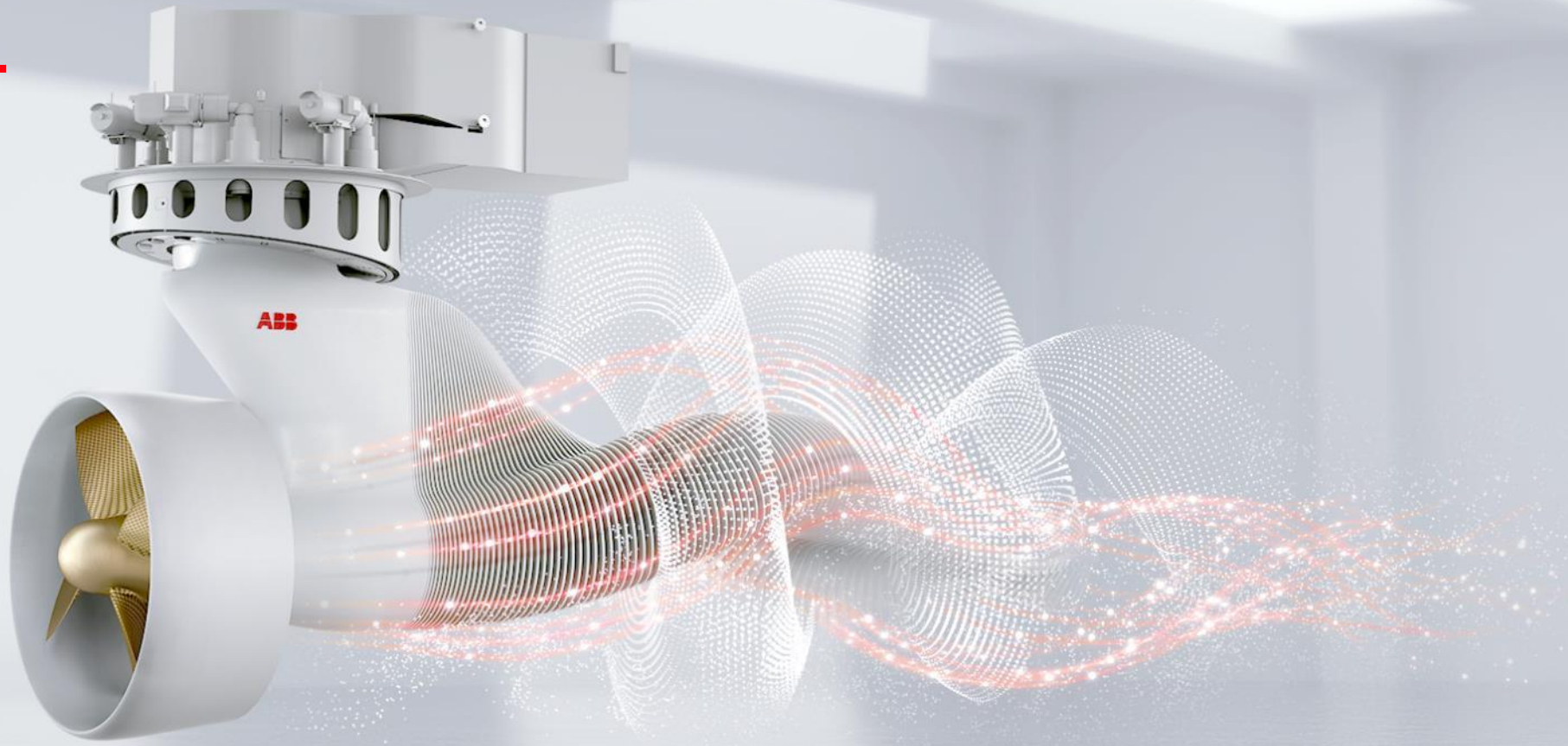


HELSINKI, 13.10.2023

Propeller Borne Noise

Aalto lecture

Introduction

Topics

- ABB & Hydrodynamics
- Acoustic Noise phenomena
  - Basics
  - Standards
- Propeller noise
  - Vibration sources
  - Blade passage pressure
  - Cavitation
  - Singing
- Propeller design
  - Methods
  - Design to avoid noisy cavitation
  - Design to avoid singing
  - Effect of ship hull

ABB & Hydrodynamics

Contents

ABB - Electrification and automation.
Marine and ports - Electrical propulsion and integrated solutions for ship and shore

- Azipod™

Various vessels

Hydro team

- 3 Hydrodynamists
- 2 dedicated CFD analysists
- 1 Noise specialist

Acoustic noise phenomena

Physics

In physics, sound is a vibration that propagates as an acoustic wave, through a transmission medium such as a gas, liquid or solid. -Wikipedia

Vibration
- Pressure change

Wave:
- Amplitude
- Frequency

Transmission medium
- Sea, air
- Ship hull

Acoustic noise phenomena

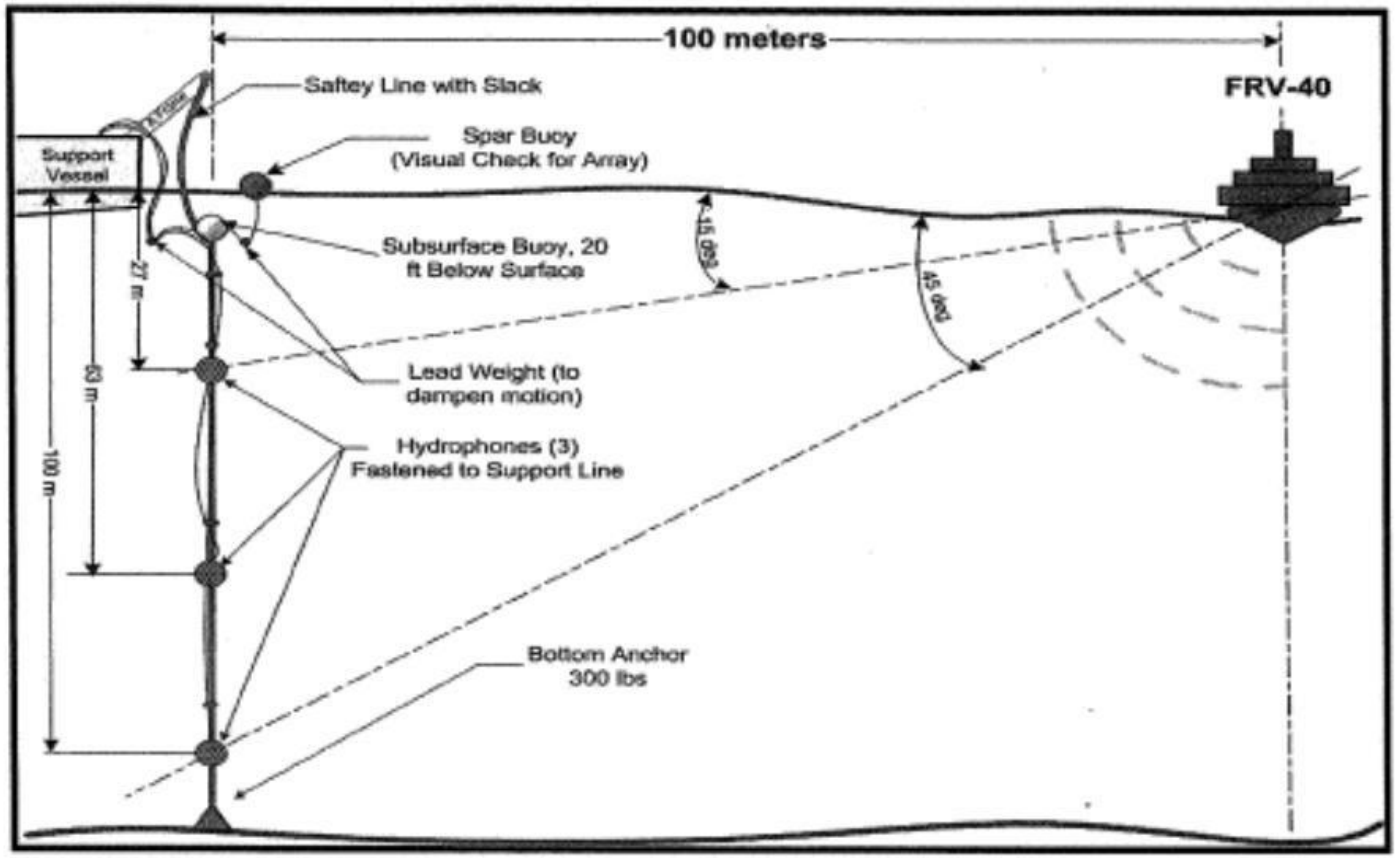
How to obtain

Empirical methods

Simulation based methods

Measurements

- Model scale
- Far field vs nearfield



Acoustic noise phenomena

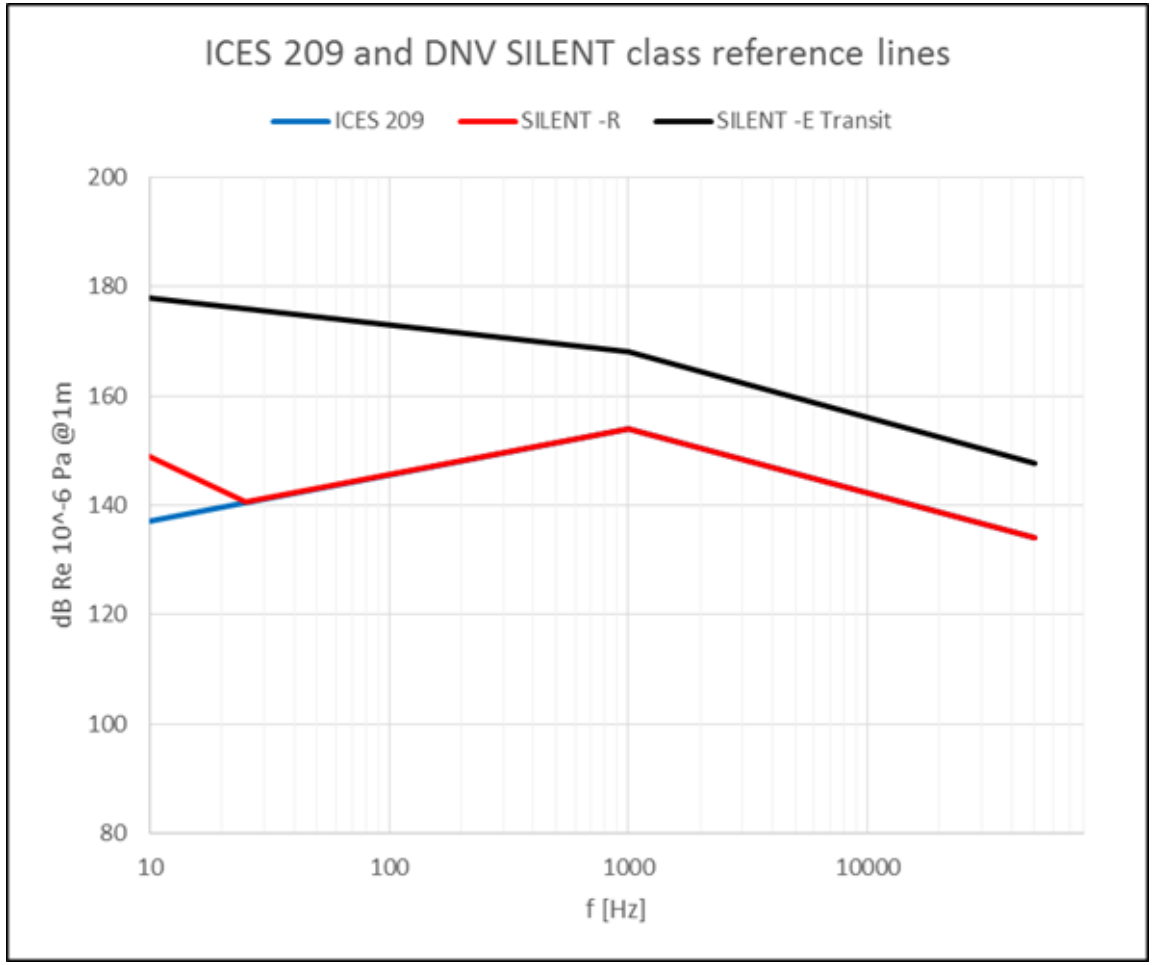
Standards

Noise in oceans is increasing – legislature – standards for shipping

Onboard and Underwater Radiated Noise

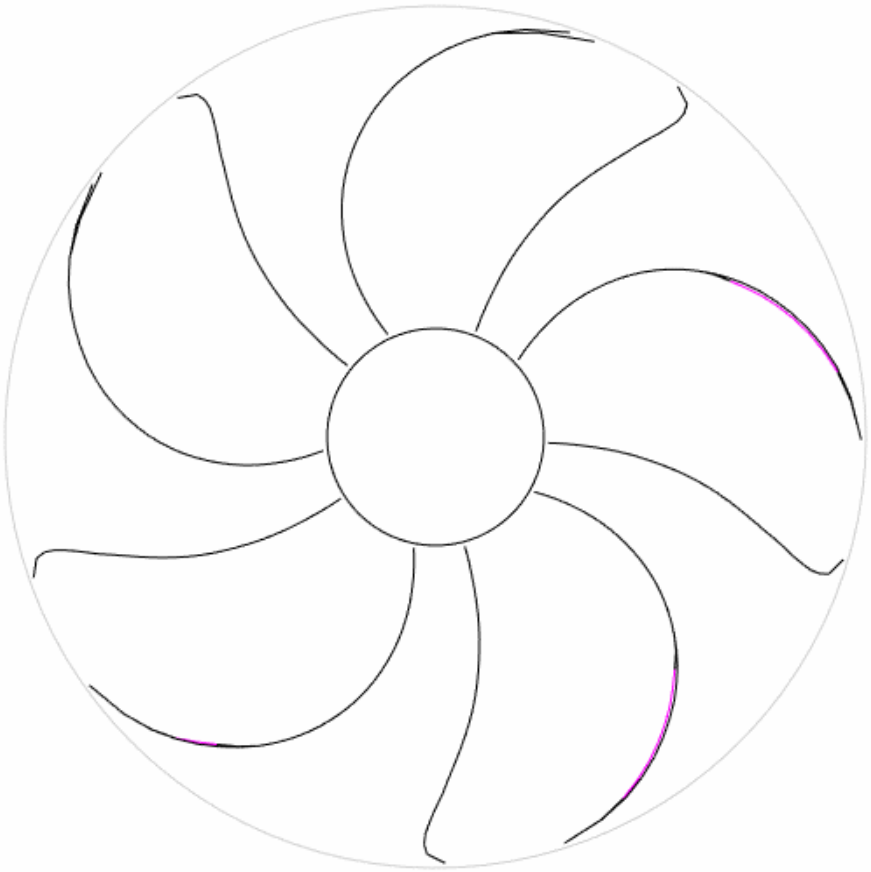
Standards based on operation type:

- Research vessel vs cargo vessel



Propeller noise

Blade passage pressure



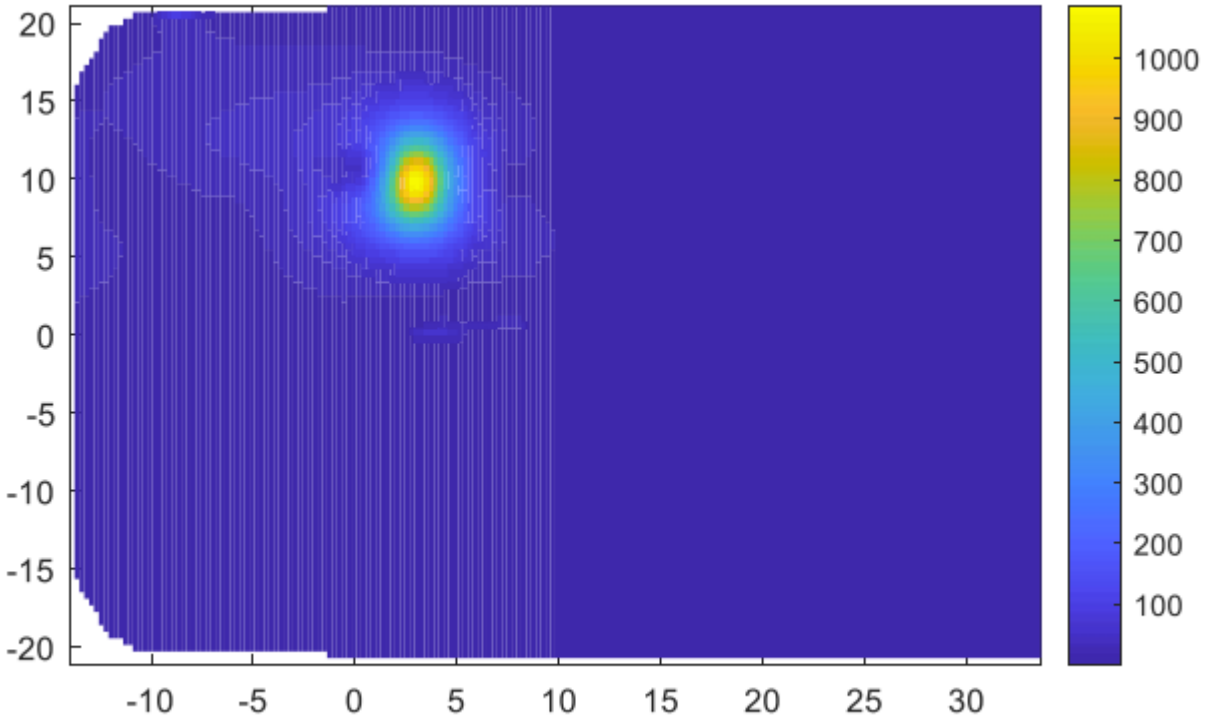


Figure 4-6:Amplitude of the pressure field at first harmonic, 83% MCR

Propeller noise

Cavitation

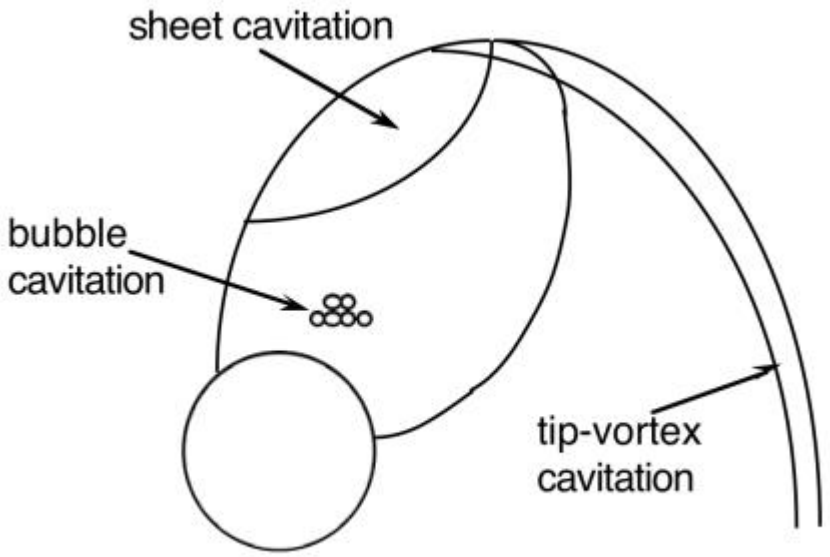
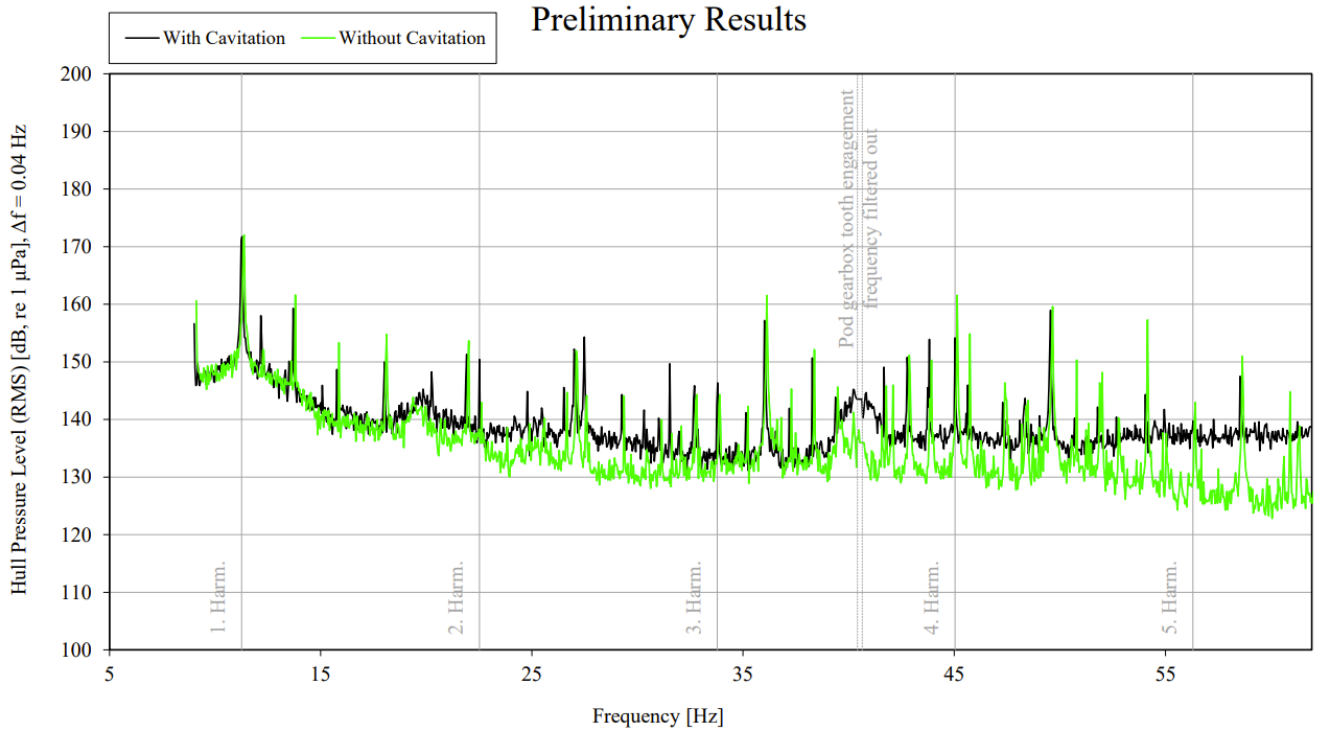
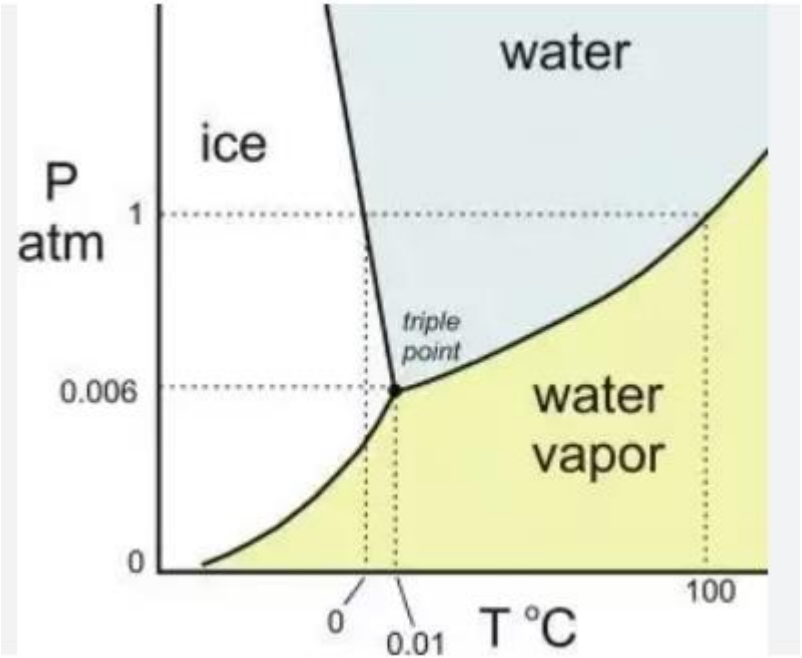


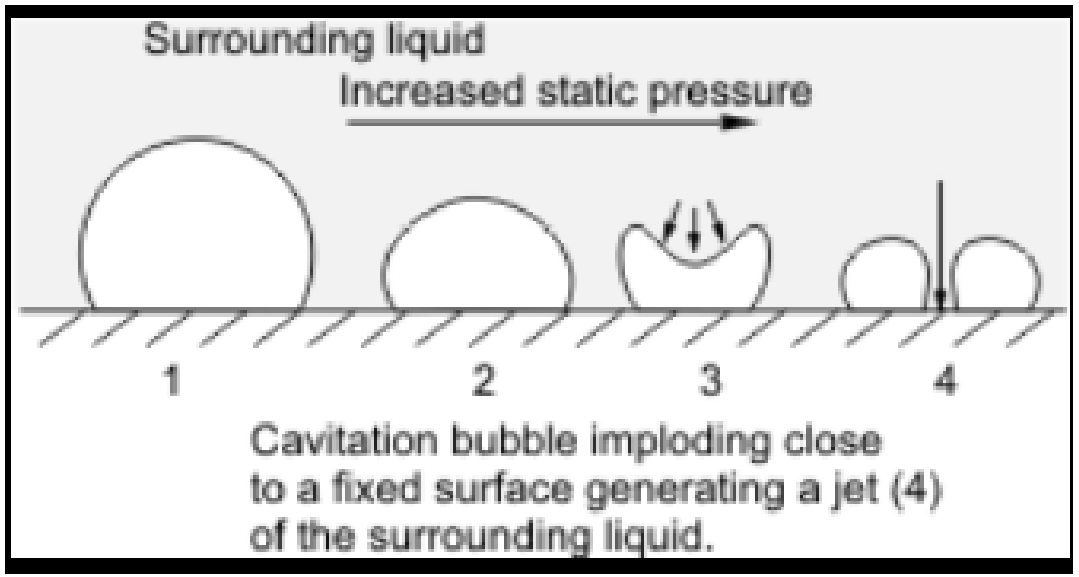
Figure 5.27. Propeller cavitation types.



Propeller noise

Cavitation





Propeller noise

Cavitation

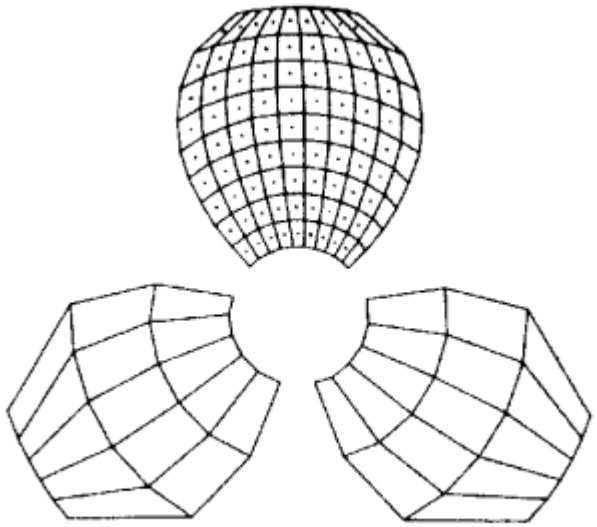


Fig. 7 Illustration of discrete singularity elements on key blade and other blades

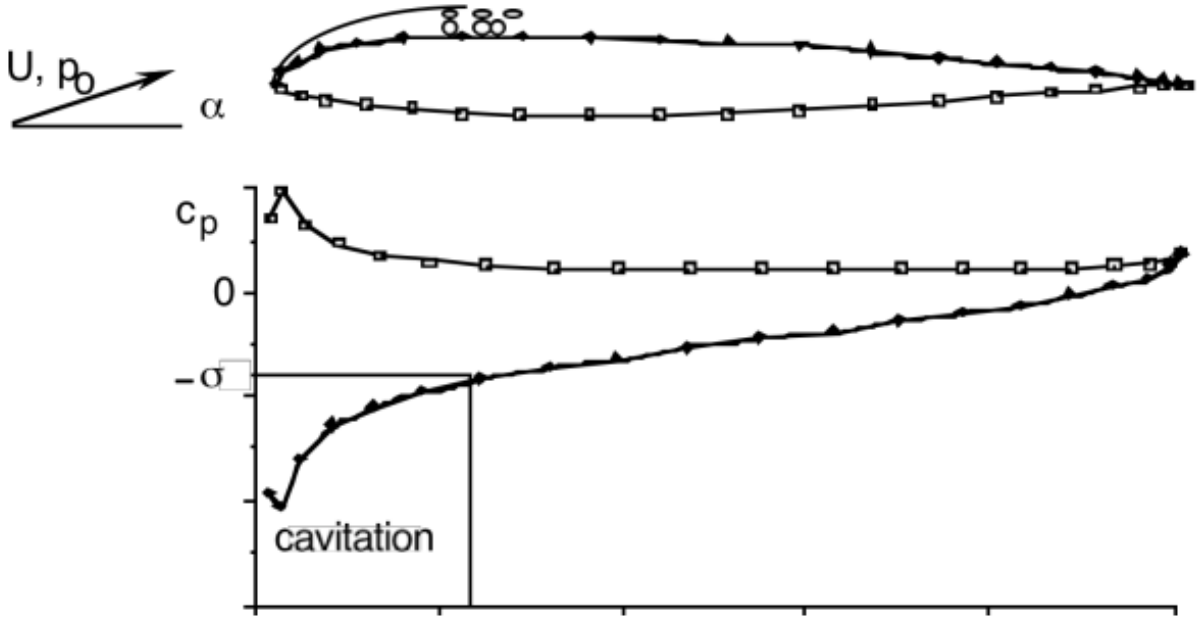
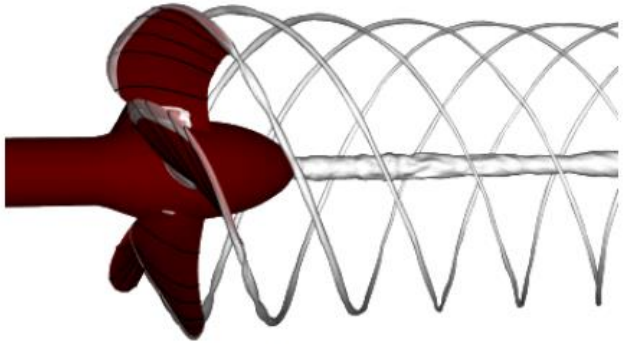


Figure 5.28. Illustration of a cavitating hydrofoil.

Propeller noise

Cavitation

(a) EFD.

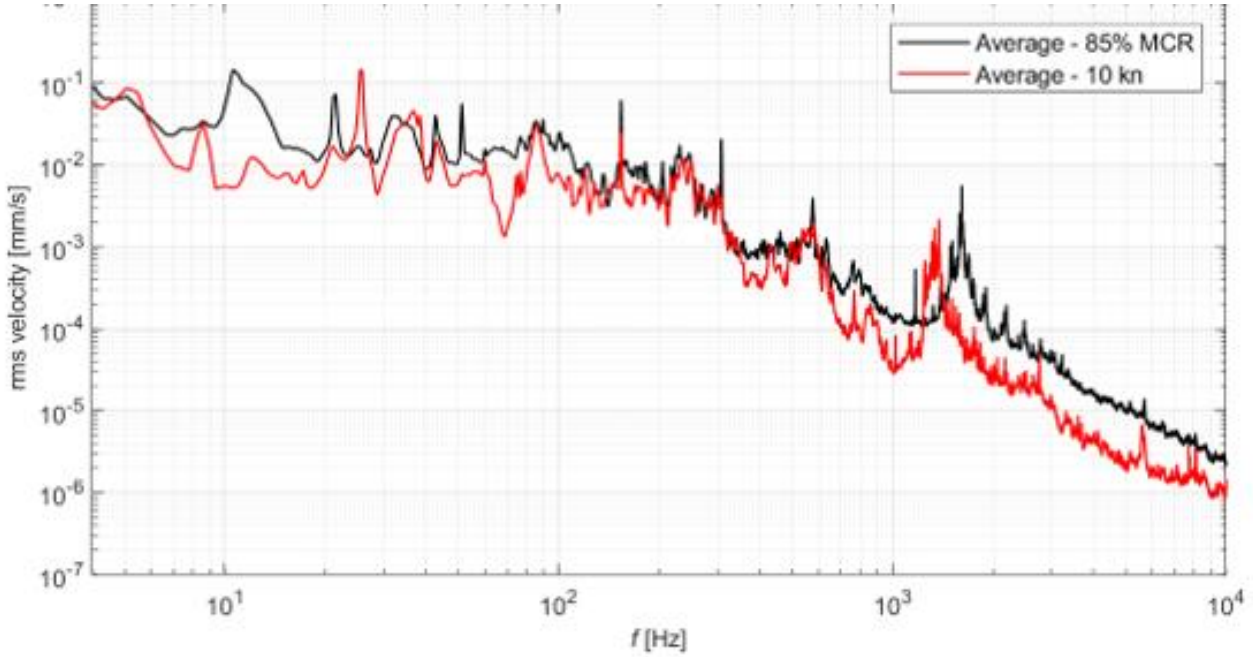


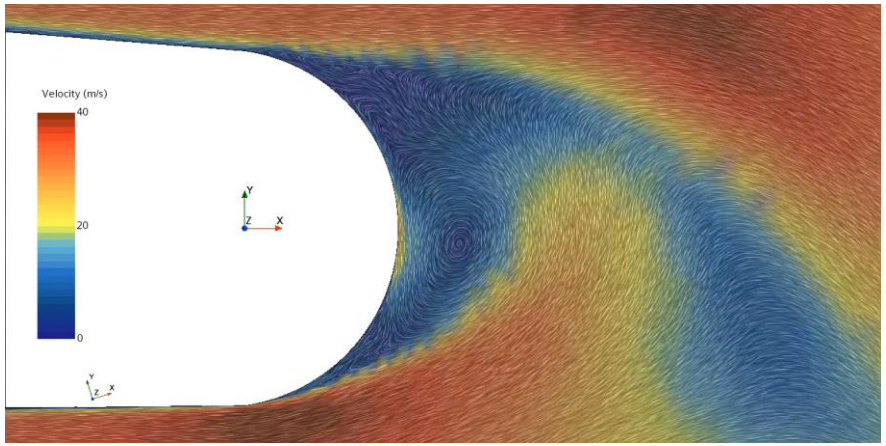
(b) CFD.

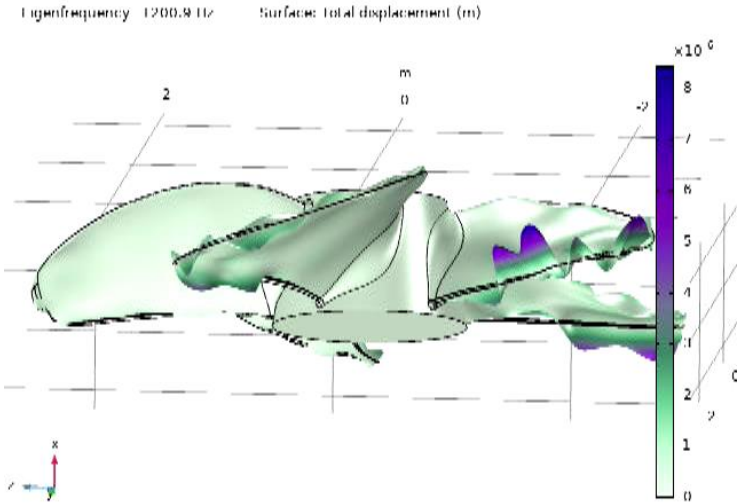
Figure 13. Comparison of the tip and hub vortex cavitation extents behind the propeller.

Propeller noise

Singing

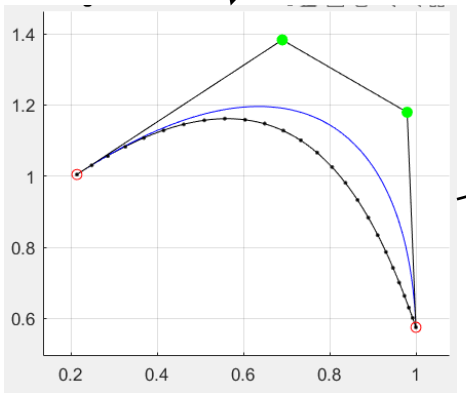






Propeller design

Methods



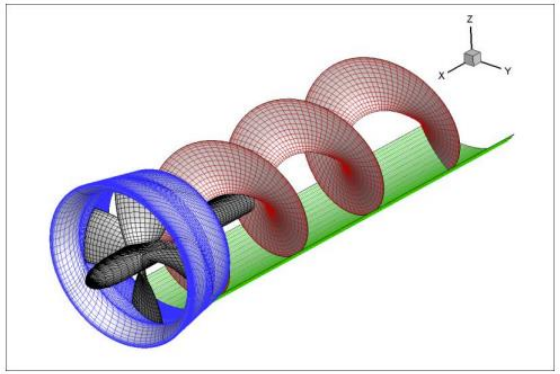
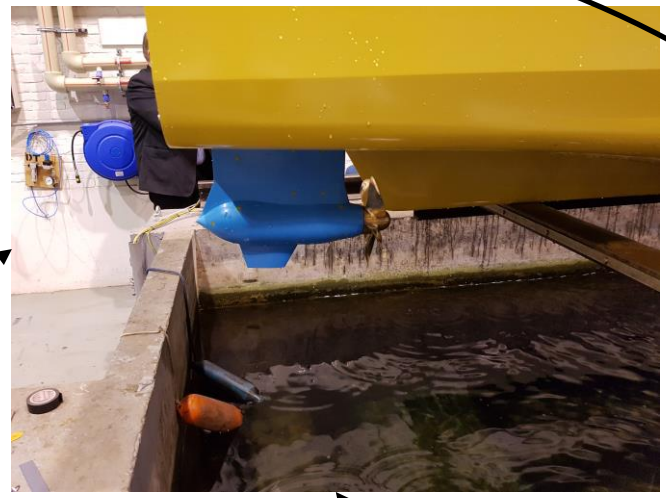
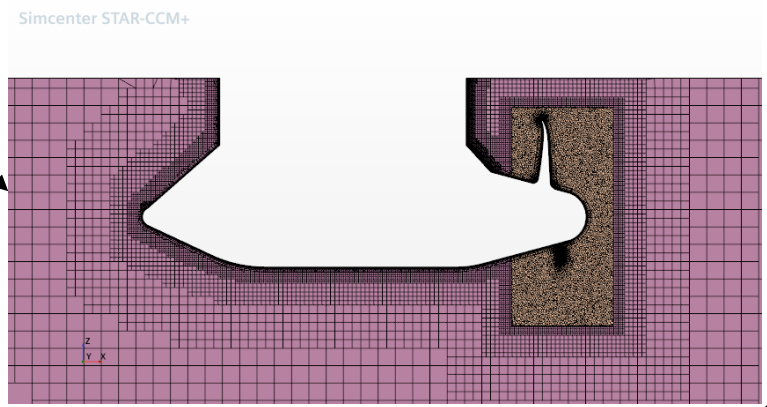


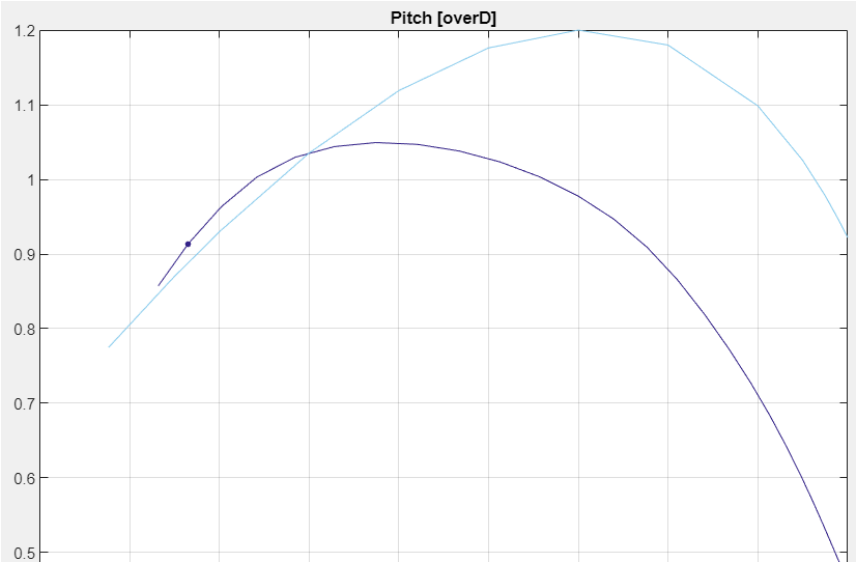
Figure 2.1: Surfaces Used in Ducted Computation



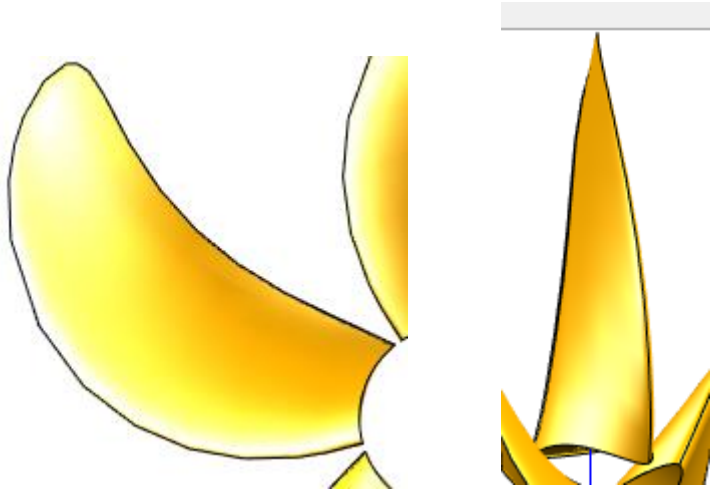


Propeller design

Design to avoid noisy cavitation



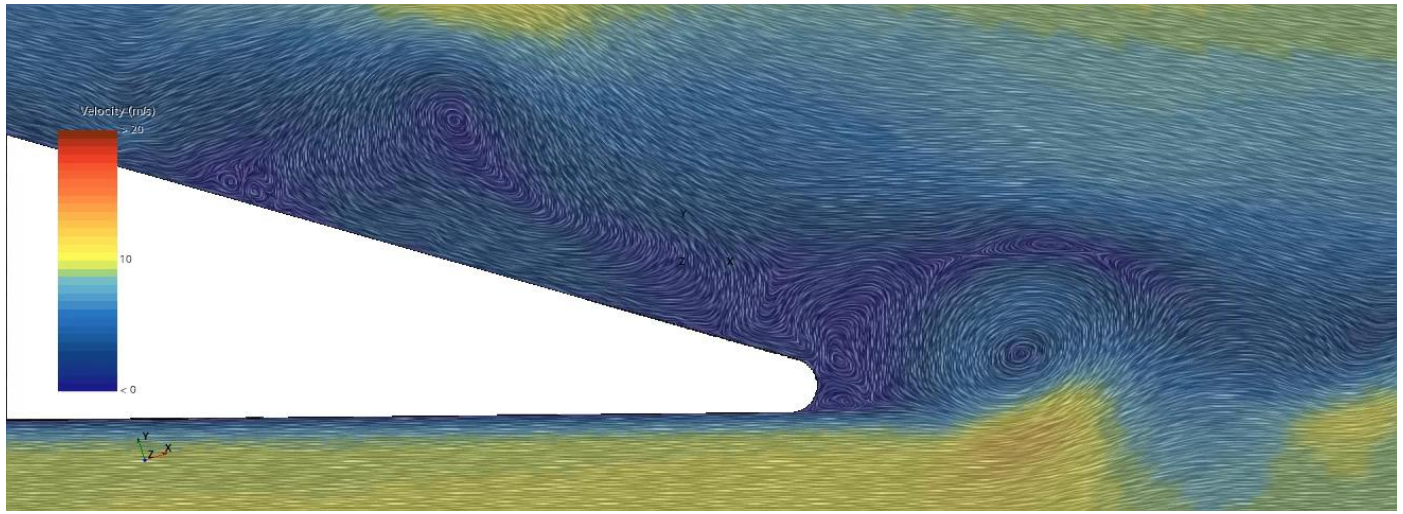
High efficiency propeller

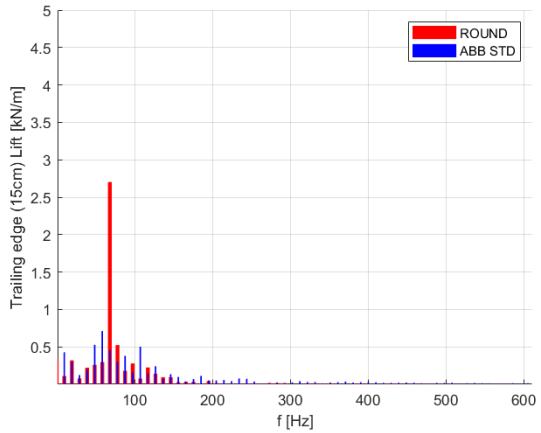


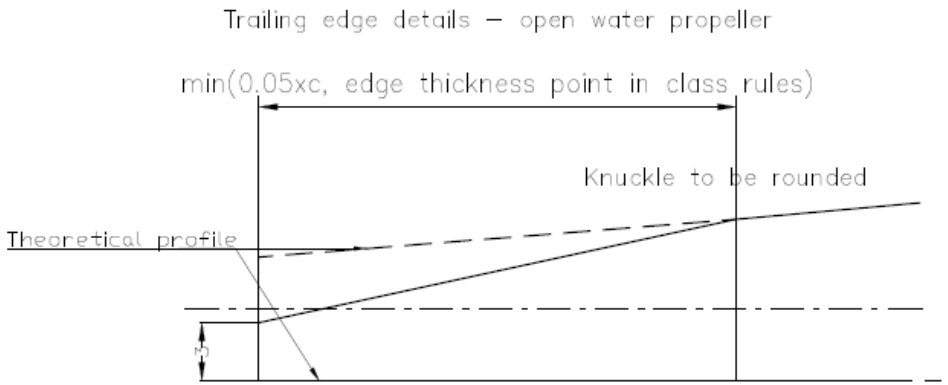
Research propeller

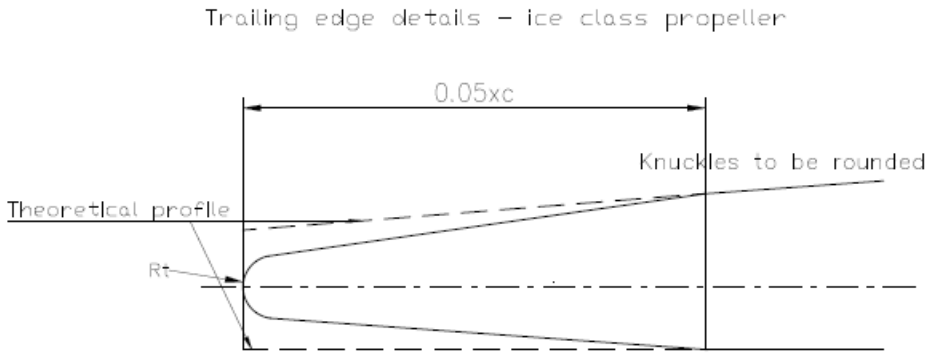
Propeller design

Design to avoid singing



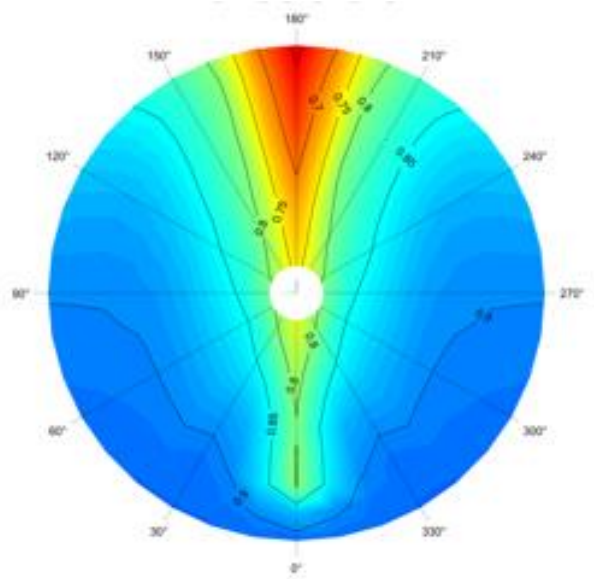


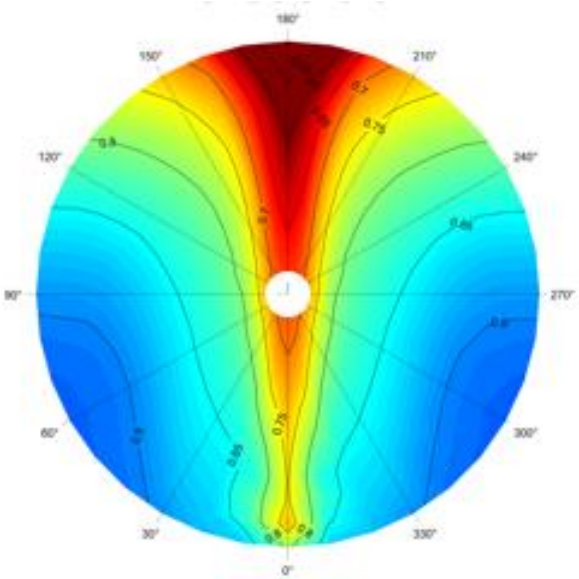


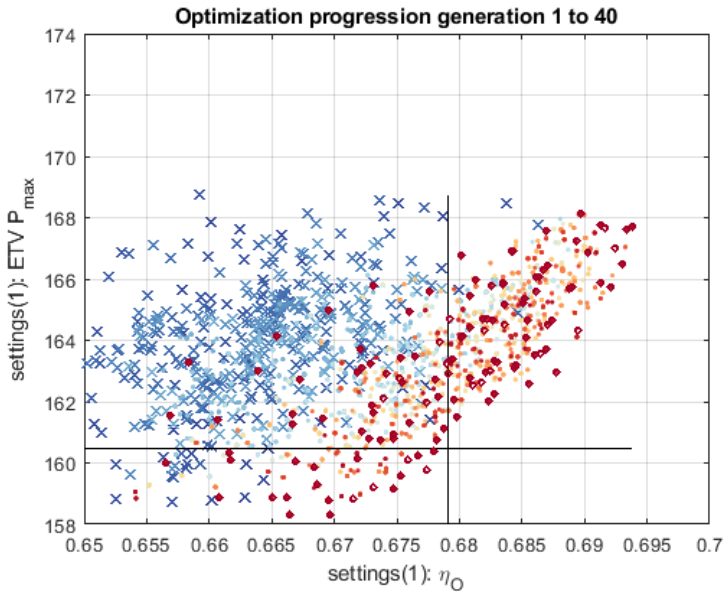


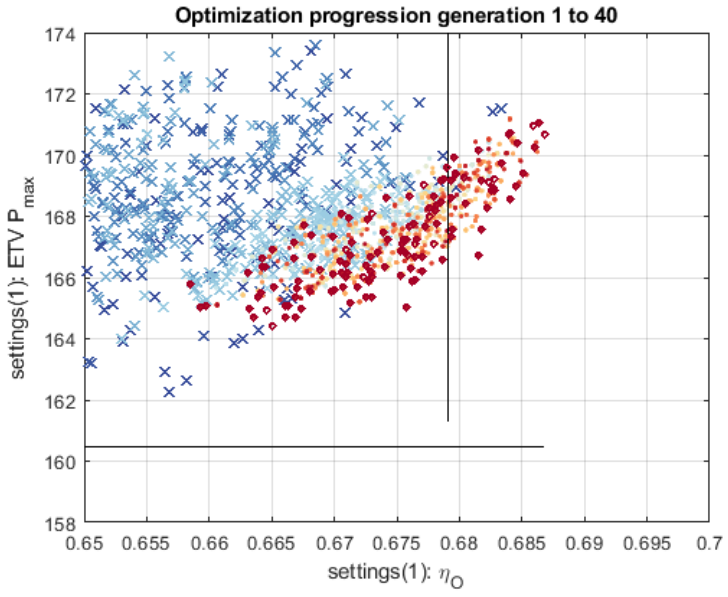
Propeller design

Effect from ship hull









Any questions?

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