About
The Hamburg Ship Model Basin

- Service Provider for the Maritime Industries -

HSVA

- Independent, private company, founded 1913
- Located in Hamburg, Germany
- 100 employees
- 11 million € turnover per year
- Customers worldwide (70 % turnover international)

Key Figures & History

- 17 shareholders
  (shipyards, shipping companies, suppliers, classification society)
- ~85 % commercial orders
- ~15 % Research

- ISO9001:2015 certified
- ITTC member
- Recognised towing tank institute for EEDI/EEXI verification
- Recognised for tests according to (selection):
  - IMO MSC/Circ.608/Rev.1 (Open Top Container Vessels)
  - IMO MSC.137(76) (Manoeuvring Standards)
  - IMO SLF 53/Inf.3 (Weather Criterion)

- 1913 Founded
- 1952 Restart with modern facilities
- 1975 Start of manoeuvring tests
- 1984 Commissioning of the large ice model basin (LIMB)
- 1989 Commissioning of the hydrodynamics and cavitation tunnel
- 2006 Upgrade of main towing carriage
- 2011 Installation of side wave generator in large towing tank
- 2014 Installation of new wave generator in LIMB
- 2016 Modernisation of arctic environmental test basin (AETB)
- 2017-19 Refit of large towing tank building / insulation tank roof
- 2024 Installation of photovoltaic system (999 kWp)

UMWELT PARTNER 2021

Sustainability

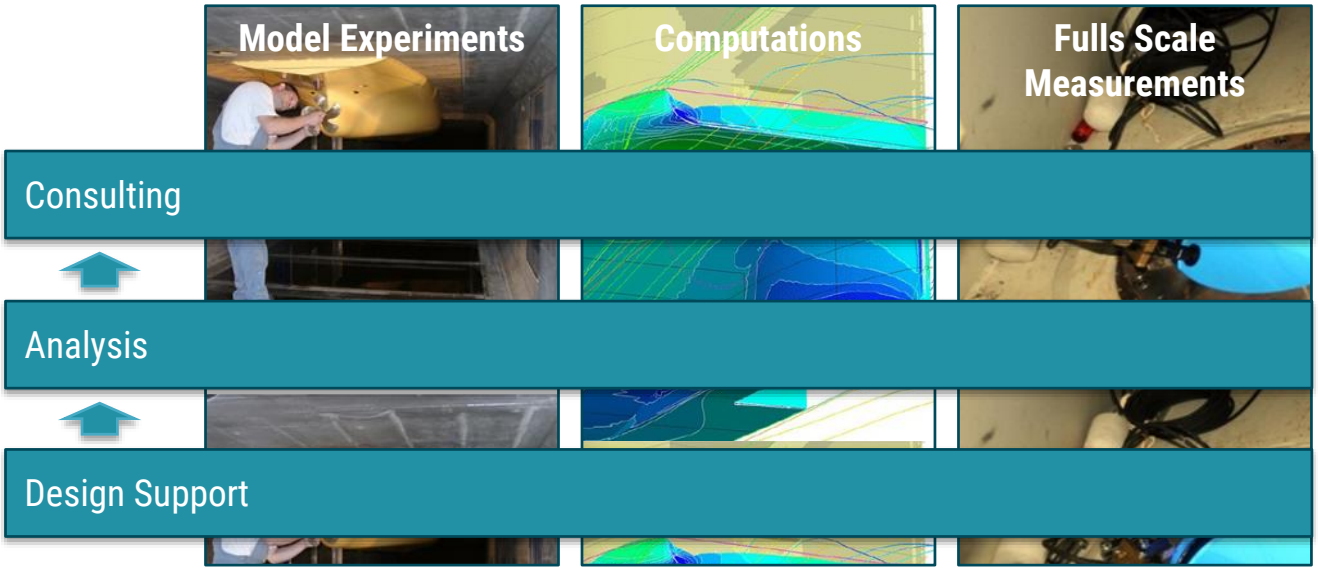
- HSVA is active environmental partner of the Hanseatic city.
- As an active member of the Hamburg Environmental Partnership 2021, we voluntarily support more towards environmental and climate protection beyond the legal requirements.
- Our voluntary contributions are reflected in the energy-efficient construction of part of our buildings, purchase of sustainable production material of our models and support of enviromentally friendly mobility.
- We are operating the second largest photovoltaic system in Hamburg.

UMWELT PARTNER 2021

Mission

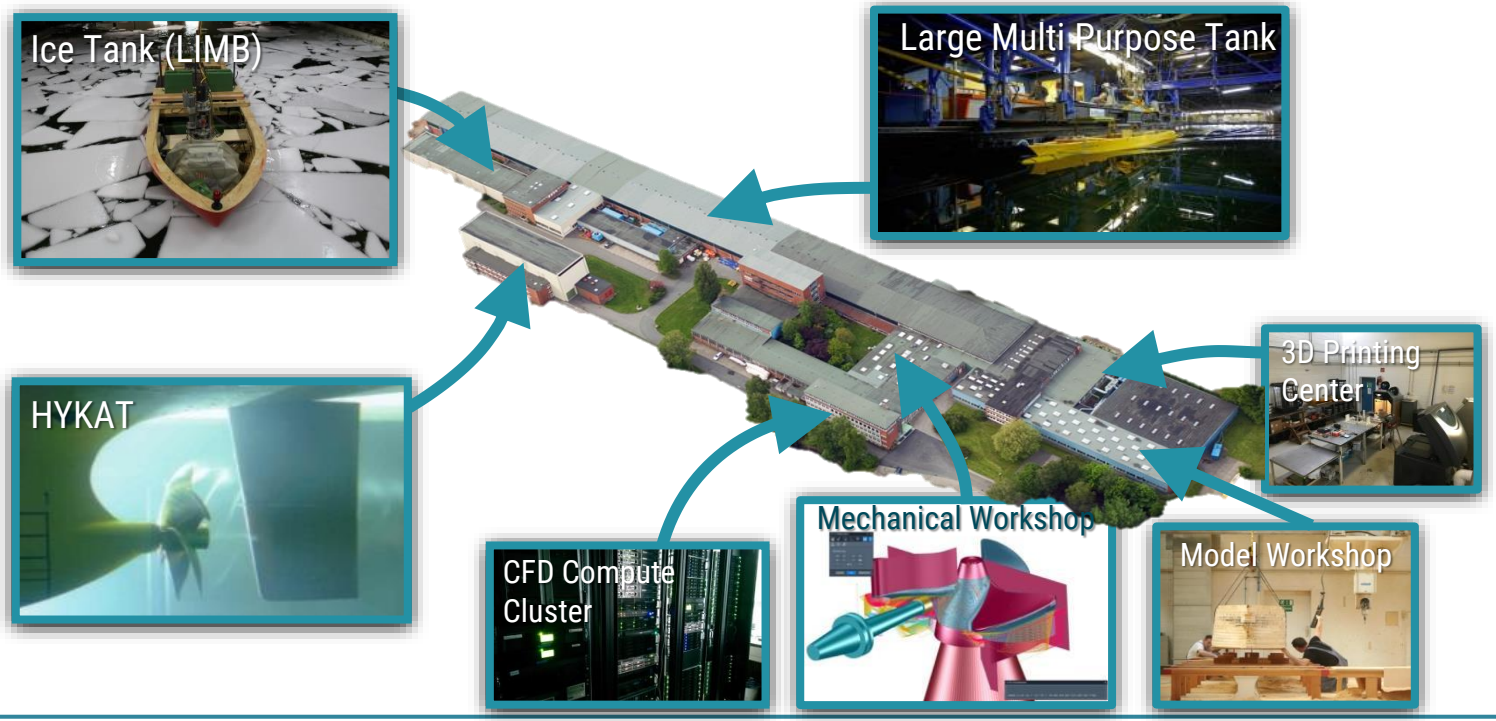
- We are a research-based service provider for the maritime industry.
- We aim to make the technical use of the oceans safer, more efficient and more resource-efficient by applying our knowledge, skills, facilities and creativity.
- We develop innovative, individually designed solutions for our customers by constantly combining our skills in new ways.

HSVA‘s Services



Maritime Hydrodynamics ▪ Maritime Aerodynamics ▪ Arctic Technology

Facilities & Services



Manufacturing Capabilities

- CNC manufacturing
  - 5 axis milling
  - High precision manufacturing
  - Max. traverse paths: 13000 x 4500 x 1800
- 3D Printing Centre
  - Polyjet and FDM printer
  - Max. installation space 700 x 700 x 820
  - Layer thicknesses from 0,016 - 0,8 mm

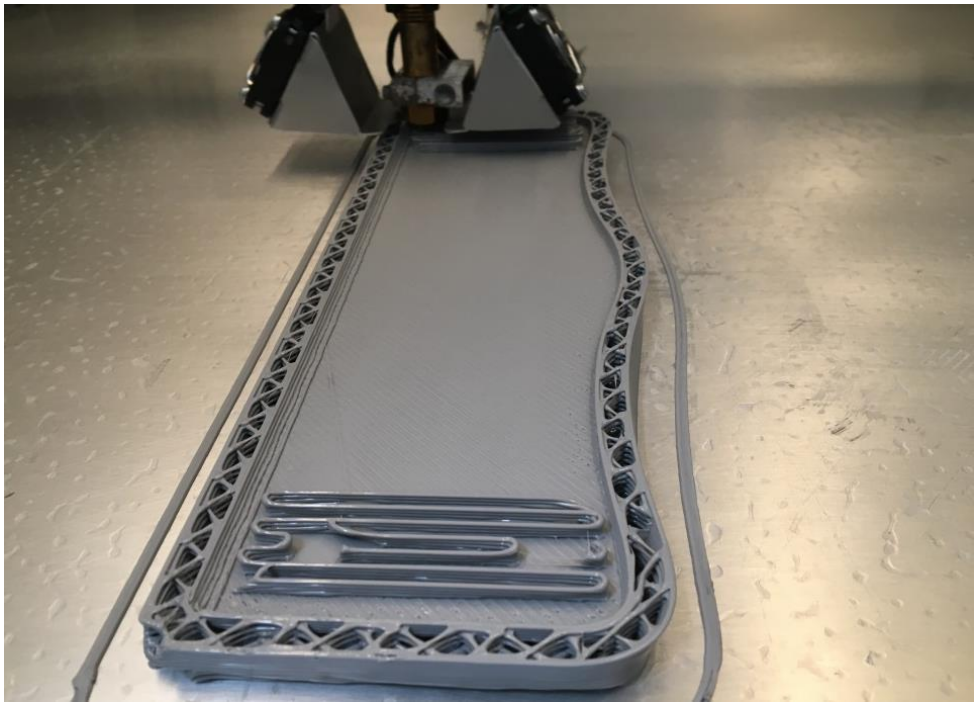
3D Printers

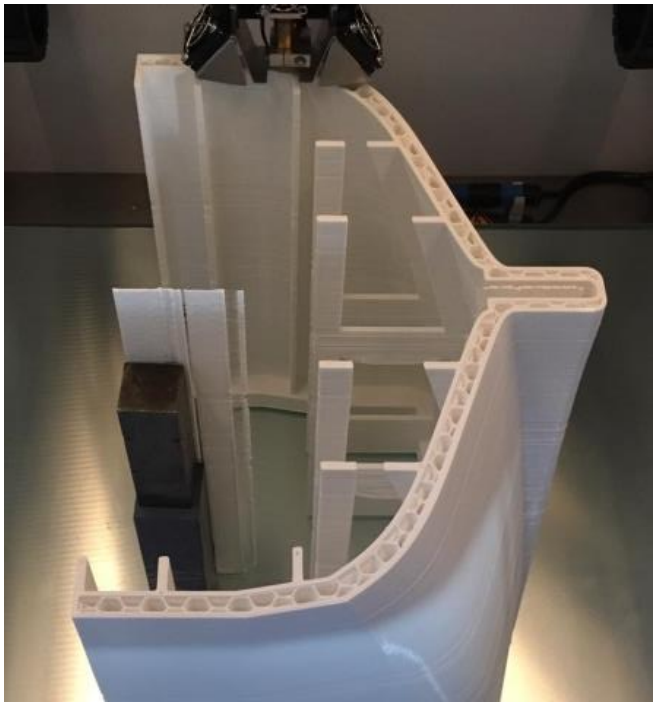
Forecastle for Seakeeping Tests

2010

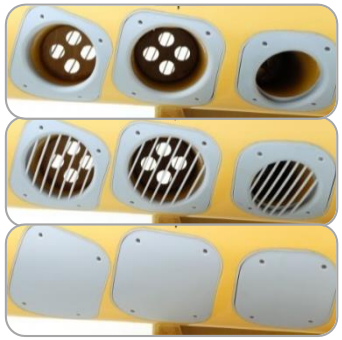
2020

3D-printed Hull - Structure





3D-printed Parts



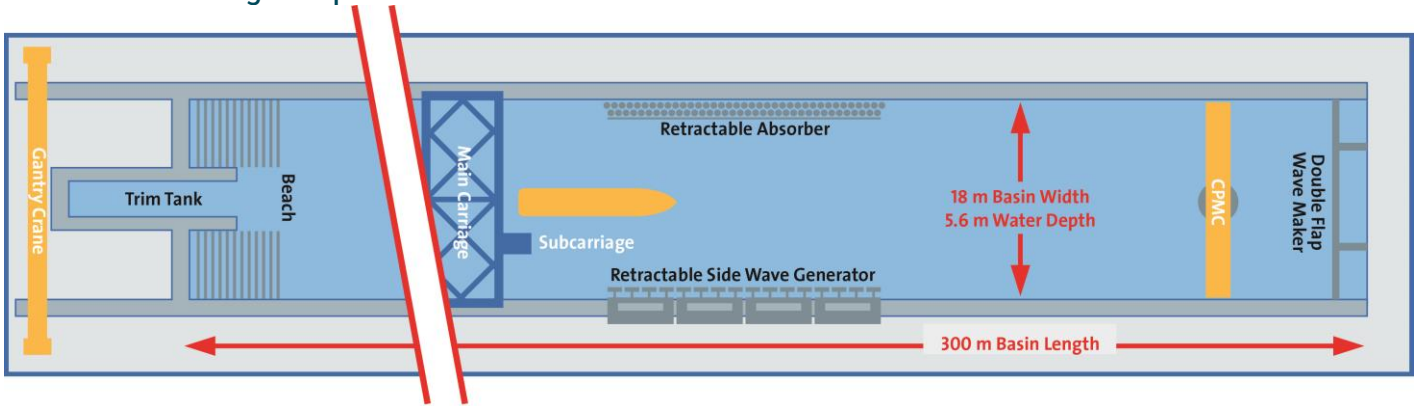





Large Towing Tank

- Main carriage equipped with a transverse sub-carriage
- Computerized Planar Motion Carriage (CPMC)
- Double-flap wave make at short side
- Snake type wave maker at long side
- Submarine testing setup

Tank length:	300.00 meters
Tank width:	18.00 meters
Water depth:	5.60 meters
Max. Speed:	10.00 m/s

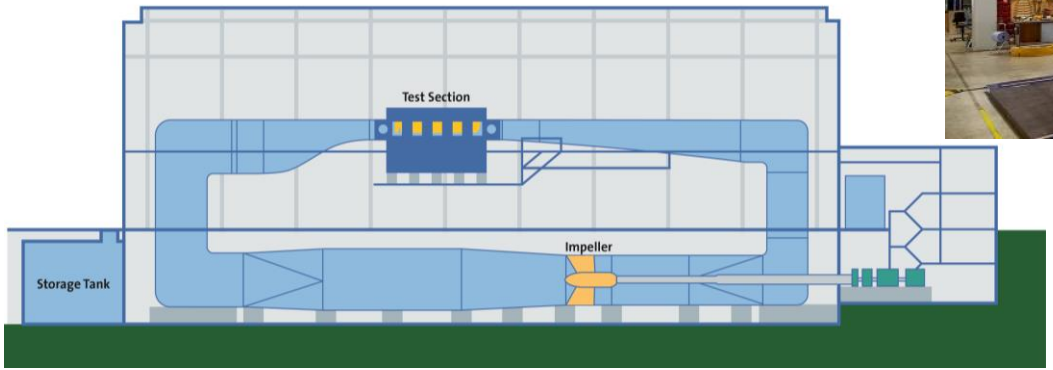


Side Wave Generator

- Length: 40.0 m
- Number of flaps: 80
- Max. wave height: 0.40 m
- Electric driven snake type
- Generation of long- and short-crested waves

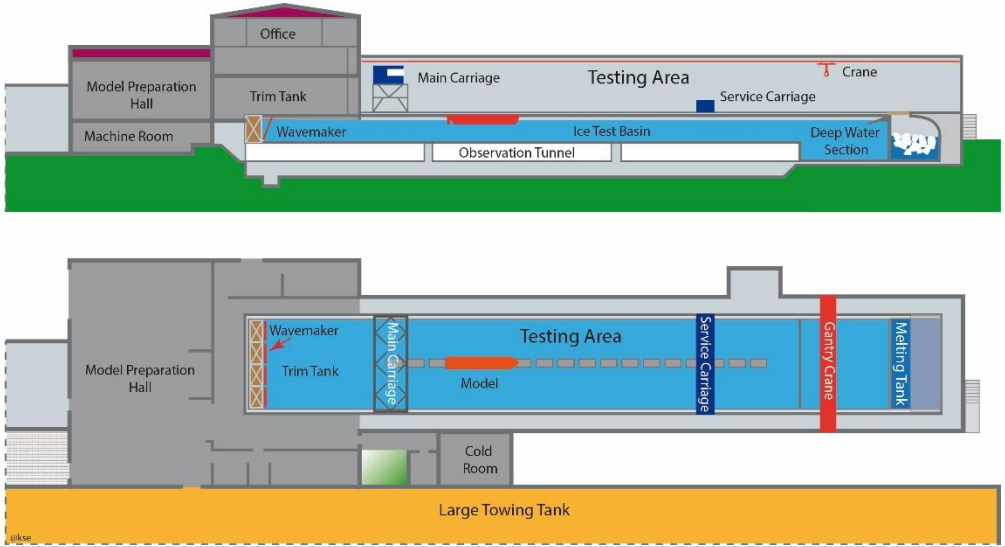
HYKAT (Hydrodynamics and Cavitation Tunnel)

- Closed type circulating water tunnel
- Dimensions of test section: 2.80 x 1.60 x 11.00 m
- Max. speed: 12.6 m/s
- Pressure range (abs.): 0.15...2.5 bar
- Gassing/ degassing system
- Planar motion mechanism
- Hydroacoustic chamber



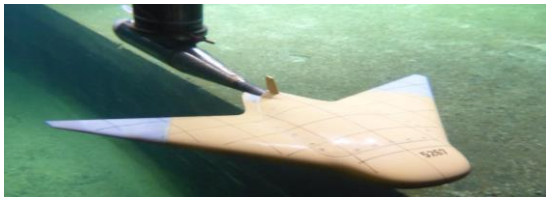
Large Ice Model Basin

- Length: 78 m
- Width: 10 m
- Depth: 2.5 to 5 m
- Shallow water bottom
  24 Elements 10 x 2.5 m
- Towing carrige: max 3 m/s
- Ice thickness: 10 to 100 mm
- Ice freezing rate: 2 mm/hour
- Wave maker
- Underwater Video Carriage



Experiments in Open Water

- Calm water:
  - Resistance and self-propulsion tests
  - 3D - wake survey
  - Flow visualisation tests
  - Propeller open water tests
- Seakeeping
- Manoeuvring
- Outdoor Experiments
- Underwater Vehicles

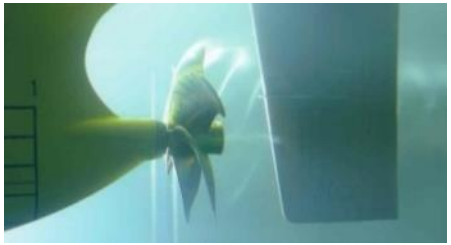


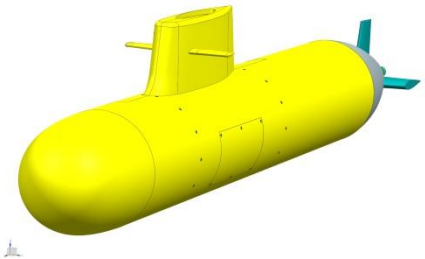
Experiments in Ice

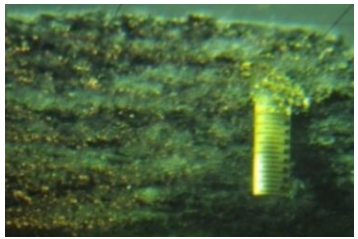
- Generation of different ice conditions:
  - Level ice,
  - Broken ice,
  - Brash ice
  - Pressure ridges, rubble fields
- Ships
  - Resistance tests
  - Self-propulsion tests
  - Manoeuvring Tests (e.g. turning, break out, berthing)
  - Ice management
- Offshore Structures (fixed and floating)
  - Global and local ice forces on fixed structures
  - Ice induced motions
  - Ice induced vibrations
  - Mooring forces on floating structures

Cavitation, Hydroacoustics & High Reynolds No. Testing

- Various model propeller drives and dynamometers
- Cavitation observations (high speed video cameras)
- Pressure pulse measurements
- Hydroacoustic (propeller radiated noise) meas.
- Surface Friction measurements
- Special Test Setups

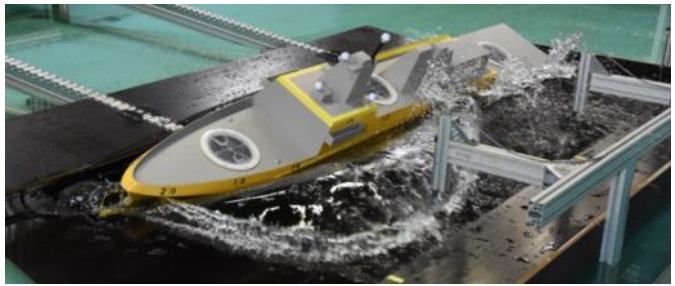






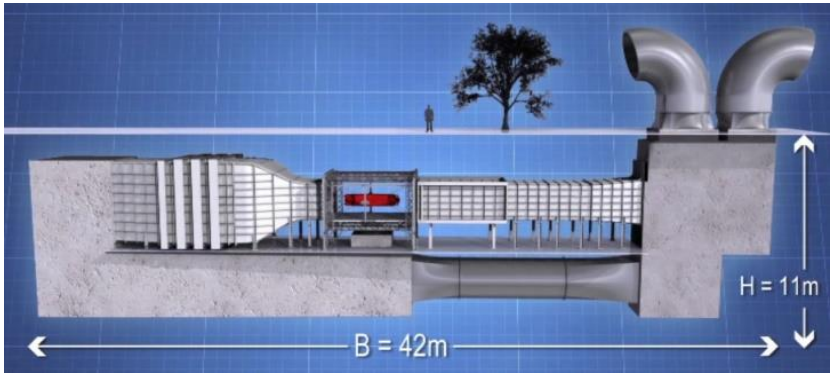
Offshore and Specials

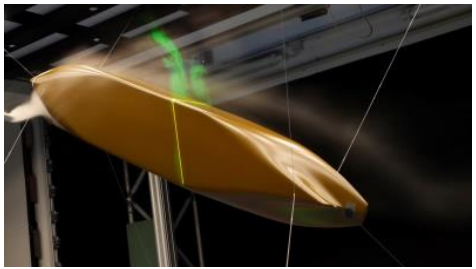
- Floating structures
  - Ships
  - Floating wind
  - Floating solar
  - Semi sub
- Fixed structures
  - Coastal structures
  - GBS
- Technical components
  - Risers
  - Hydrofoils
  - Surfaces
- Installation process
  - Towing
  - Launching
- Testing of large and heavy objects
  - Models up to 8 t



Windtunnel Testing

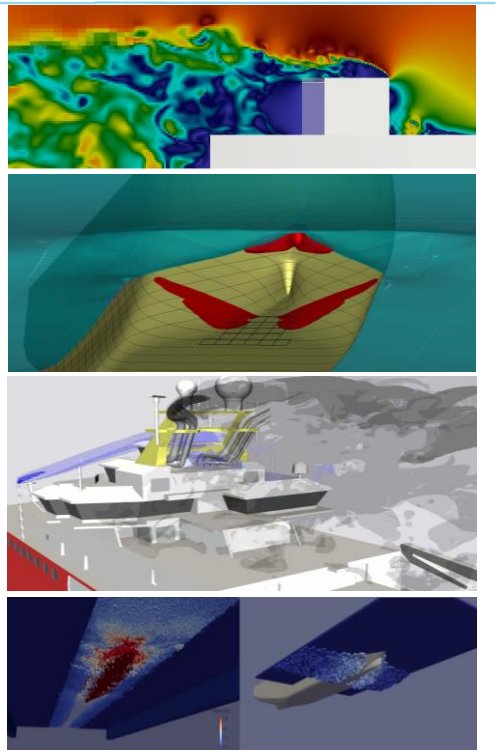
- Large Low-Speed Wind Tunnel at the Hamburg University of Technology (TUHH)
  - Outlet cross section of the nozzle 3.0 m x 2.0 m (2.0 m x 2.0 m)
  - Measuring section 5.0 m x 3.0 m x 2.0 m
- Equipment
  - Force – balance 6 DOF
  - Flow visualization (smoke and laser – light sheets)
  - 3-component stereoscopic) PIV
  - 3-component thermographic PIV
  - Hot-wire and hot-film anemometry
  - Motion simulator rail system





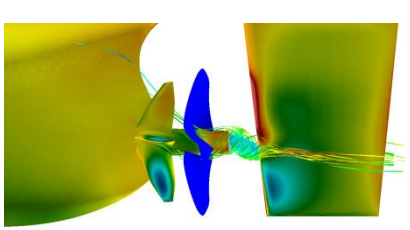
CFD & Numerical Assessment

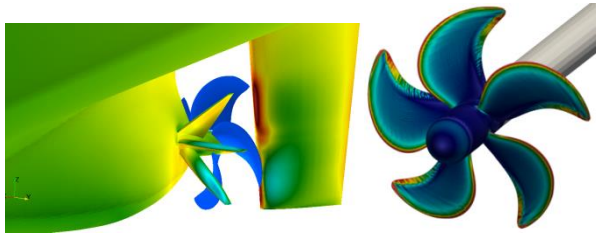
- In-house CFD code FreSCo+
  - 2nd order accurate finite-volume multiphase-solver
  - Turbulence modelled via RANS / DES / LES approaches
  - MPI/OpenMP parallelized for HPC applications
- ν-SHALLO (BEM method for free surface flows)
- QCM (Vortex-lattice code)
- PPB (propeller panel method)
- ECOLIBRIUM (wind propulsion)
- Uthlande (Software suite for ship dynamics)
  - STRIP
  - ROLF
  - MANOEUV
- IceDEM
- PerformIce

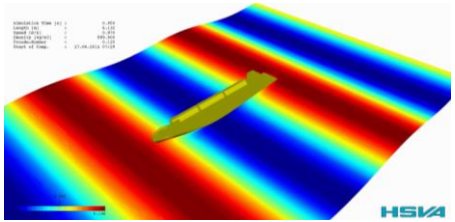


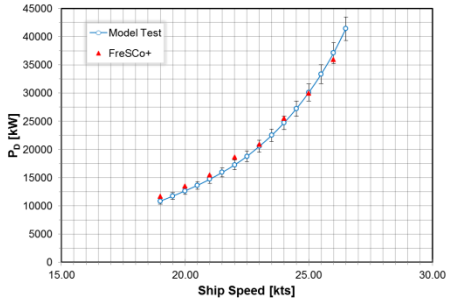
CFD & Numerical Assessment Applications

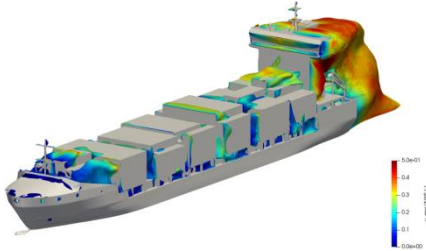
- Numerical Analysis of complex propulsion configurations
- CFD-supported full-scale powering prognosis
- Analysis of added resistance in waves
- Assessment of the aerodynamic performance of superstructures

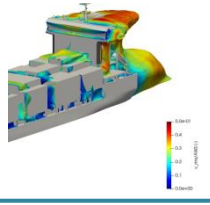






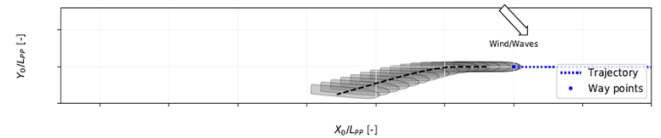


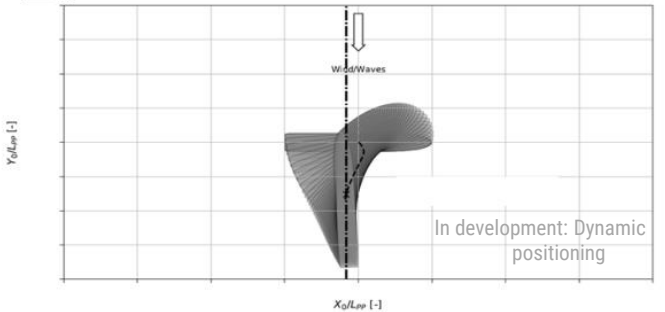


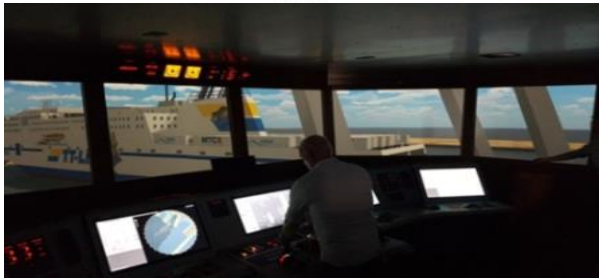


Simulation

- manoeLISA
  - Software developed for manoeuvring model, investigation, simulations and analysis of ships under the influence of wind, waves and current
- Simulations with manoeLISA
  - Fast time simulations
  - Harbour manoeuvres, crabbing, (un)berthing
  - Crash stop and ahead simulations
  - Acceleration and acceleration turning
  - Course keeping and track keeping
- Developed for:
  - Single/twin screw propulsion, incl. bow thrusters
  - In short/long crested sea states
  - Models for implementation in full mission simulators (cooperation with MTC Hamburg)

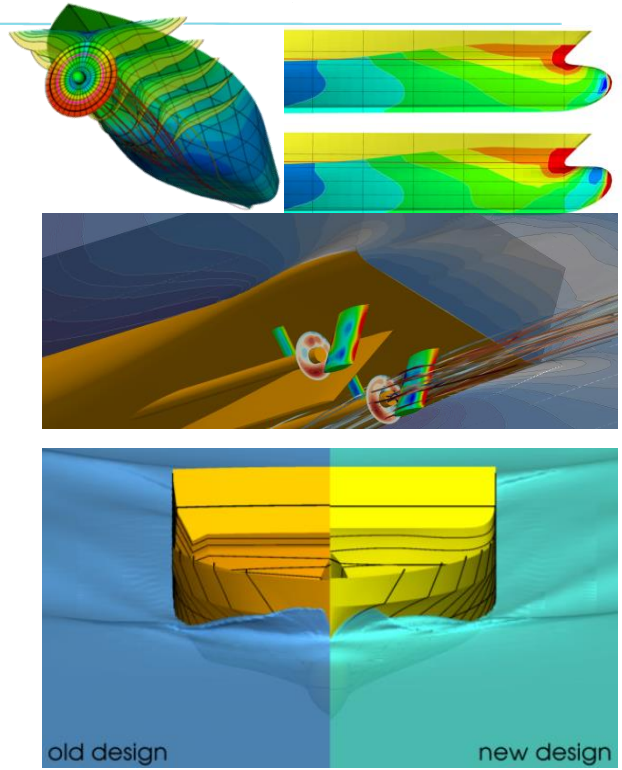






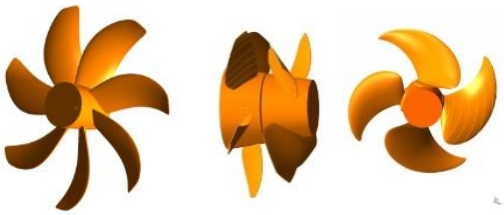
Design and Optimisation – Hull Form & Appendages

- 3D CAD/CAE model
- Optimisation supported by CFD and BEM methods, adjoint solver
- Parametric hull modelling
- Multiple boundary conditions (endurance speed, maximum speed, sea-keeping, …)
- Consideration of operating profile
- Shaft lines incl. bracket arms
- Appendages (Interceptors, Bow thruster positioning, Exhaust gas outlet)

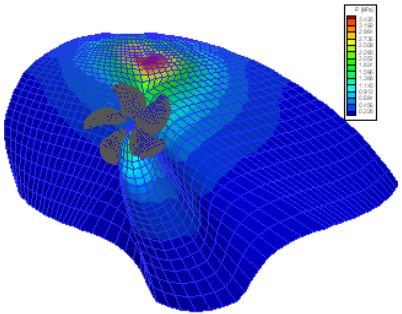


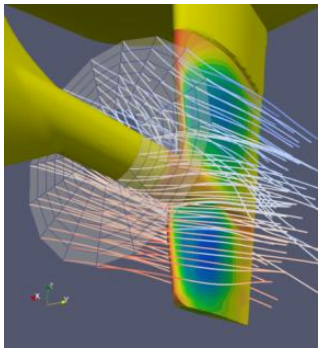
Design Support – Propellers & Rudders

- Design of Propellers for Navy-, Merchant Vessels and Axial Pumps
- Determination of Hydrodynamic and Cavitation Performance
  - Maximizing efficiency
  - Minimizing cavitation, Reducing pressure pulses and related ship vibration
- Load Determination
  - Hydrodynamic loads
  - Loads due to ice interaction for ice class propellers
- Application of Potential Flow Codes as well as RANS-Solver
- Symmetric and Twisted Rudders
  - CFD-based design process
  - Objectives: avoid flow separation / cavitation



Submarine (FP) Torpedo (CR) RoPax (CPP)

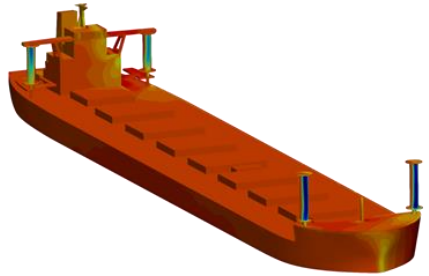


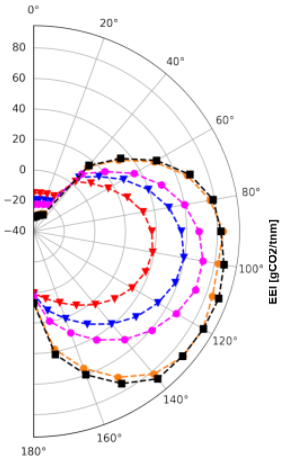


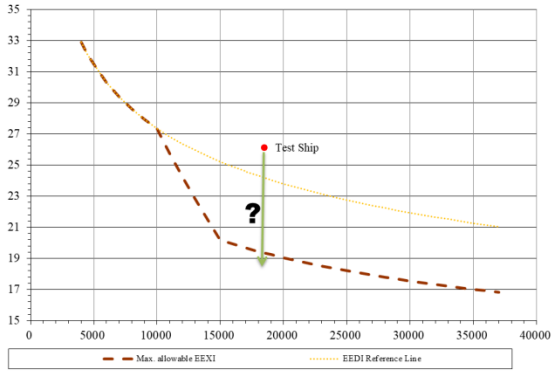
Consultancy, Design & Optimisation

- Hull, Rudder, Propeller, Appendages
- EEDI/EEXI/CII Compliance
  - Calculate/assess/improve the v_{Ref}
  - Hull Form/ Propeller/ ESD adaptions
- Evaluation and Analysis of On-board Monitoring Data
  - Data evaluation
  - Statistical analysis
  - ISO 19030
- Propulsion Concepts
  - Concept development and Optimisation
  - Holistic Design of Hull, Propellers and Appendages
- Wind-assisted Propulsion solutions
  - Assessment and Performance Prediction
- Concept Designs
- Basic Designs
- Machinery
- Electrical Layout (Single Line, etc.)

SDC
SHIP DESIGN & CONSULT

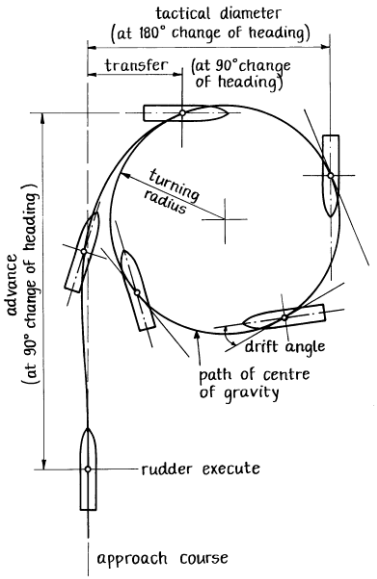


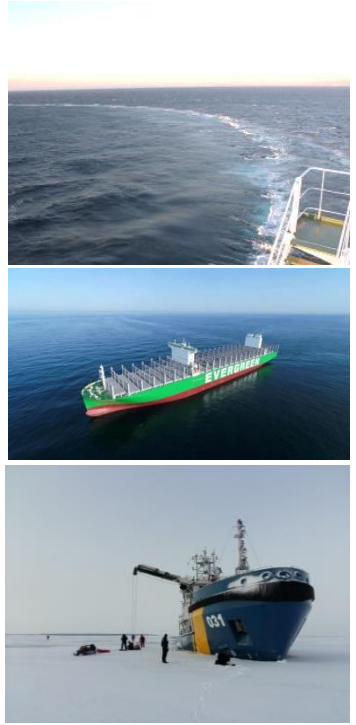




Full-Scale Performance & Full Scale Measurements

- Sea trial measurements & evaluation
  - Speed Trial, ISO 15016, ITTC 7.5-04-01-01.1, HSVA in-house standard
  - Manoeuvring Trials, MSC.137(76)
- Full scale ice trials
  - Speed, manoeuvring and operational tests
  - On-board and on-ice measurements
- Cavitation observations & measurement of propeller pressure pulses
- Local vibration & noise measurements
- Measurement of ship dynamics in waves
  - Global ship motions
  - Local accelerations
- Load measurements in ice
  - Hull instrumentation (strain gauges, pressure panels)
- HSVA in-house measurement equipment



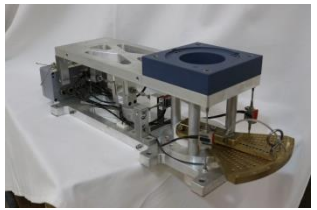


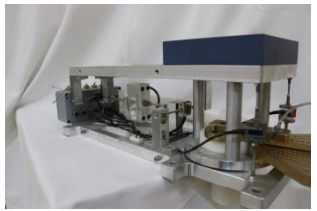
Ways of Cooperation

- Facility Support
  - Conceptual dimensioning of model test facilities
  - Basic specification for technical installations and equipment
  - Support for procurement and project management; concept review
  - Assistance with starting up the facility and training of scientists and personal
  - Manufacturing of parts for precision mechanics
- On-site training of staff
- Workshops
- Joint research projects/working groups/technical committees
- Joint Development Projects
- Funded Research Projects
  - BMWi
  - EU

Equipment for Model Testing

- Testing / Measurement equipment
  - Multi-component force balances
  - Thrust and torque dynamometer
  - Wake measurement
  - Wave maker
- Models
  - For towing tanks
  - For outdoor testing
- Design of testing facilities
  - Cavitation tunnels
  - Basins





Thank You!
Questions?

Various Videos