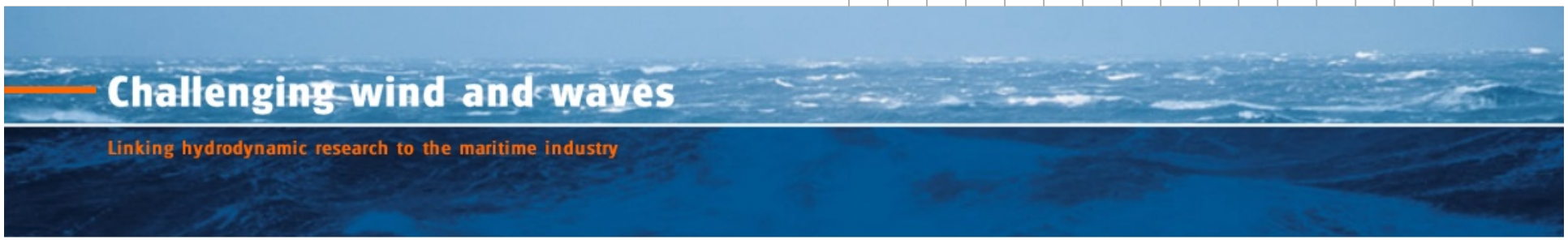
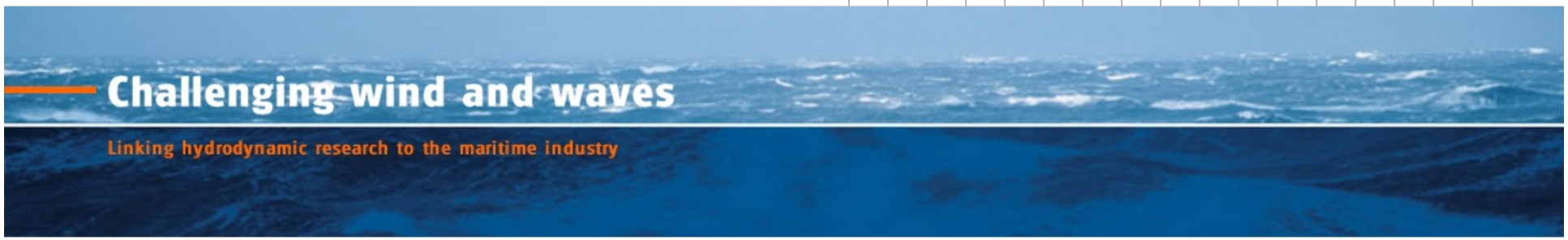


CO_2 emission reduction by hull form optimisation using CFD

Karola van der Meij

CCNR 12-04-2011 Strasbourg



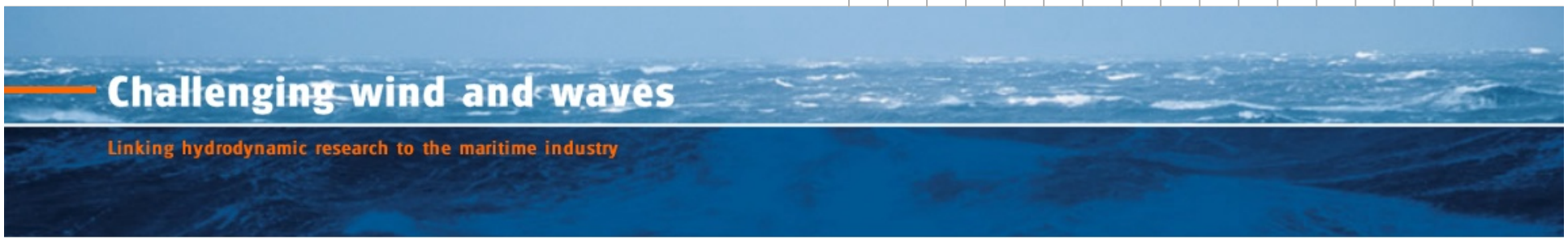
CO_2 emission reduction for existing ships by hull form optimisation using CFD

Karola van der Meij

CCNR 12-04-2011 Strasbourg

Structure

- MARIN
- Approach
- Diagnose of existing ships
- Hull form optimization
- Costs - Benefits
- To conclude


Challenging wind and waves
Linking hydrodynamic research to the maritime industry

MARIN

MARIN: Maritime Research Institute Netherlands

Independent and innovative service provider
for the maritime sector
in hydrodynamic
and nautical research

Dual mission

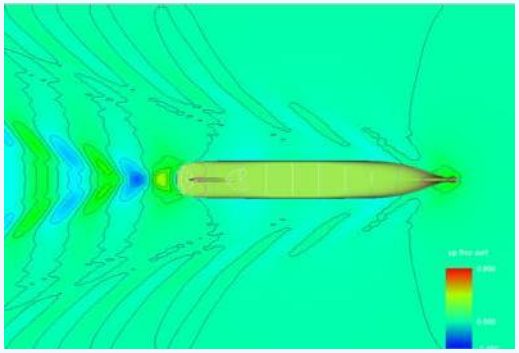
- To provide industry with innovative design solutions

- To carry out advanced research for the benefit of the maritime sector as a whole

Organisation

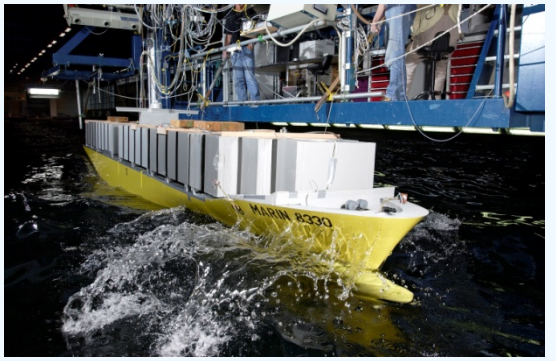
- 300 employees
- Non-profit foundation
- Since 1932
- GTI (Large Technical Institute)
- 150 ships assessed/year
- Competitors
  - HSVA, SSPA
  - MARINTEK,FORCE
  - OCEANIC
  - DTRC, BEC in navy

Activities



Simulations

MARIN expertise



Model tests

Full scale

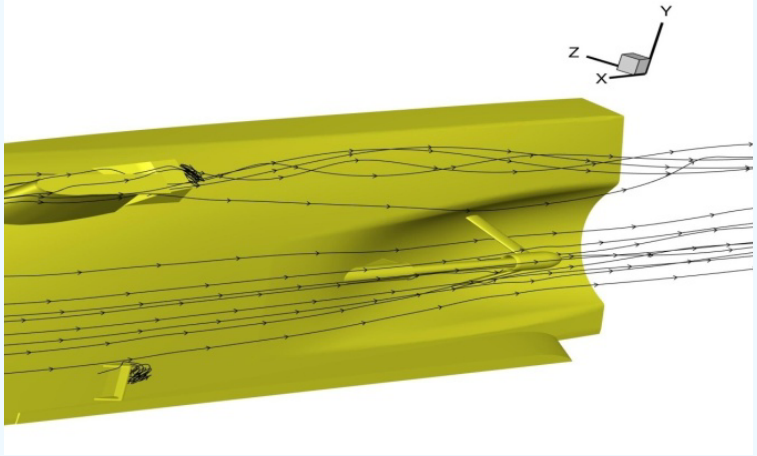
Training

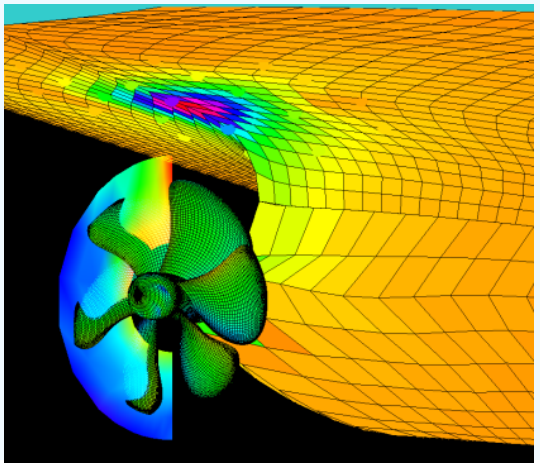
Services & products

- R&D and industrial services for the maritime sector
- Applied contractual research
- University and engineering company in one
- Services
  - Concept design
  - Design support
  - Operation support
  - Tool development

Experimental facilities

- 7 large facilities, 3 simulators
- Full scale measurement systems
- Computer models





MARIN - Business Units

- Ships
- Offshore
- Nautical Centre MSCN
- Trials & Monitoring
- R&D
- Maritime Simulation & Software Group

MARIN and inland waterway transportation

1. Determination of **feasibility of integrating ships** in transport chains
   - Conceptual design of chains and ships
   - Conceptual design of ships
2. Detailed design of inland ships: hull and propellers
3. Environmental impact of inland navigation
4. Nautical safety and efficiency (MSCN)


Challenging wind and waves
Linking hydrodynamic research to the maritime industry

APPROACH

Objective

Hydrodynamic measures to reduce CO_2 emissions for existing ships

Measures

- Reduce resistance of the ship
- Increase efficiency of the propulsion chain

Results

- A reduction in fuel consumption
- A reduction in CO_2 emissions

Approach

Current fleet

Less fuel consumption

Reduction of environmental impact

- Reduction of CO_2
- Reduction of other emissions

Approach

1. Diagnose of existing ships
   - Benchmarking
2. Hull form optimization
   - Calculations (CFD)
   - Improvements to the hull
   - Calculate indication of fuel reduction
3. Cost - benefit

DIAGNOSE OF EXISTING SHIPS

Diagnose of existing ships

- How does the ship perform?
  - Required fuel per transported ton/km
- Taking into account the environment the ship is sailing in

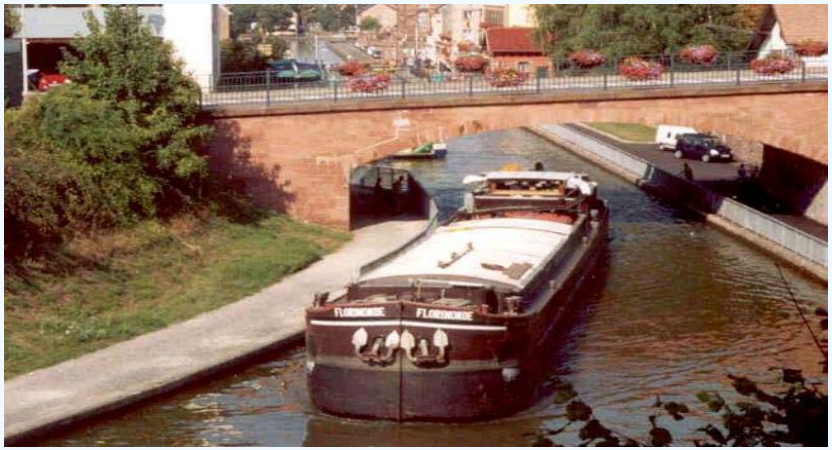
On board measurements

- Ship
  - Fuel consumption
  - Speed
  - RPM
  - Loading condition
  - Position
- Environment
  - Water depth
  - Chanel width
  - Current

Benchmarking

- Compare the performance of the ships
- Benchmarking
- In case of significant negative deviation:

  How can we improve?



HULL FORM OPTIMIZATION

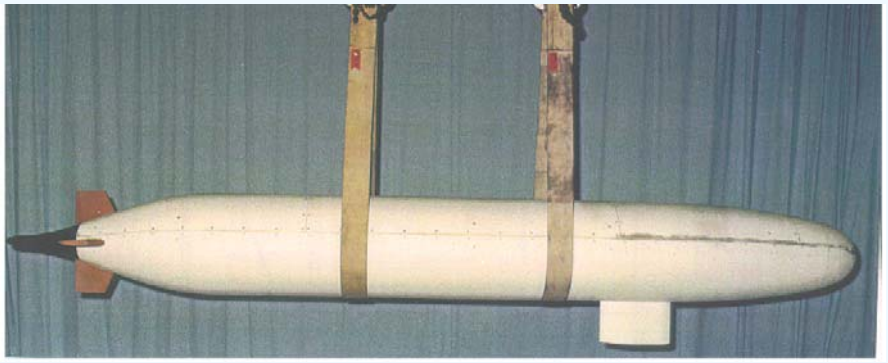
Possible improvements

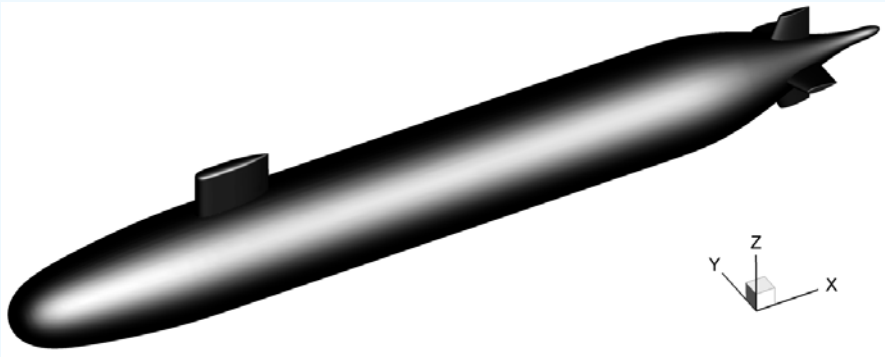
- Propeller
- Rudder
- Aftship configuration
- Tunnels
- Side skirts
- Other appendages

CFD calculations

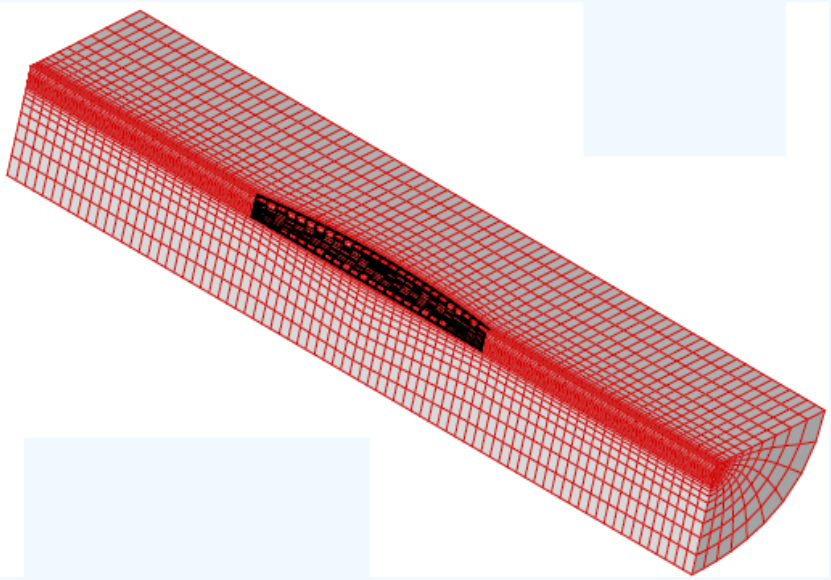
- Computational Fluid Dynamics (CFD)
- Developed at MARIN
- Computational capacity of 1456 cores @ MARIN

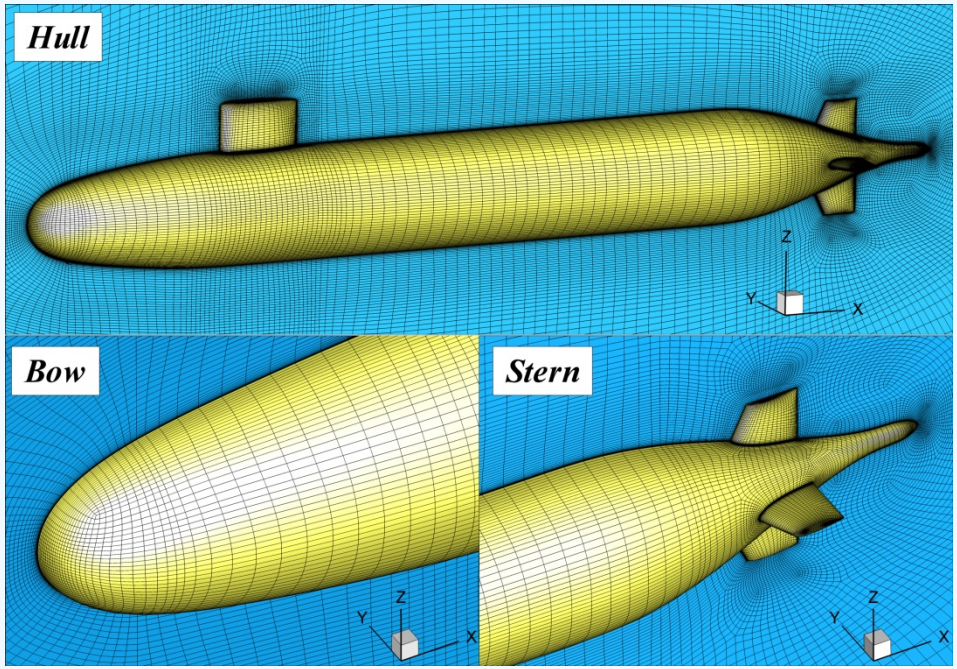
Calculation example



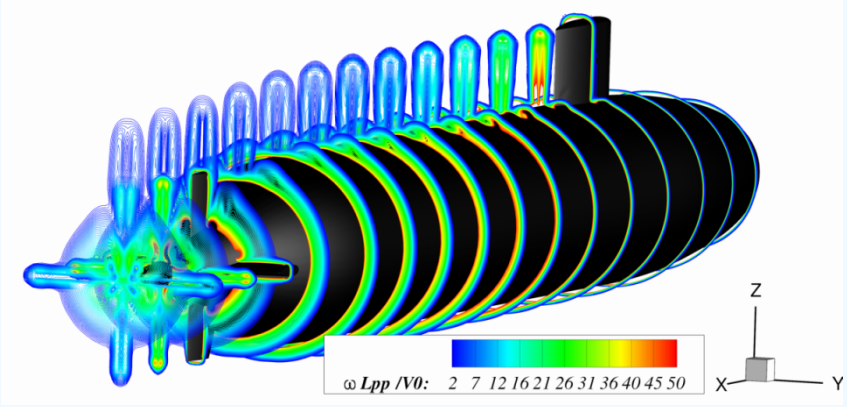


Calculation example

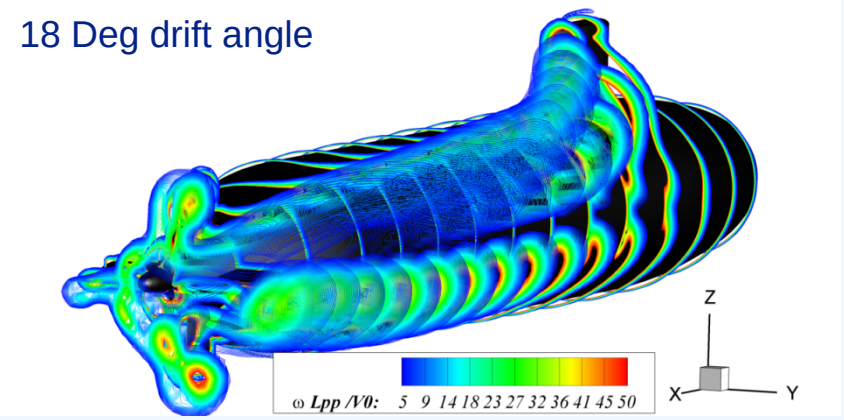




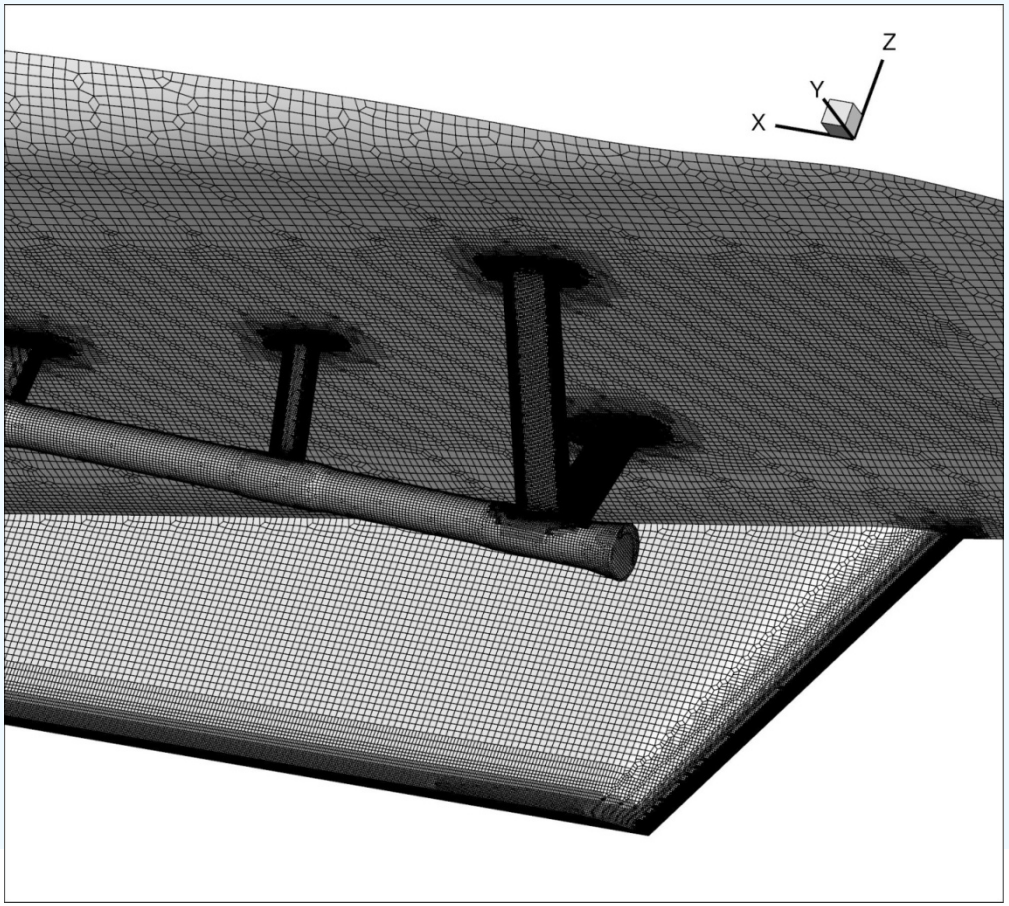
Calculation example



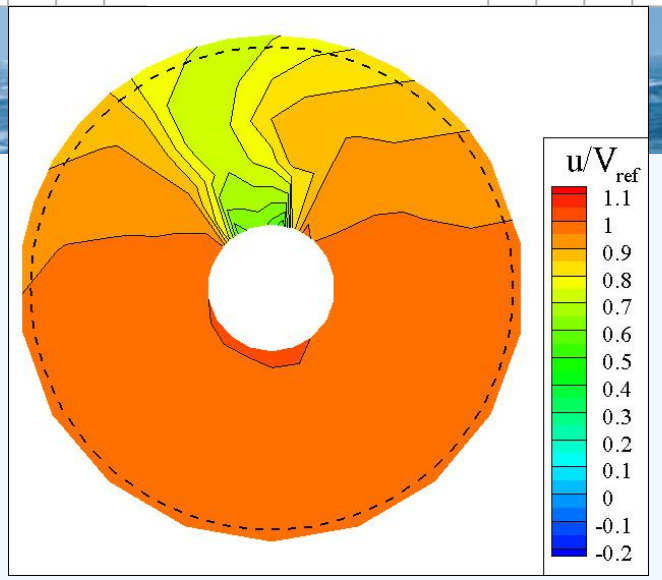
18 Deg drift angle



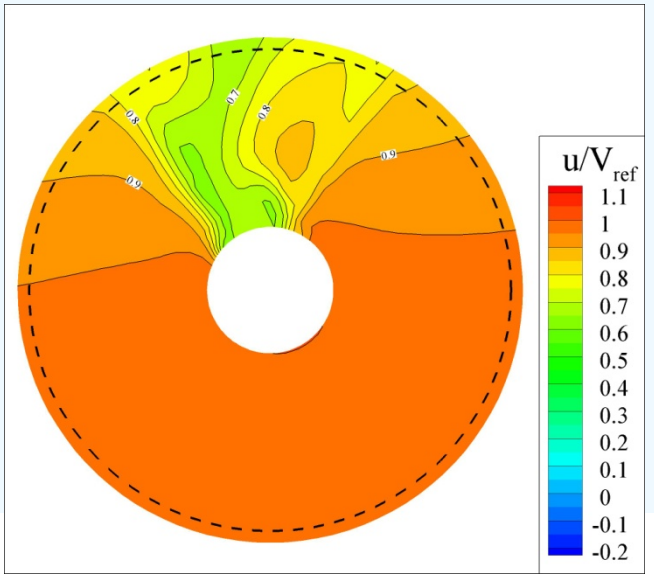
Calculation example



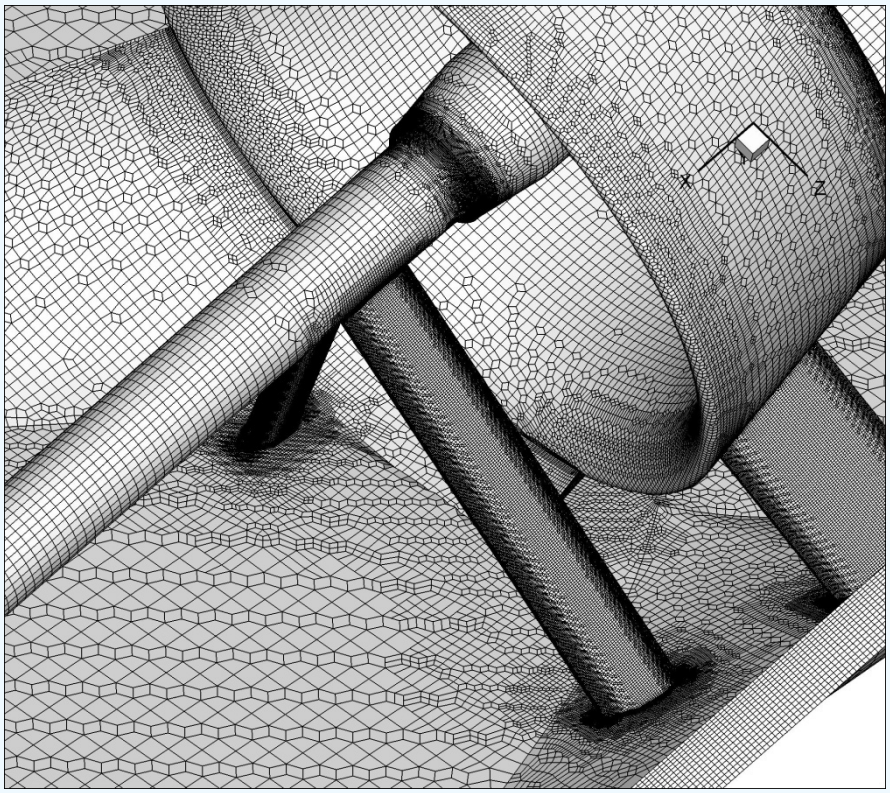
Experiments

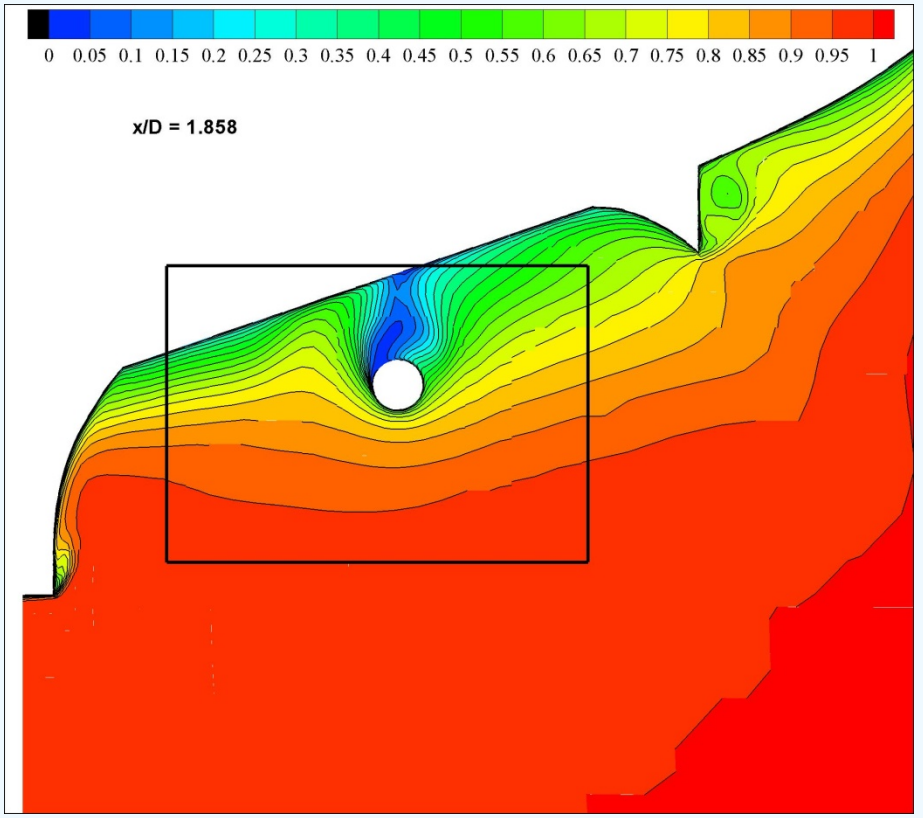


ReFRESCO



Calculation example





Hull optimization

- With CFD the hull form including appendages can be analysed
- Possible improvements will be generated and implemented
- Check: second CFD calculation
- Most important result:

  Reduction of fuel consumption

  - Determine cost of realisation

COSTS - BENEFITS

Effect on exploitation

- Reduction in fuel consumption on yearly basis
- Capital costs due to required investments
- Determine return of investment

Realisation

- Research MARIN
- JIP SAVE
  - 15 Dutch partners
- FP 7: MoVe IT!
  - EU

To conclude

- The approach was initiated the Dutch ship owners
- High expectations with respect to the possible improvements
- We will see in the coming year

Thank you for your attention!