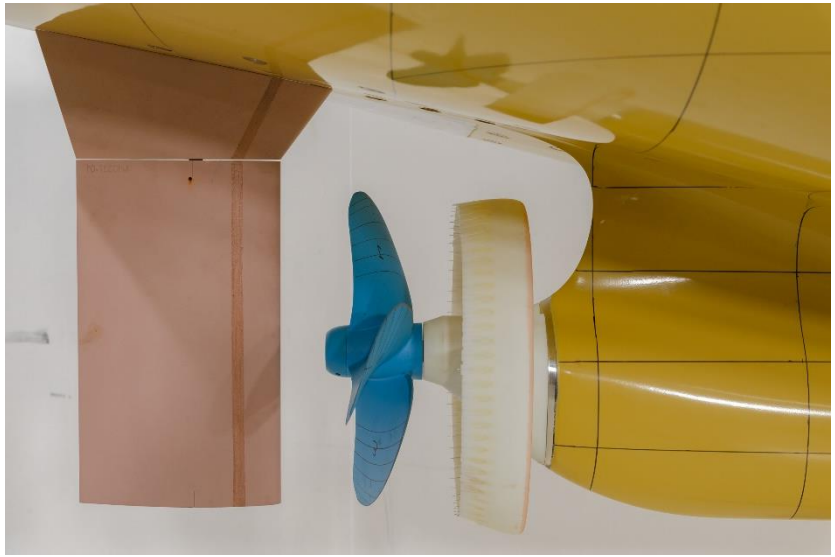
Solution 2 + 3 combined: System optimisation

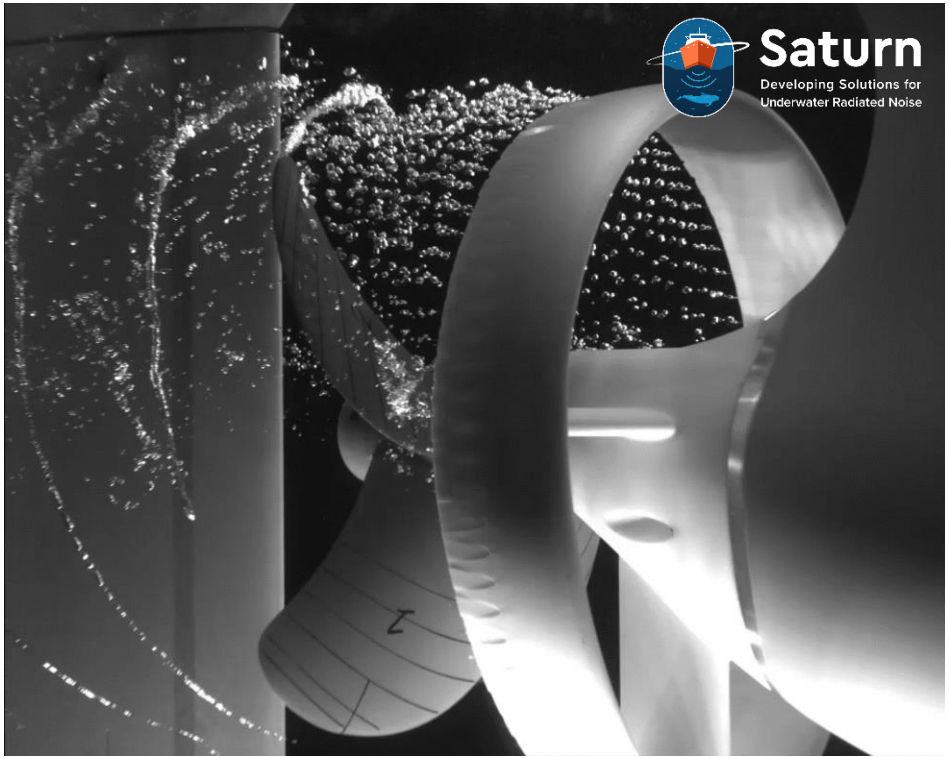
- Traditionally:
  1. optimise hull form for resistance
  2. optimise propeller in the resulting wakefield
- Integrated aproach:
  - optimise system of hull and propeller *simultaneously* for efficiency and URN



Solution 4: Prairie-like system







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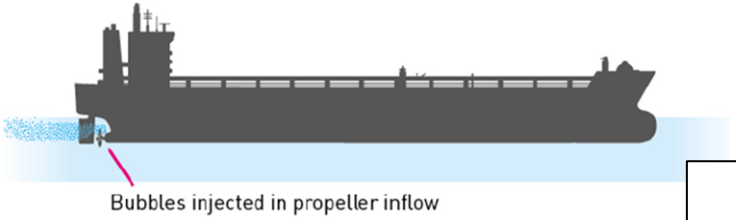
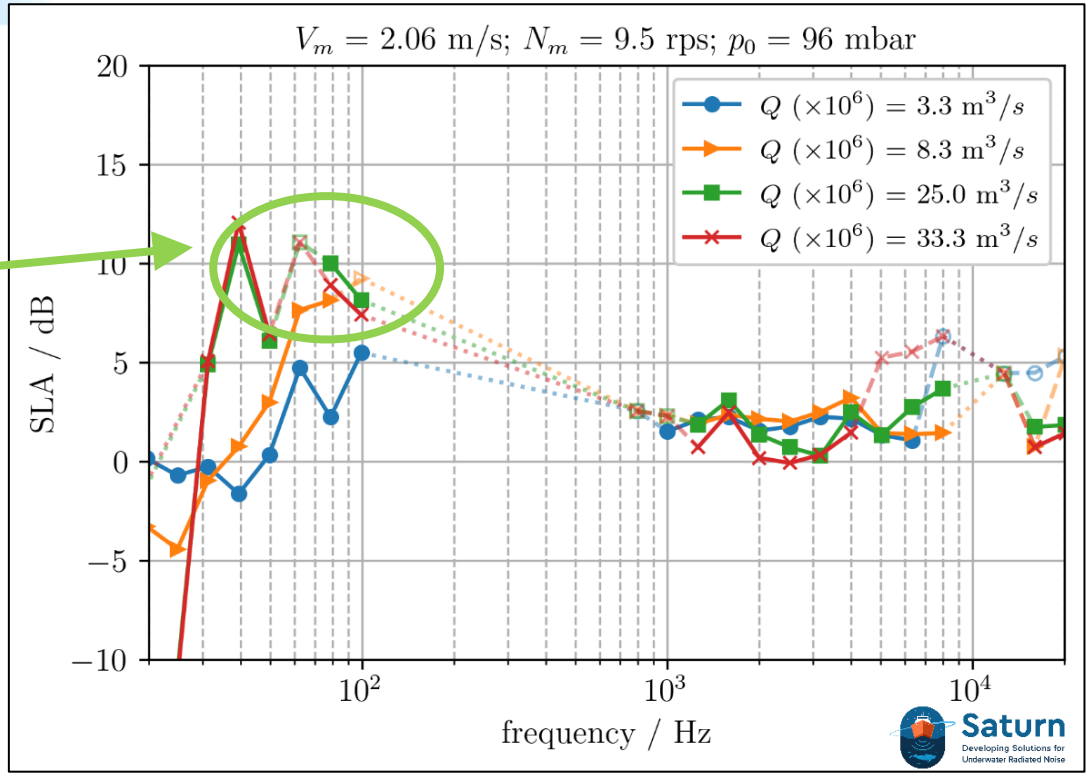
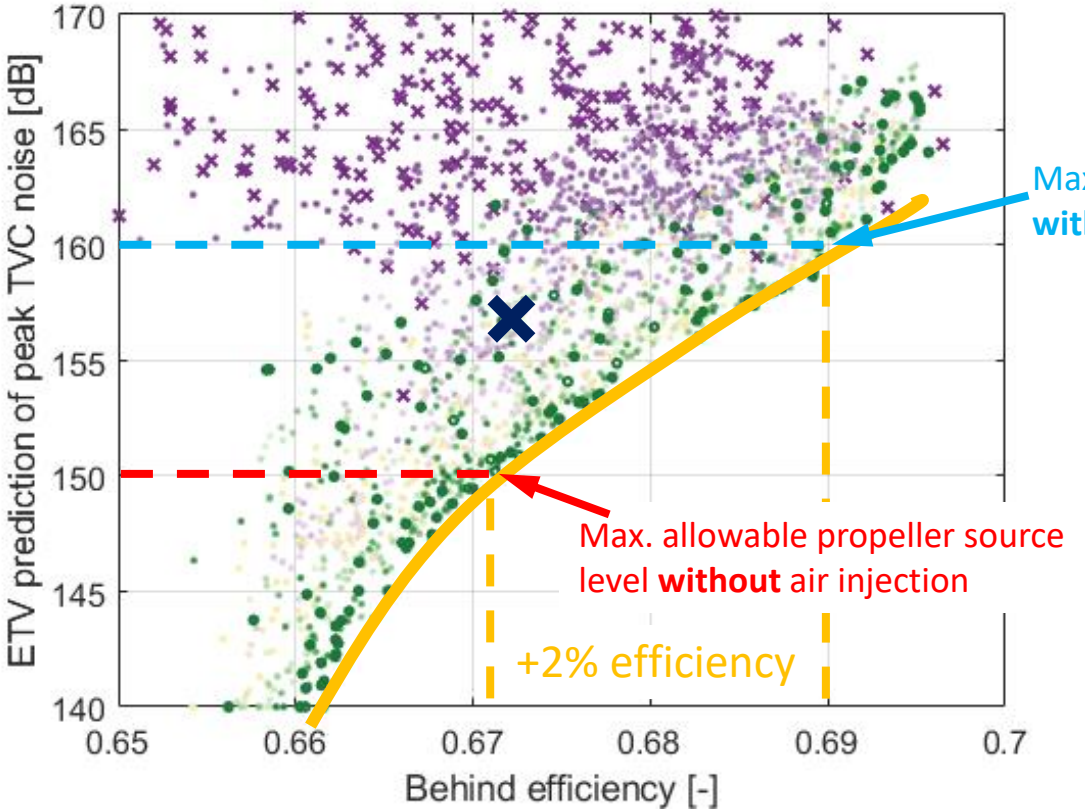


Source level attenuation:
10 dB low frequencies
(tip vortex cavitation)

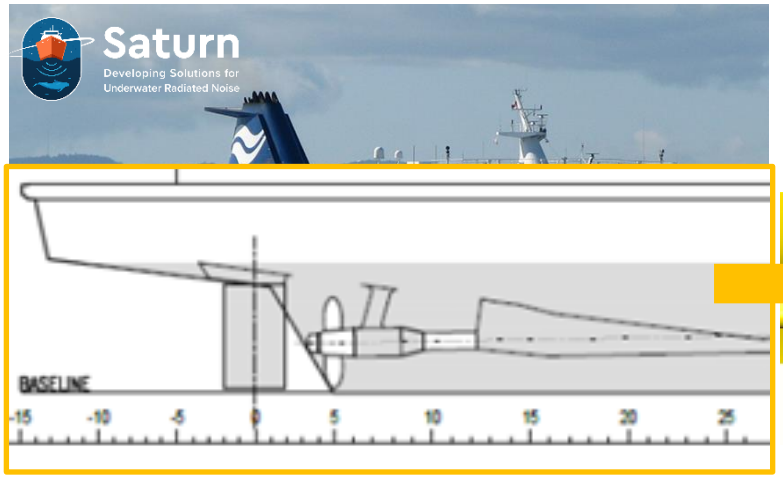


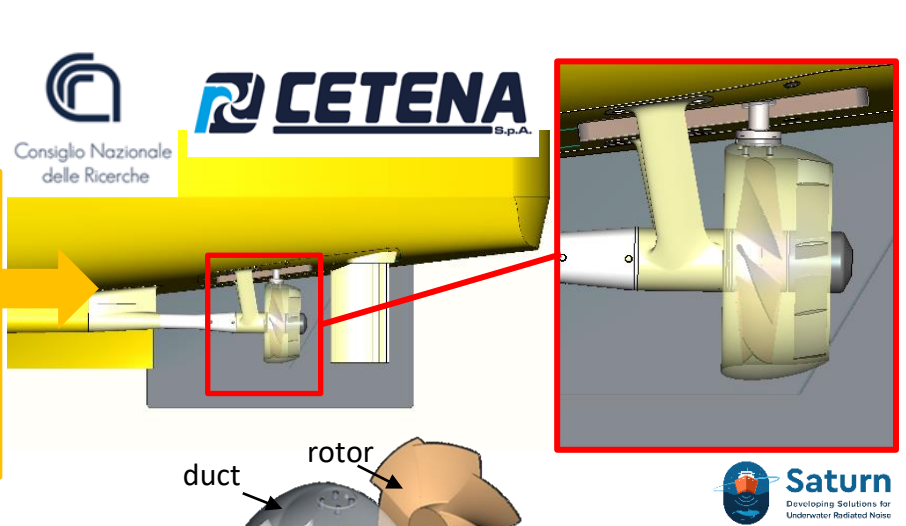
Solution 4: Prairie-like system – propeller selection

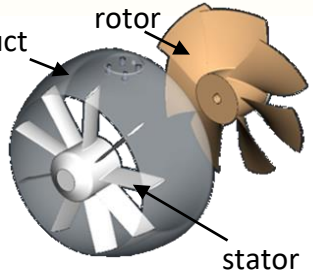


- Influence of air on efficiency not taken into account:
  - Small drop expected due to lower density

Solution 5: Change propulsion concept







Pumpjet (Saturn T4.3):

- Suppresses cavitation on rotor
- Efficiency +2% w.r.t. existing propeller
- Will be tested for Saturn (CNR cavitation tunnel) in 2024

Solution 5: Change propulsion concept

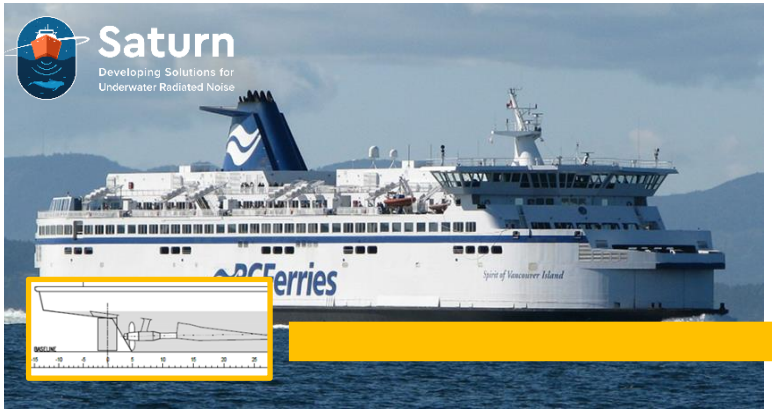


Photo credits: SIREHNA, NAVAL Group, ADV-Propulse, Formes & Volumes

Trochoidal propeller (Saturn T4.5):

- Large propulsor area and uniform inflow reduce noise
- Model tests and computations completed
- Results to be analysed

Cost-benefit analysis

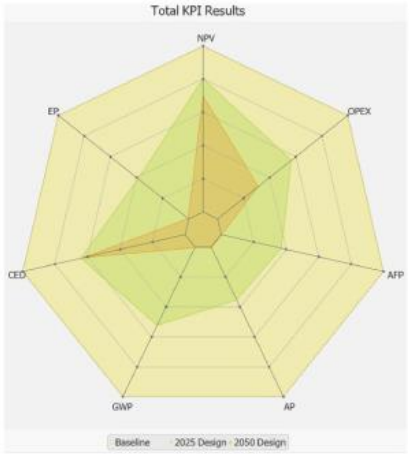
Saturn
Developing Solutions for Underwater Radiated Noise

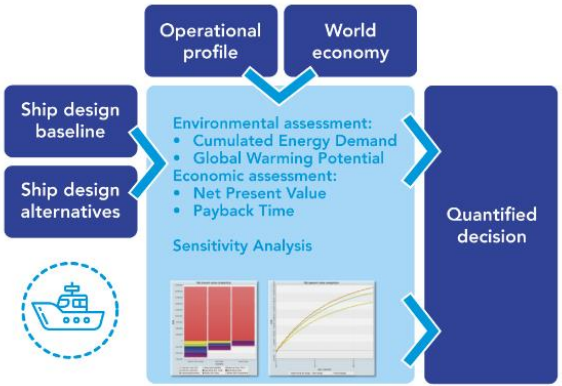
- Cost-benefit analysis of technical mitigation solutions
  - Planned for Saturn T4.6

CETENA B.p.A.

DNV

- KPI: Capital costs + operational costs
  - Depends on ship type and operational profile
- KPI: Reduction of impact on marine species
  - Translate change in source levels to change in impact for a single ship
- KPI: Impact on energy efficiency
  - Use will be made of LCPA software





Thank you

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