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CFD SPECIALISTS & MARINE TECHNOLOGY SOLUTIONS

SHIP DESIGN OPTIMISATION | RENEWABLE ENERGY | YACHT DESIGN OPTIMISATION

Welcome to Cape Horn Engineering

Cape Horn Engineering is a UK based company, providing best-in-class independent CFD (Computational Fluid Dynamics) consultancy with clients all over the world. As industry leaders in numerical modelling and marine technology solutions, we specialise in hydrodynamic and aerodynamic analysis, full-scale performance prediction and design optimisation.

Cape Horn Engineering was founded in 2007 by Dr.-Ing. Rodrigo Azcueta with the vision of providing world-class expertise in marine CFD to support the design of racing yachts. We have since led the numerical analysis in four America's Cup campaigns and dominated the design space for the Volvo Ocean Race for almost a decade, with yachts designed using our technology winning the circumnavigation consecutively for three editions.

Working for the America's Cup requires rigorous testing and validation to remain competitive at the highest level with access to large resources and benefiting from other disciplines. R&D and validation has always remained a corner stone in the development of our methodologies and experience, ensuring the best possible solutions are offered.

Our technology and experience, grown in this performance led environment, has since been refined for application to the wider marine sector. Our flow analyses are continuously proven in a wide variety of other marine applications including design optimisation for superyachts, production yachts, power boats, fully foiling and foil assisted high speed vessels, advanced and unconventional vessels and commercial vessels.

With environmental concerns influencing a greater need for renewable and sustainable energy across the world, our specialist technologies are at the forefront of new designs and solutions. We assist design teams by investigating carbon-free alternatives for commercial cargo ships, such as wind assisted ship propulsion technologies (WASP). We are experts at performance analysis to achieve decarbonisation, and specialise in EEXI/EEDI calculations.

Our vast experience with the free surface for floating bodies under the effect of the external forces of wind and waves can be applied to offshore floating platforms and work boats for the renewable energy industry.

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SEE CASE STUDY

America's Cup design optimisation

Delivering best-in-class service

* Years of verification and validation with towing tank data, tank testing programmes, wind tunnel tests and most recently with full scale sea trials
* No compromise on software quality, we use the best CFD package on the market, STAR-CCM+ from Siemens Digital Industries
* Our work flow is highly automated, allowing us to run hundreds of simulations per day
* We have access to powerful High Performance Computing clusters and large amounts of software licenses
* We communicate clearly with our clients, ensuring their needs are met, while presenting results on time and to the highest standards
* We use advanced visualisation techniques to investigate the flow features, sharing that knowledge with clients
* We pride ourselves on an unrivalled level of commitment, client confidentiality and strong customer relations. The continued relationship with our customers demonstrates our ability to provide the best service

Main features of our simulations

* Our simulations are run at full scale including all appendages and details, removing the need for extrapolation from model scale
* Hydrodynamic simulations include the free surface deformation and the dynamic sailing attitude of the vessel
* Propulsion simulations can be modelled with different levels of fidelity, from virtual disks to rotating propellers
* Simulations can include complex physical phenomena when present, like cavitation, transition from laminar to turbulent flow, ventilation, sprays, etc.
* We perform manoeuvring simulations according to ITTC procedures
* We assess ship responses in regular waves and irregular sea states
* Fluid Structure Interaction for hydrofoils and other structures
* Aerodynamic simulations in steady state or transient flow, coupled to structural models for deformation of sails
* Slamming loads, sloshing, water entry, wave piercing, water on deck and any associated dynamic phenomena
* Multi degree-of-freedom simulations allows complex dynamic behaviours like surfing, rolling, capsizing, etc.

Using CFD technology

CFD technology offers a huge benefit for naval architects when optimising any vessel. Historically, designers have used more traditional technology, such as towing tank tests to ensure their final designs meet their client's requirements. However, the force similarities between the model at scale and the real ship cannot be achieved in a towing tank, which makes testing complex, relying upon on assumptions and empirical formulations.

Today, using CFD eliminates this problem, since it allows the vessel to be modelled at full size and directly captures the stern wake and boundary layer effects. Moreover, CFD offers a greater insight into the details of the flow through images, video animations and interactive visualisation files. Even virtual and augmented reality is starting to make an impact today. The use advanced visualisation techniques allow us to understand the flow features and to share that knowledge with clients. We post-process the simulations in a way that provides designers with load cases, internal forces and moments for dimensioning the structures of their designs.

We carry out Fluid Structure Interaction for appendages and sails. We assess cavitation of the appendages of all high speed craft. We have developed foil section optimisation loops that take into account transition and cavitation. For extensive design campaigns we enhance hull and appendage shapes using modern optimisation techniques like neural networks and genetic optimisation algorithms. Finally, CFD also offers substantial reductions in time and costs in comparison to physical testing.

Machine Learning and Artificial Intelligence models

Cape Horn Engineering has pushed the boundaries of numerical modelling since its inception. We continue to push technology to its limits, developing ground-breaking techniques and methodologies to ensure we remain at the forefront of the industry. Through collaborations with industry leaders and universities, our latest research aims to harness the potential offered by Machine Learning and Artificial Intelligence Modelling, reducing analysis times from hours to seconds, and facilitating real time analysis to changing input conditions. These new technologies could be the future of numerical analysis, and the opportunities it facilitates are exciting and monumental.

SEE CASE STUDY

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CAPE HORN engineering

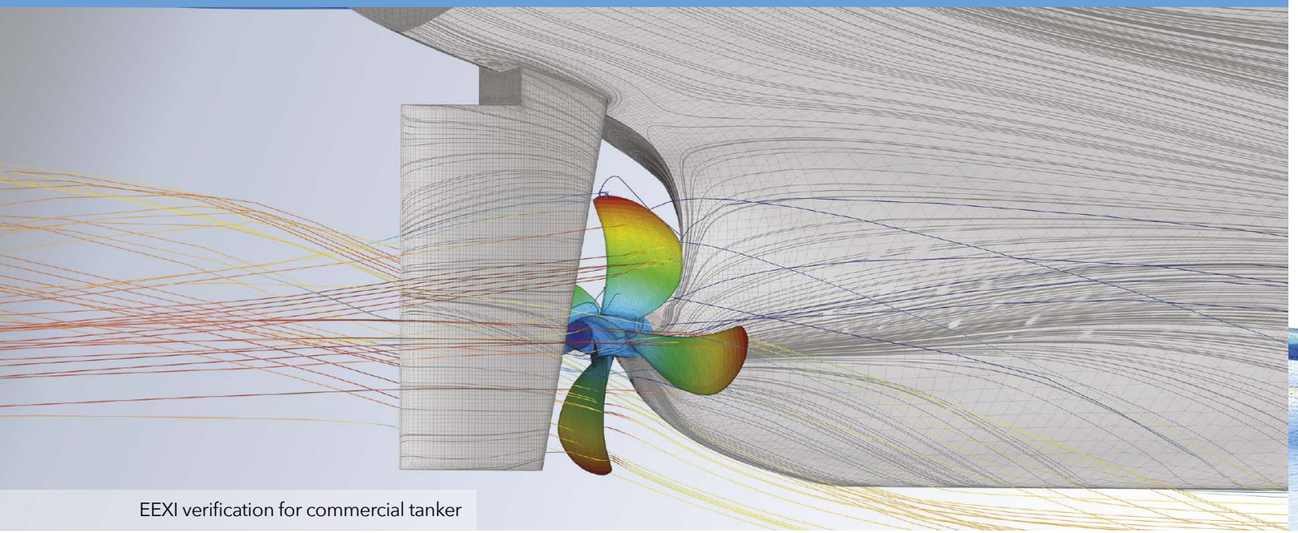
Advantages of CFD compared to tank testing

* All simulations are at full scale
* Simulations use realistic inertias and centres of gravity (something not easily achievable in tank testing)
* Oblique incident waves coming from any direction can be simulated, tank testing is usually limited to head waves
* Decomposition of individual forces and moments for the hull and each appendage and by physical origin, like friction and pressure
* Precise analysis of motion velocities, accelerations and trajectories of the body
* Flow visualisation and animation to gain insight and understanding about differences between designs
* Simulations are 100% reproducible
* Hull or appendage shapes can be easily changed without building new models
* Easy to test many design configurations eg. to swap appendages
* Time and cost reduction

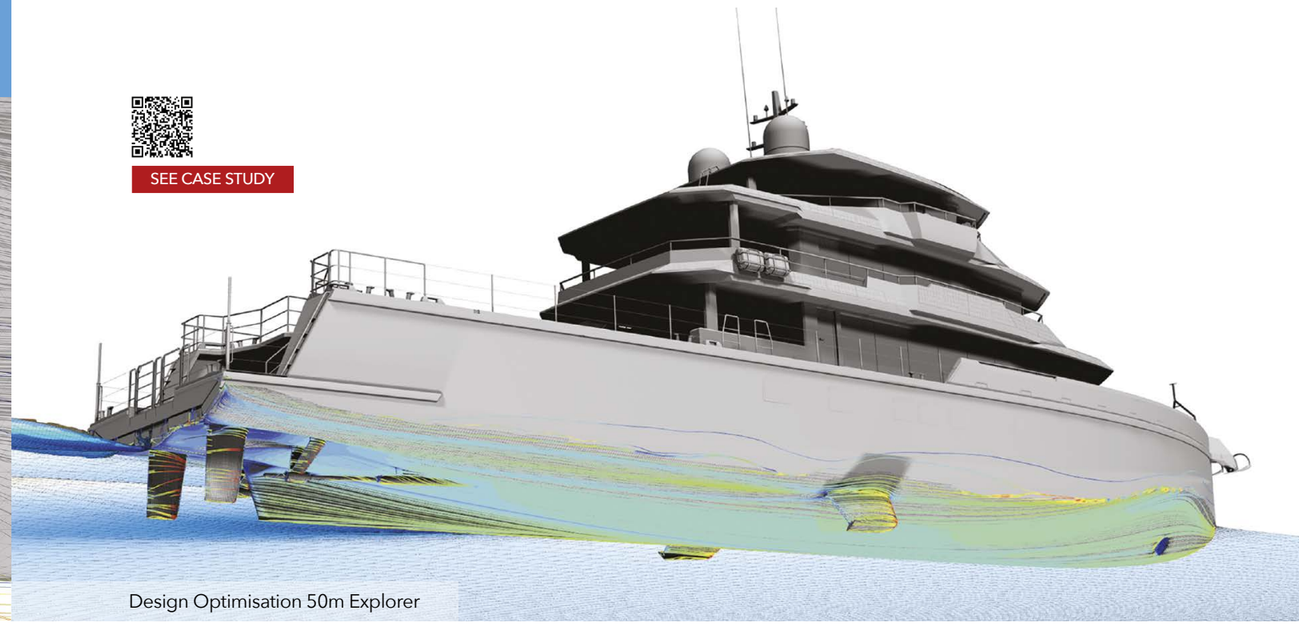
SEE CASE STUDY

Racing yacht technology, Malcolm McKeon, Baltic Yacht 112m LIARA

SHIP DECARBONISATION & EEXI/EEDI



EEXI verification for commercial tanker



SEE CASE STUDY

Design Optimisation 50m Explorer

Cape Horn Engineering is proud to provide a range of services to clients across the shipping industry. In addition to standard performance analysis, design optimisation and seakeeping analysis, Cape Horn Engineering offers services and expertise that can be tailored to individual specific needs. In recent years, the increased demand for specialist technologies within the industry has led to us gaining extensive experience in:

* EEXI/EEDI calculations
* Analysis of ESD's
* Comparison and development of WASP Devices

Energy Efficiency Existing Ship Index (EEXI)

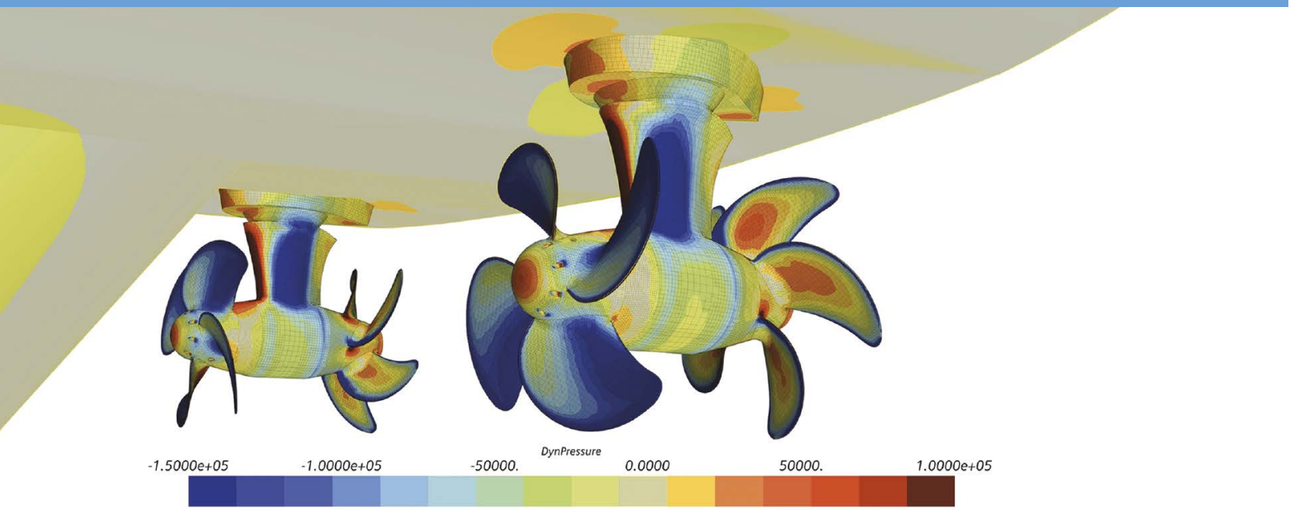
Global efforts to reduce the environmental impact of the shipping industry have accelerated rapidly in recent years, with new measures by the International Maritime Organisation (IMO), such as the Energy Efficiency Existing Ship Index (EEXI) now in force.

From 2022 the IMO accepts CFD as a mean to provide the vessel reference speed needed in the EEXI calculation. Prior to this, only towing tank tests were accepted with numerical simulations seen as a secondary option "under special circumstances". Cape Horn Engineering has been lobbying for many years for CFD simulations to achieve the accredited status necessary to become the preferred method to demonstrate the ship performance.

One of the default methods accepted by IMO for calculating the EEXI reference speed is to use an empirical formula that considers the ship type and installed power. This is a quick and dirty procedure; however, this speed will be conservative since the formula includes a penalising margin factor. Thus, it is beneficial to calculate a precise reference speed with CFD as this will aid compliance and makes the vessel more commercially viable.

Cape Horn Engineering has specialised in EEXI calculations based on high-fidelity RANS CFD. Today we can offer these calculations in a very efficient and cost-effective manner, having developed validated workflows and Best Practice Guidelines in conjunction with a leading classification society (Lloyds Register). These workflows must comply with a strict set of directives and recommendations from the International Towing Tank Conference (ITTC) and the International Association of Classification Societies (IACS).

The ITTC recommendations are concerned with the "Quality Assurance in Ship CFD Application" and describe how the Validation and Verification process must be performed. They also set the requirement for the organisations delivering the CFD results to formulate and document their own version of Best Practice Guidelines. The IACS guidelines outline the process for determining the reference speed for use in the EEXI calculation. The guidelines establish a set of criteria which the CFD organisations need to fulfil for the "Demonstration of Qualification" and detail how the validation and calibration of the CFD results must be demonstrated and documented for each new project. The Demonstration of Qualification requires that the CFD organisations have conducted Verification and Validation on a set of comparable ships and that they can demonstrate this with supporting documentation. See following sections to read more on this.



Validation & Verification (V&V)

In general, the EEXI calculation consists of 2 phases; the Verification and Validation to determine a "valid correlation factor", and the computation of the new speed-power curve for the EEXI certification at full scantling condition. The first phase is needed to assess the numerical and modelling uncertainty. Depending on the vessel in question, it can be conducted using existing measurement data from model tests or from sea trials, with sea trials being our preferred option. Sea trials are usually performed at draft ballast. The CFD simulations must be performed for at least one of the conditions documented in the sea trials, usually the one that is closest to the EEXI condition, for example for 75% MCR. The difference between the simulated results and the measured ones then must be assessed, to determine the "modelling uncertainty". This is also known as the "Validation" process. This difference will be used as a correlation factor to shift the speed-power curve in the full loaded condition to be computed in the second phase.

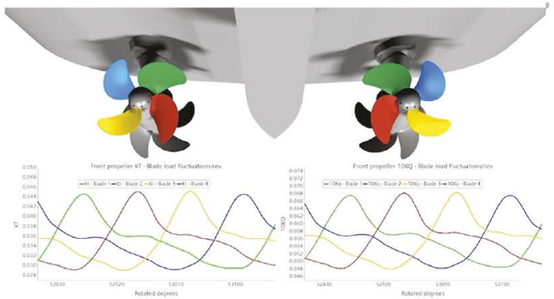
At the same time, for the same condition, the spatial discretisation (mesh density) and the temporal discretisation (time step used to advance the simulations) must be varied systematically to determine the "numerical uncertainty". This is also known as the "Verification" process. The uncertainty from the sea trials also needs to be considered, and if the correlation between CFD and measurements fall within the combined numerical and experimental uncertainties, the solution is considered to be "valid" and the correlation factor can be used in the second phase.

Finally, after the V+V process is proved to be valid and the speed-power curve is determined, considering the correlation factor, the vessel reference speed can be interpolated for use in the EEXI formula. This whole process must be documented following the IACS guidelines for submission to the classification society who will act as the "Verifier" and issue the corresponding EEXI certificate to the vessel.

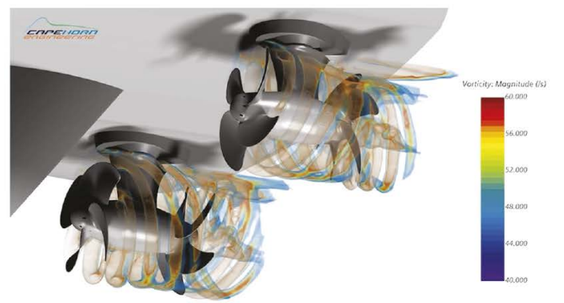
Energy Saving Devices (ESD)

A similar process will be followed in case the vessel undergoes modification to improve her performance, for instance by installing ESD like asymmetric stern bulbs, nozzles or fins in front of the propeller, fins in the propeller boss cap etc. The CFD V+V will be conducted for the same conditions in the sea trial, usually without the ESD, and then using the same simulation setup the EDS will be included to calculate the new, improved speed-power curve for the EEXI condition.

Cape Horn Engineering has experience demonstrating performance improvement using EDS. Furthermore, we have specialised in Wind Propulsion Technologies, using devices such as wing sails, suction sails, Flettner rotors, or any other wind-powered devices. For WPT, the IMO guidelines dictate that in case that more than one device is installed on deck the forces produced by the devices should consider their interactions. At Cape Horn Engineering we have specialised in computing such interaction models, making used of advanced machine learning techniques.



TRANSIENT BLADE LOAD FLUCTUATION

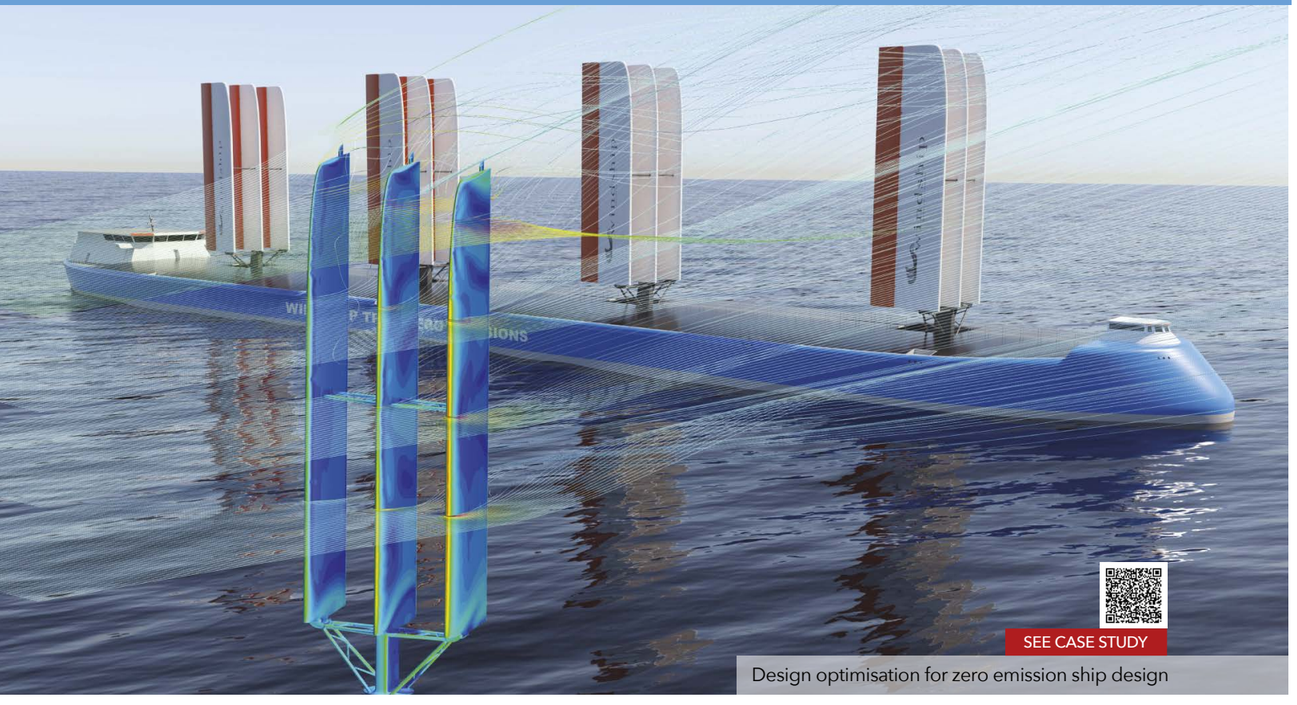


VORTICAL FLOW STRUCTURES

WATCH PROPULSION SIMULATION

Full-scale propulsion tests

SHIP DECARBONISATION & EEXI/EEDI



SEE CASE STUDY

Design optimisation for zero emission ship design

Environmental concerns are influencing a greater need for renewable and sustainable energy across the world, with specialist technologies being at the forefront of new designs and solutions. As maritime industries tackle climate change issues, ports and shipping companies are looking for carbon-free alternatives by testing potential solutions for vessels.

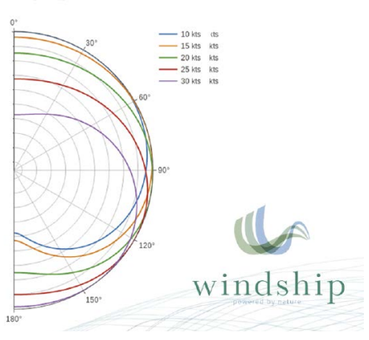
Wind-Assisted Ship Propulsion (WASP)

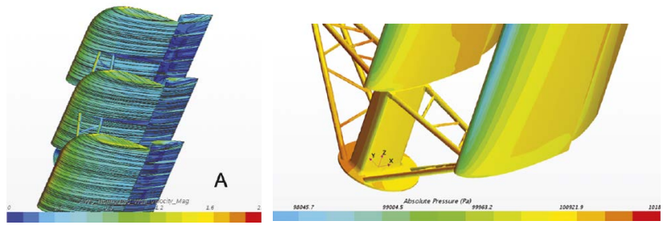
One innovative technology being applied is Wind Assisted Ship Propulsion (WASP), using devices such as wing sails, suction sails, Flettner rotors, or any other wind-powered devices. These systems can offer fuel savings of 10 to 30% when retrofitted to existing vessels.

Due to our renowned experience and specialist technology, we are working for several technology developers to help optimise their Wind Propulsion Technologies, either by running systematic shape and condition variations to be used in Velocity Prediction Programs or by running bespoke Six-Degrees-of-Freedom (6DoF) to validate the final products.

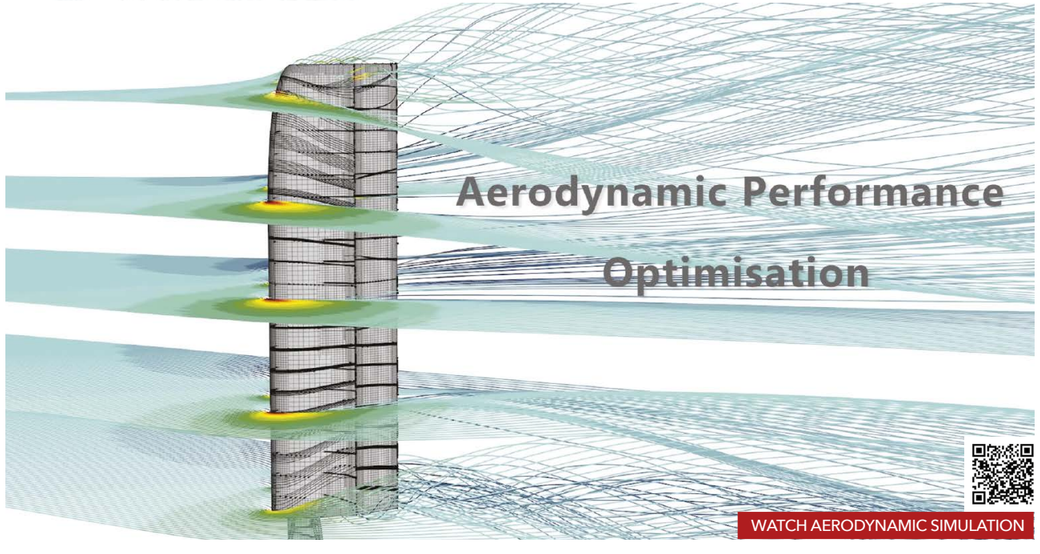
The Digital Twin

High-fidelity RANS-based CFD all-in-one simulations can capture all the physics, including interactions among WASP devices and between the devices and the hull, all at once. This workflow has been recently developed by Cape Horn Engineering to directly compare the efficiency of different Wind Propulsion Technologies and to validate lower fidelity modelling tools.

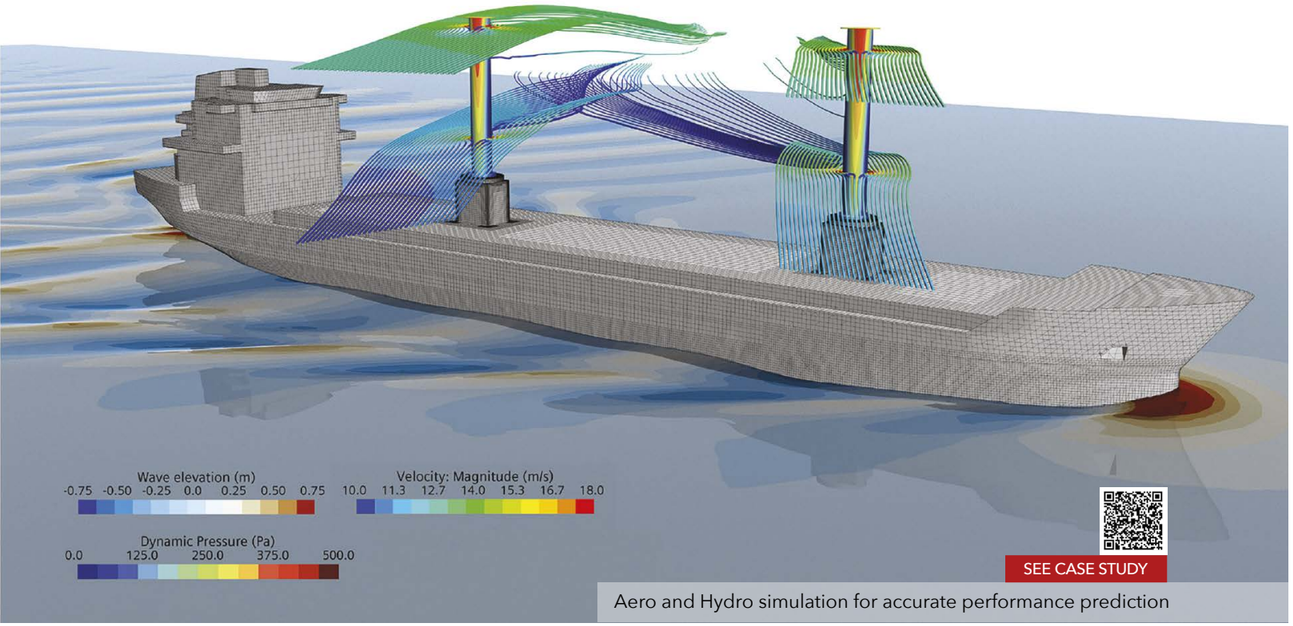




Extensive CFD testing to further improve the design of the solid wings



WATCH AERODYNAMIC SIMULATION



Aero and Hydro simulation for accurate performance prediction

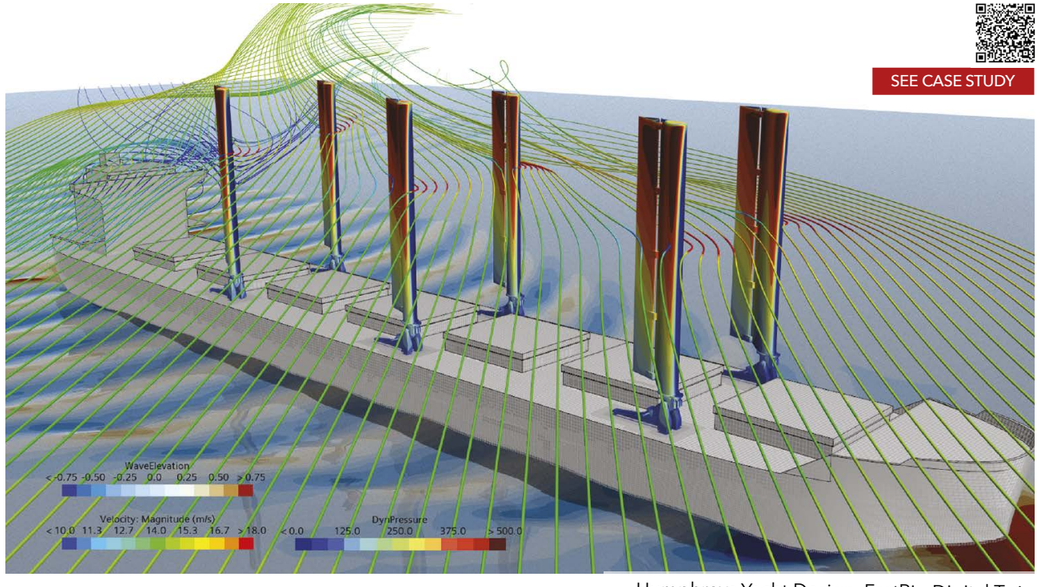
Both the water flow experienced by the hull at a given vessel speed and the air flow experienced by the WASP devices are modelled simultaneously in a single simulation. The devices are mounted on deck, and aerodynamic details include the hull top sides, deck, hatches and superstructure. The wind conditions above the water surface are modelled with an accurate wind profile considering the atmospheric boundary layer wind gradient. This results in a variable apparent wind speed and direction at different heights, due to the combination of a moving ship and a wind strength that varies with height, something that sailors are very much aware of so that they need to twist the sails towards the top of the mast.

In the simulations, the vessel is sailing at a constant speed and an actuator disk models the effect of the propeller using the open water propeller curves. Depending on the vessel resistance and the amount of thrust generated by the WASP devices, the thrust produced by the propeller balances the Degree-of-Freedom in the direction of travel and is used as an input to the actuator or virtual disk model. This determines the propeller RPM and propeller torque and therefore the delivered power.

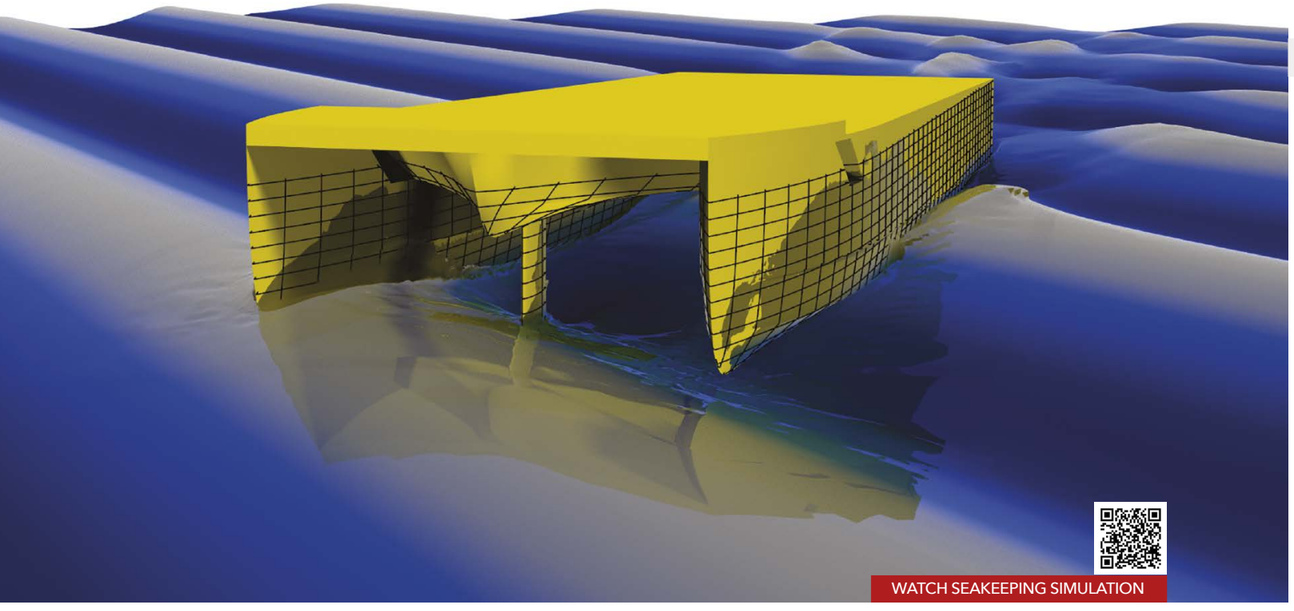
The simulation further considers the deformation of the free surface or waves generated by the vessel, the dynamic sinkage and trim, the drift or leeway angle, the heel angle, and the rudder angle to keep a constant course. The wind forces on the hull, superstructure and WASP devices induce the drift and heel angles, with the rudder angle changing during the simulation via a PID controller, balancing the yaw moment of the whole system. Thus, in total the 6 Degrees-of-Freedom are considered.

The simulations are stopped once they have converged to a quasi-steady solution. Then, comparing the cases with and without the WASP devices for the same wind conditions, the reduction in delivered power to the propeller can be compared, and with that the engine fuel and emissions reduction.

For the shipping industry to adopt these new technologies, the accurate CFD analysis of potential savings and improved performance provide crucial information.



Humphreys Yacht Design, FastRig Digital Twin



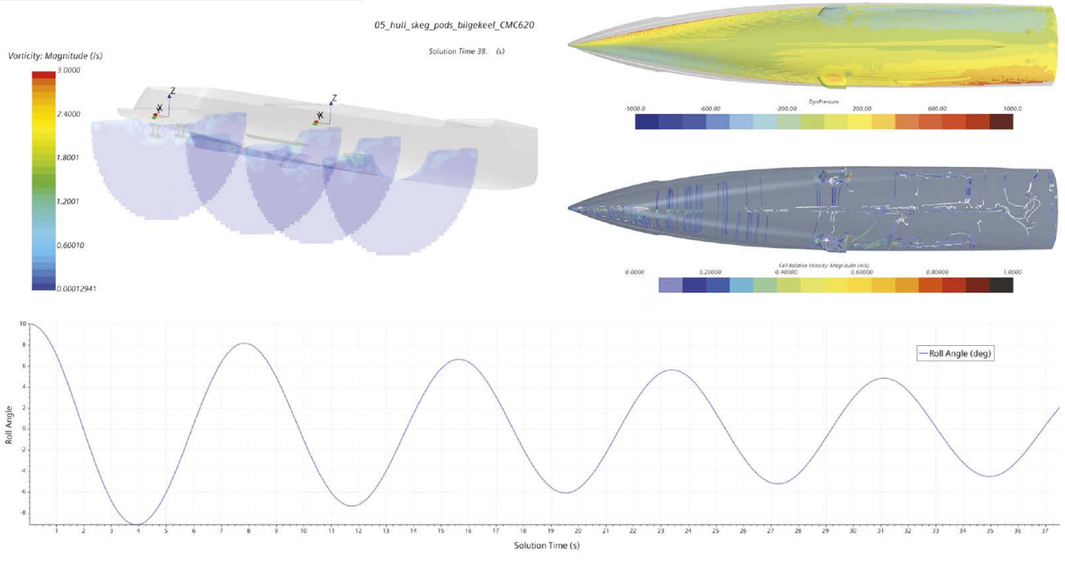
CFD Technology for Seakeeping

Seakeeping simulations have traditionally been extremely computationally expensive to run, due to the stringent spatial and temporal discretisation requirements. Recent developments in the CFD solver we use, combined with our custom setup, allow us to efficiently compute a vessels motions in incident waves from any direction, including the most challenging condition of following waves. Several useful characteristics can be obtained, ranging from the amplitude of the motions and accelerations in specified locations, to the occurrence of green water on deck.

We have developed statistical models to characterise a vessel's motion in response to an irregular sea state, allowing long term operability analysis of a vessel operating in a particular location. By using carefully selected regular wave simulations, we calculate a vessel's Response Amplitude Operator (RAO). Once fed through our custom modelling software, response characteristics can be obtained, including the motion response spectrum, added resistance, RMS motions, Motion Sickness Incidence (MSI), and probabilities of exceeding operational criteria such as vertical acceleration.

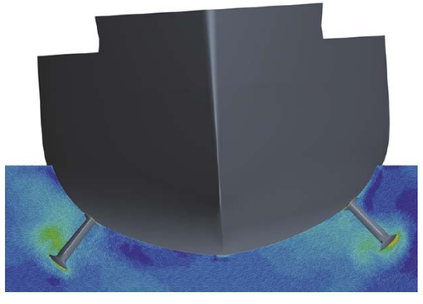
WATCH ROLL DECAY SIMULATION

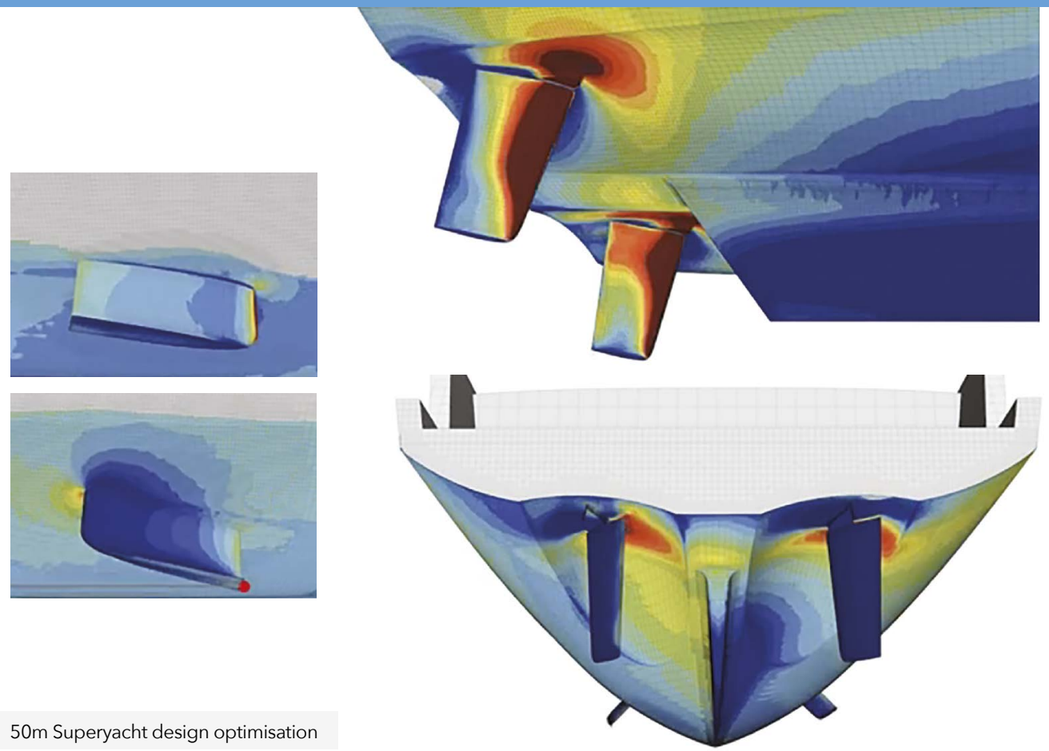
Roll Decay simulation for motor yacht



Roll Damping Coefficients

We simulate roll decay tests to determine the contributions to damping of appendages. The vessel configurations are at full scale with different appendages included. In the simulation shown above, the vessel start in a position with 10 degrees of heel, with or without forward speed, from which it is instantaneously released. The vessel is then free to roll and the time history of the motions recorded over several periods. The amplitude and period of the roll are assessed, allowing roll damping coefficients to be calculated. Advanced simulations of roll mitigation in waves by moving roll stabiliser fins with a PID controller are also possible. This allows different control algorithms and fins shape can be assessed and compared.



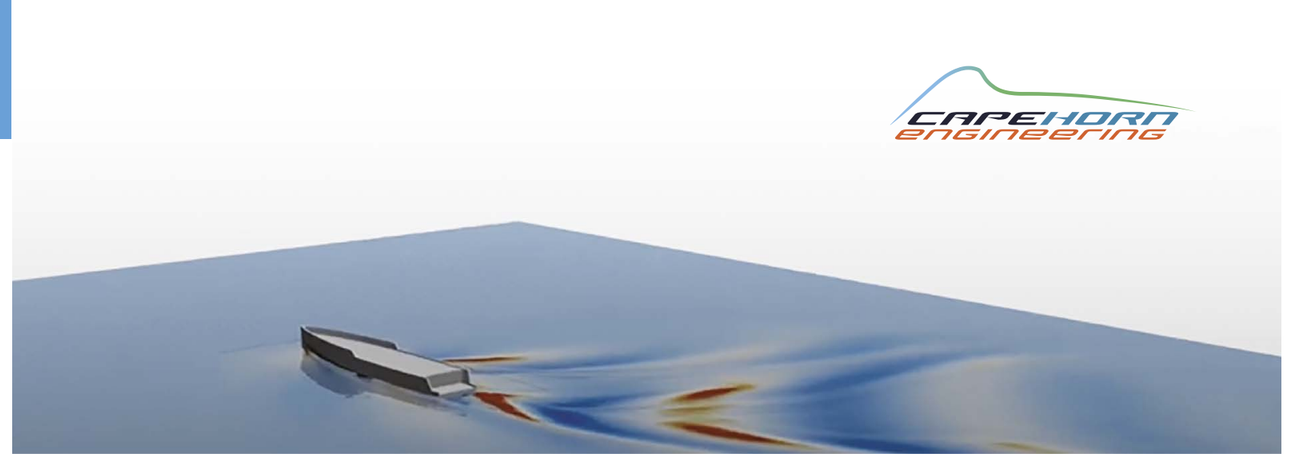


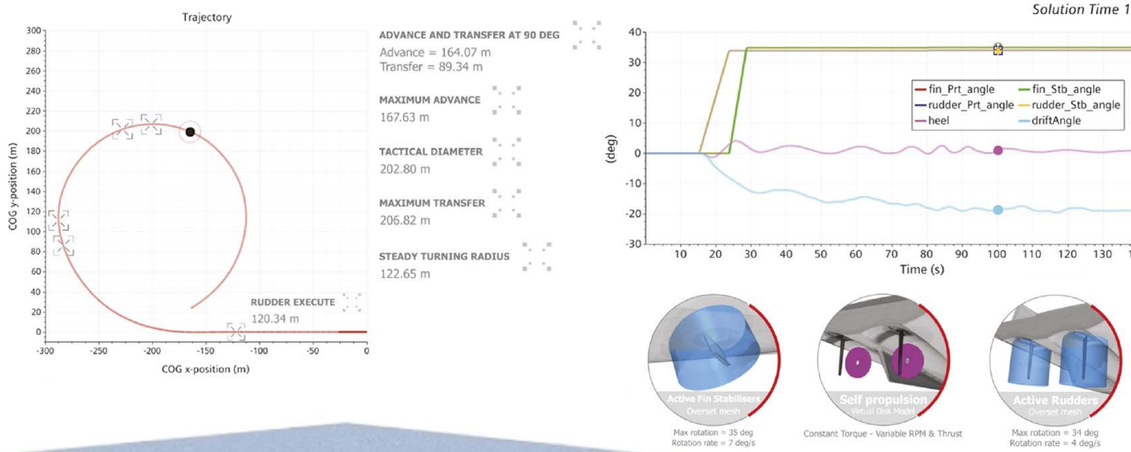
50m Superyacht design optimisation

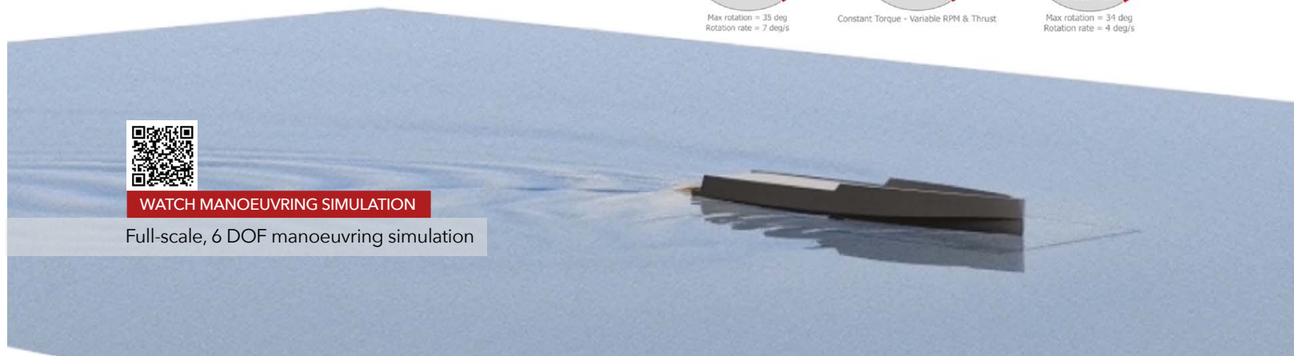
CFD Technology for Manoeuvring

6 Degrees-Of-Freedom manoeuvring simulations at full scale are performed, following ITTC procedures. The CFD simulations are a good option to replace many costly sea trials. Validation with a single sea trial is performed and then different parameters like variationof loading condition or vessel speed can be simulated and assessed.

The example here shows a 50m superyacht performing a turning circle, where the full-scale yacht is in self-propulsion mode, using the virtual disk propulsion model. The rudders rotate to initiate the turning circle, followed by the stabiliser fins rotating to counteract the roll angle. The virtual disk model keeps a constant torque or RPM during the manoeuvre and after a full circle we obtain all the ITTC manoeuvring coefficients, including the advance and transfer at 90 degrees, the tactical diameter, the drift and heel angles, the speed loss, and vessel the trajectory.



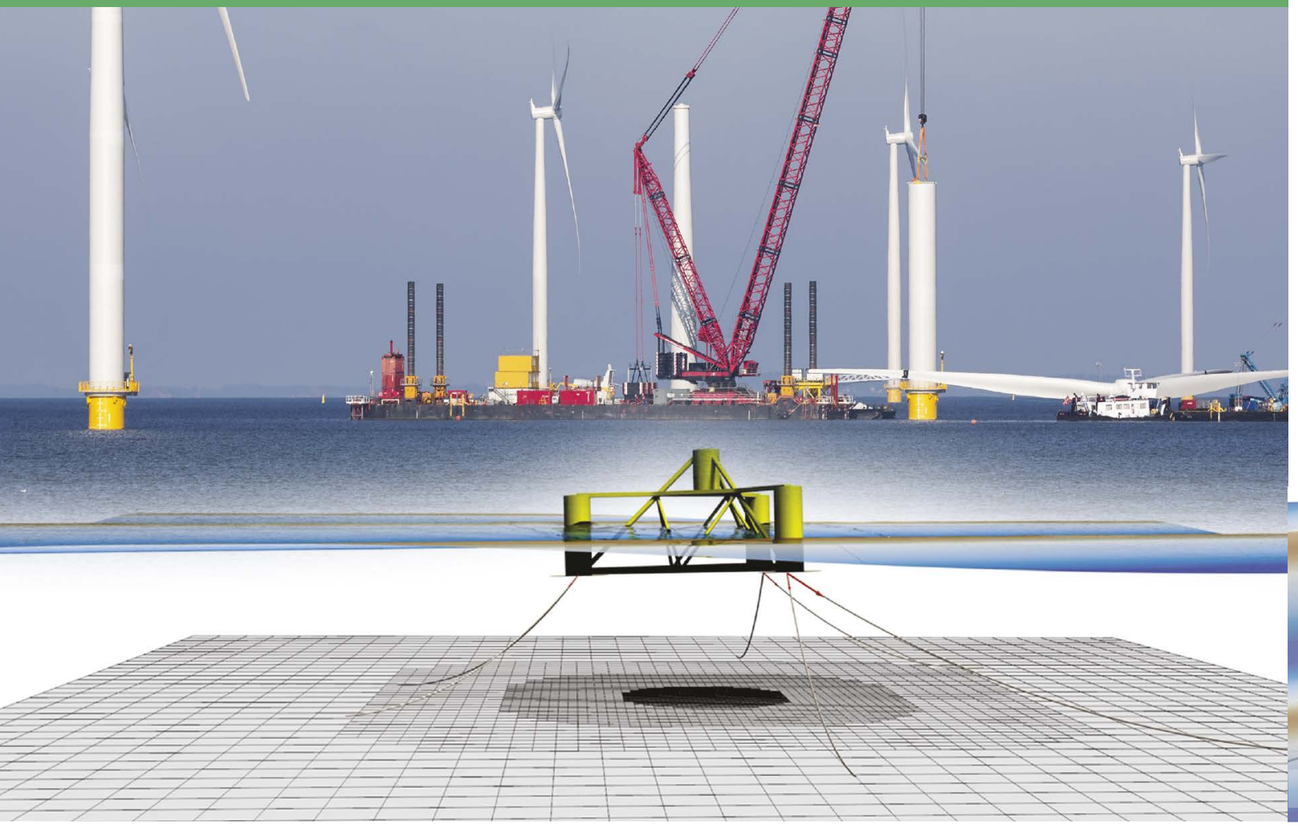




WATCH MANOEUVRING SIMULATION

Full-scale, 6 DOF manoeuvring simulation

RENEWABLE ENERGY - STRUCTURES



We care passionately about the environment and can assist companies to develop efficient solutions for producing renewable energy. With our specialist expertise, we can apply our CFD technology to these developments, to improve the performance of wind or ocean energy structures. We are interested in partnering in R&D efforts for developing concept solutions and improving renewable energy structures to reduce the cost of energy and increase safety and reliability. Our simulations can be applied to any type of offshore platform, including different mooring systems, for offshore wind, ocean waves and tidal energy.

SEE CASE STUDY

We can support your project

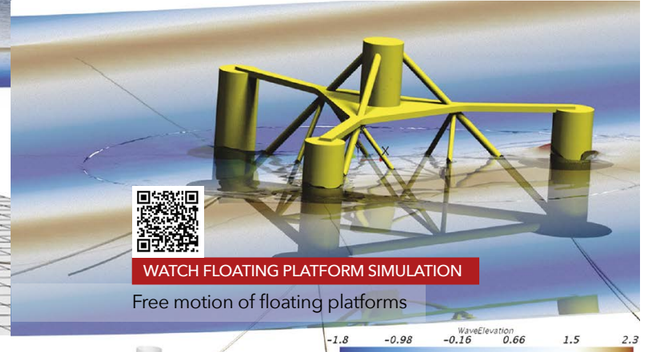
* Improve rotor blade performance including section profile
* Motions and extreme loads of offshore floating platforms
* Investigate mooring systems
* Investigate wave energy devices
* Investigate tidal turbine devices
* Reduce noise emissions and vibrations
* Reduce high fatigue loads
* Meet stringent safety standards
* High fidelity, CFD-based wind and tidal forecast embedded in global models

Floating Platforms

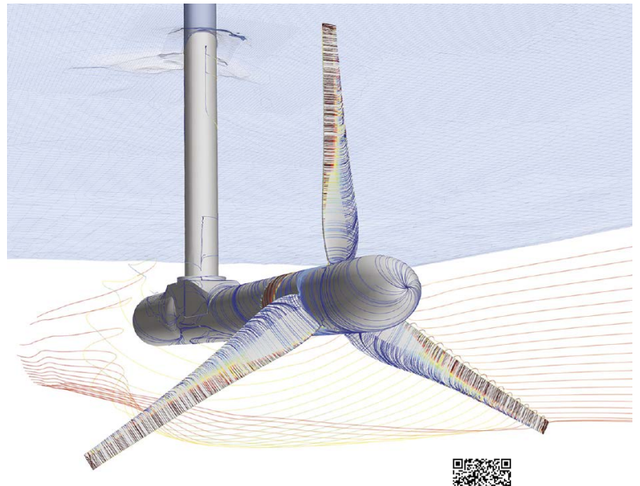
With our expertise in aerodynamics and hydrodynamics we can assess and compare the performance of different types of renewable energy structures. We have experience in high-fidelity modelling of Offshore Wind Platform motions under the effect of waves, current and wind to investigate high fatigue load cases, extreme load events, meeting stringent reliability and safety standards.

Tidal Energy Structures

To fully harness tidal energy as a significant source of clean energy, it is critical that researchers explore ways to increase its viability for being commercially feasible. We partner in R&D efforts with Tidal Energy companies to analyse designs to help improve their performance and efficiency and to reduce environmental impacts on marine life.

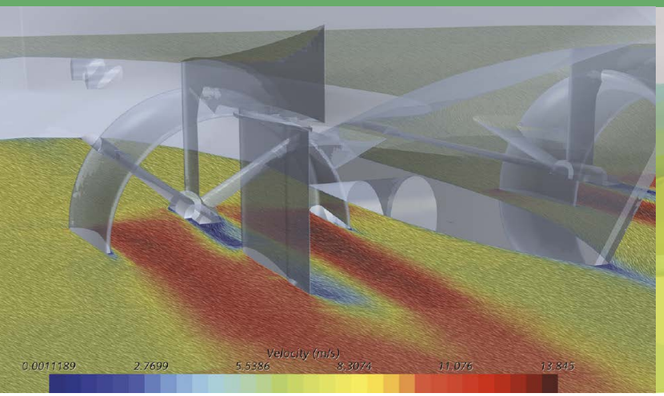


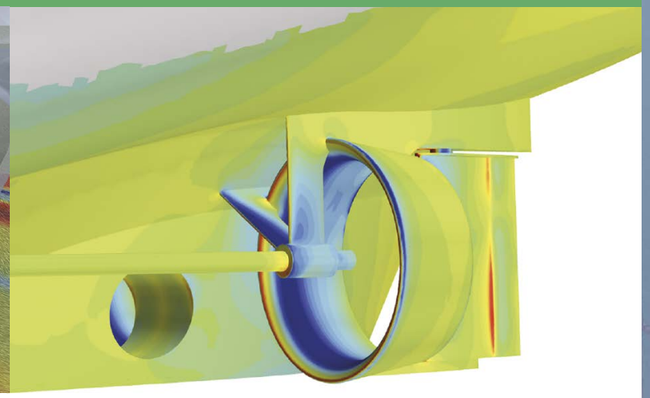
Free motion of floating platforms



SEE CASE STUDY

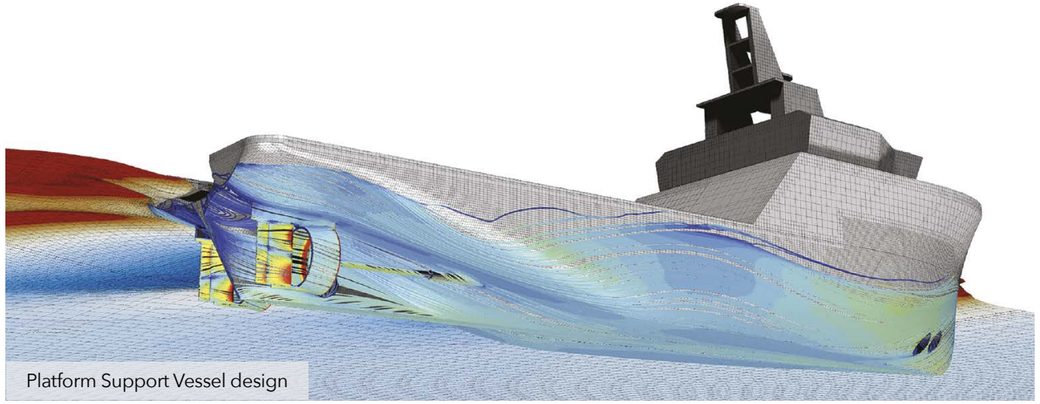
Tidal turbine blind validation





Service Operation Vessels (SOV), Crew Transfer Vessels (CTV)

In addition to helping improve the performance of wind or ocean energy structures we also apply our technology and expertise to the Service Operation Vessels (SOV), Crew Transfer Vessels, (CTV) and other work boats that are required to operate offshore, sometimes in hazardous weather and extreme sea states. At Cape Horn Engineering we have developed statistical models to characterise a vessels motion in response to an irregular sea state, allowing long term operability analysis of a vessel operating in a particular location. We can assist in significantly improving safety, comfort and workability for wind farm technicians, even in the roughest sea conditions.



Platform Support Vessel design

SEE CASE STUDY

Platform Support Vessel ride stability

YACHT DESIGN OPTIMISATION - RACING

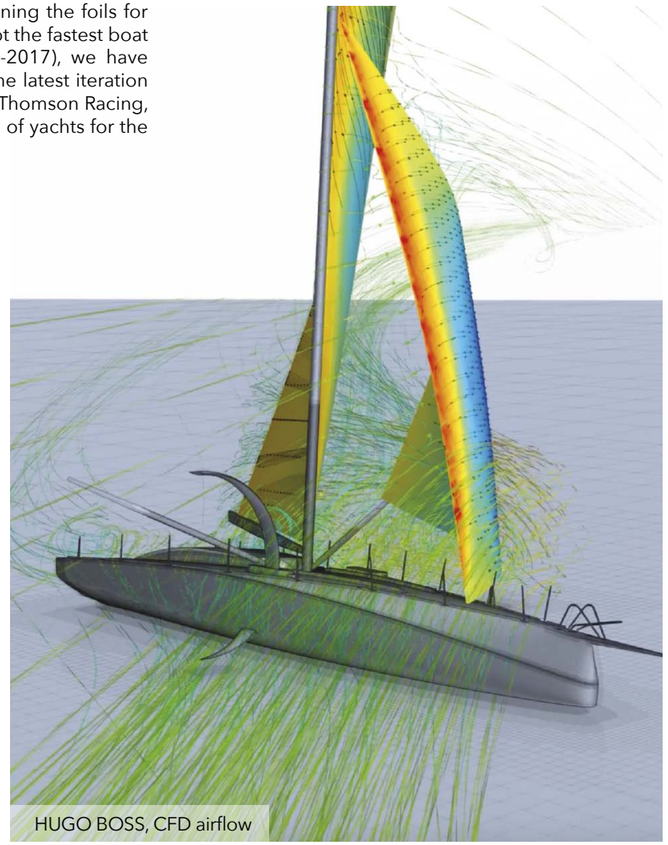
Dr.-Ing. Rodrigo Azcueta has been at the core of simulation-based America's Cup and Volvo Ocean Race design campaigns for 15 years, always pushing the boundaries. Our designs and engineering solutions have helped three sailing teams win the famous Around-the-World Volvo Ocean Race: ABN Amro in 2005/06, Ericsson Racing Team in 2008/09 and Groupama Sailing Team in 2011/12. We have been involved in 4 America's Cup Campaigns: the 32nd with BMW Oracle Racing, the 33rd with Team Origin, the 34th with Artemis Racing and the 35th with Land Rover BAR.

After our successful involvement in designing the foils for the previous HUGO BOSS (without a doubt the fastest boat in the fleet during Vendee Globe 2016-2017), we have recently been involved in the design of the latest iteration of IMOCA Open60 HUGO BOSS for Alex Thomson Racing, as well as for some of the next generation of yachts for the 2024 Vendée Globe Race.

How can we help you win races?

* Running simulations to help design the sails, hull and appendages of your boats
* Running Velocity Prediction Programs to assess the yacht performance and optimising your design for a given handicap system
* Using state-of-the-art optimisation methods and algorithms to come up with the best design for a given condition or multiple conditions in yacht racing
* Obtaining accurate load cases for reliability or for designing structures to the edge when it matters

WATCH AERODYNAMIC SIMULATION



HUGO BOSS, CFD airflow

SEE CASE STUDY

HUGO BOSS, designed for Vendee Globe 2021

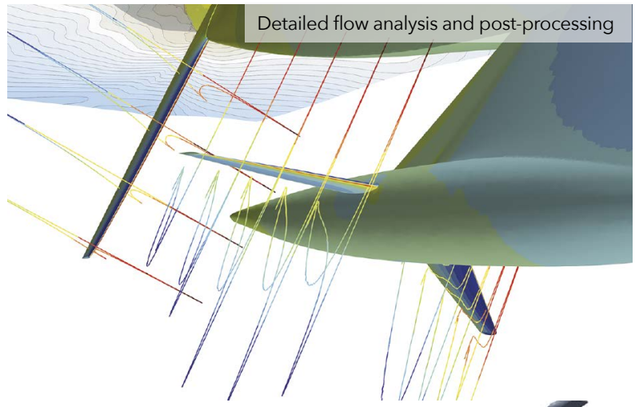
Making a difference...

Cape Horn Engineering´s methodologies have been developed and rigorously tested in a highly competitive environment where the slimmest of margins can make the difference between winning and losing a race.

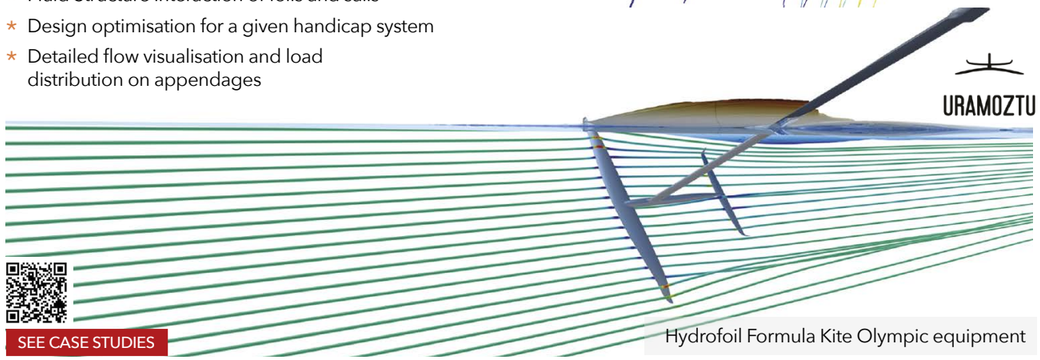
Besides America's Cup, VOR70 and Open60 we have been involved in the design of winning yachts for ORC, IRC, Superyacht class, 12 and 6mR, TP52s, Mini Maxis, classic yachts and production boats. We have also designed Formula Kite hydrofoils for the Olympic class, working alongside Team GB athletes to perfect the design.

Areas where we can help...

* VPP and Polar curves
* Hull and appendages performance and optimisation
* Yaw balance, appendage torques and bending moments, load cases
* Seakeeping, added drag, motions and accelerations, slamming loads
* Sail design and sail coefficients
* Windage of hull, deck and rigging
* Cavitation on hydrofoils
* 2D foil section optimisation, laminar sections free of cavitation
* Fluid Structure Interaction of foils and sails
* Design optimisation for a given handicap system
* Detailed flow visualisation and load distribution on appendages



Detailed flow analysis and post-processing



Hydrofoil Formula Kite Olympic equipment

SEE CASE STUDIES

SEE CASE STUDY

Racing yacht technology, America's Cup AC35

YACHT DESIGN OPTIMISATION - SAIL

SEE CASE STUDY

Design optimisation for 53ft sailing yacht

CFD analysis is increasingly being used to optimise the design of production yachts. Our collaboration with international yacht designer Roberto Biscontini, to optimise the design of the new Beneteau First 53 has proved to be a winner for Europe's largest boat builder. Rigorous testing with CFD was carried out on 25 different hull designs, plus keel bulb, rudder and displacement investigations in a very wide range of wind and sea conditions. Extensive work on weight analysis, precisely positioning the boat's centre of gravity, centre of effort and centre of buoyancy helped to achieve the desired result… a well balanced, powerful hull with high speed potential but also a good level of sailing comfort.

ONLINE SAIL DESIGN SERVICE

AEROSIM
SAIL DESIGN PORTAL

Online sail design service - for sail makers, naval architects and yacht designers

The AeroSim Portal offers a cost-effective solution for a complex task. It has been designed and engineered to offer a cloud-based sail design tool to boost sailing yacht performance.

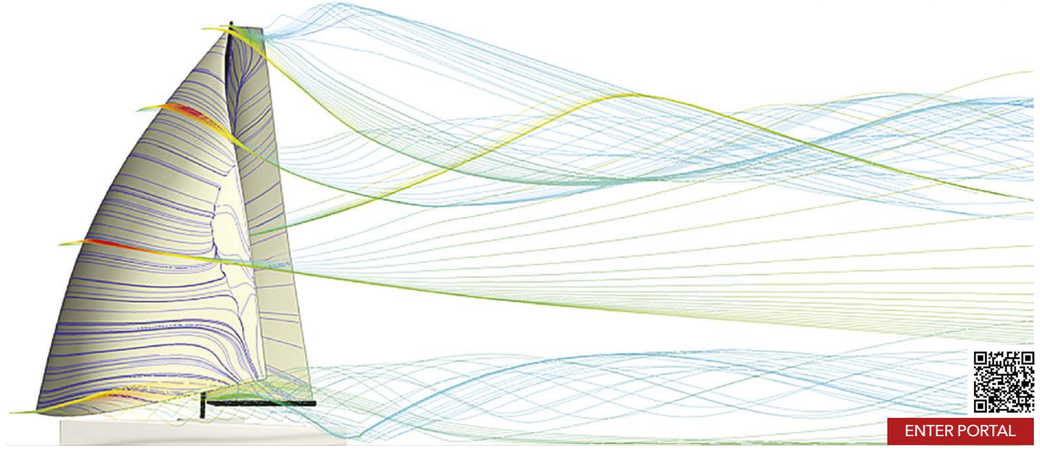
The service is developed with technology originating from Volvo Ocean Race and America's Cup campaigns and is truly state-of-the-art. Applied simulation methodologies are rigorously examined and validated. Accurate results of your sail geometries plus efficient visualisation of the sail loads are available in less than 1 hour. With this service you will be able to efficiently analyse and evaluate the performance of single or multiple sail configurations in different weather and race course conditions.

Increase your sail performance...

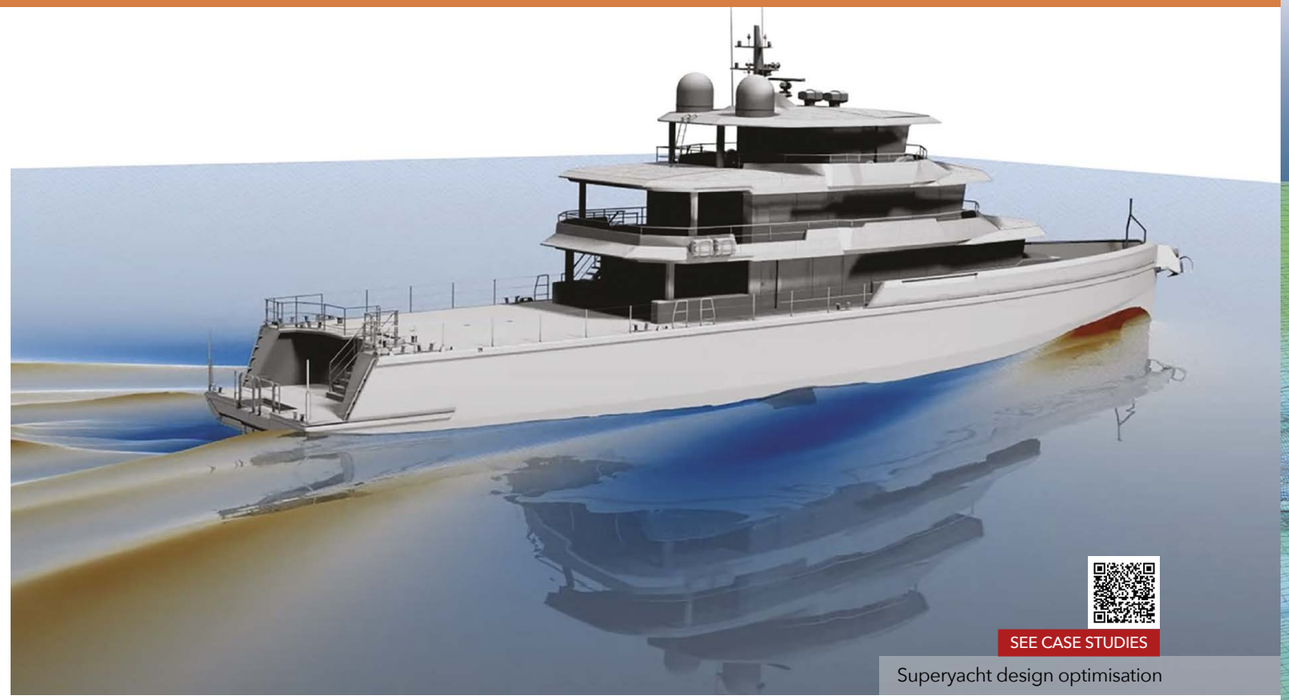
* Submit a single sail design to multiple geometries
* Specify weather conditions / racecourse conditions
* Purchase tokens through a secure payment system
* Run simulations in less than 1 hour

See the results...

* High fidelity simulations
* Evaluates the performance of the sails
* Efficient visualisation of the sail loads
* Accurate results of the best possible sail geometry



ENTER PORTAL



SEE CASE STUDIES

Superyacht design optimisation

Improving comfort, efficiency and performance

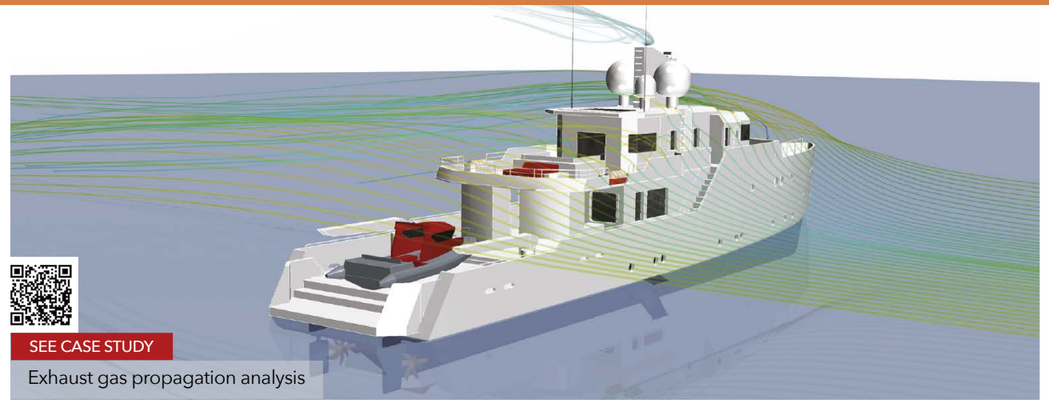
Cape Horn Engineering have pioneered RANSE based CFD since its very beginning and continues its research work on a daily basis. Due to our proven expertise in the America's Cup, Volvo Ocean Racing and other high profile sporting events, we can apply this cutting edge technology to a wide variety of other marine applications including superyachts, sailing yachts and motor yachts, fully foiling and foil assisted high speed vessels, to improve performance, comfort and safety, increase energy efficiency, and to save fuel and reduce emissions.

A good design process involves investigating the hull with its appendages and propellers simultaneously, as there is no isolated engineering component without an effect on the whole system. CFD allows us to perform calculations on the system as a whole, so the design process can be steered for fuel efficiency, comfort and safety. CFD technology can also be used for aerodynamic simulations to capture wind effects around exhaust vents in order to investigate where the smoke will travel for passenger comfort.

SEE CASE STUDY

CFD validation for 58ft motor yacht

YACHT DESIGN OPTIMISATION - POWER



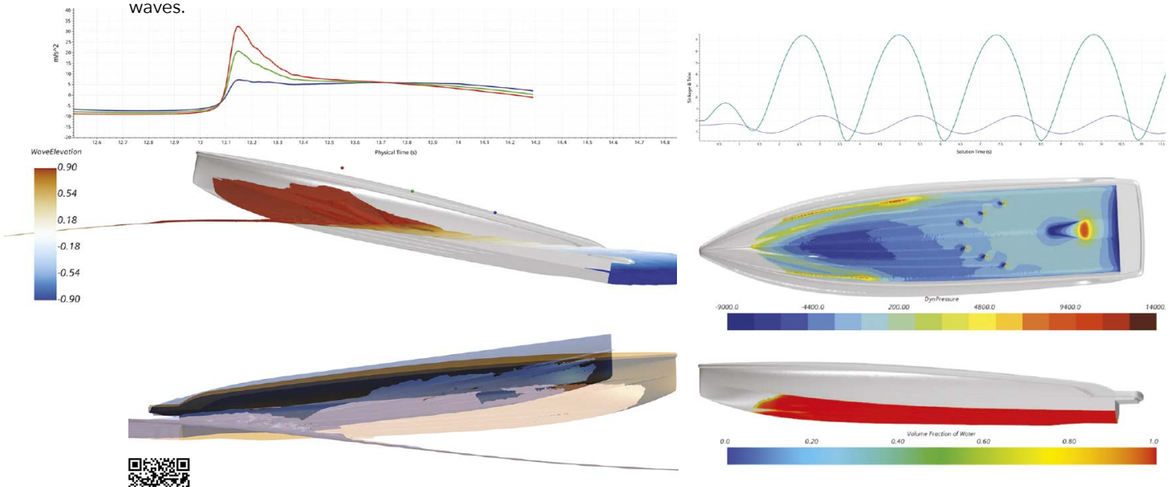
SEE CASE STUDY

Exhaust gas propagation analysis

SEE CASE STUDY

Fleming 85 in following waves

Innovative and highly efficient hull forms are analysed for performance, comfort, stability and safety. Designs are investigated for performance through the motions and vertical accelerations in waves, and the yaw moments when riding in following waves.



SEE CASE STUDY

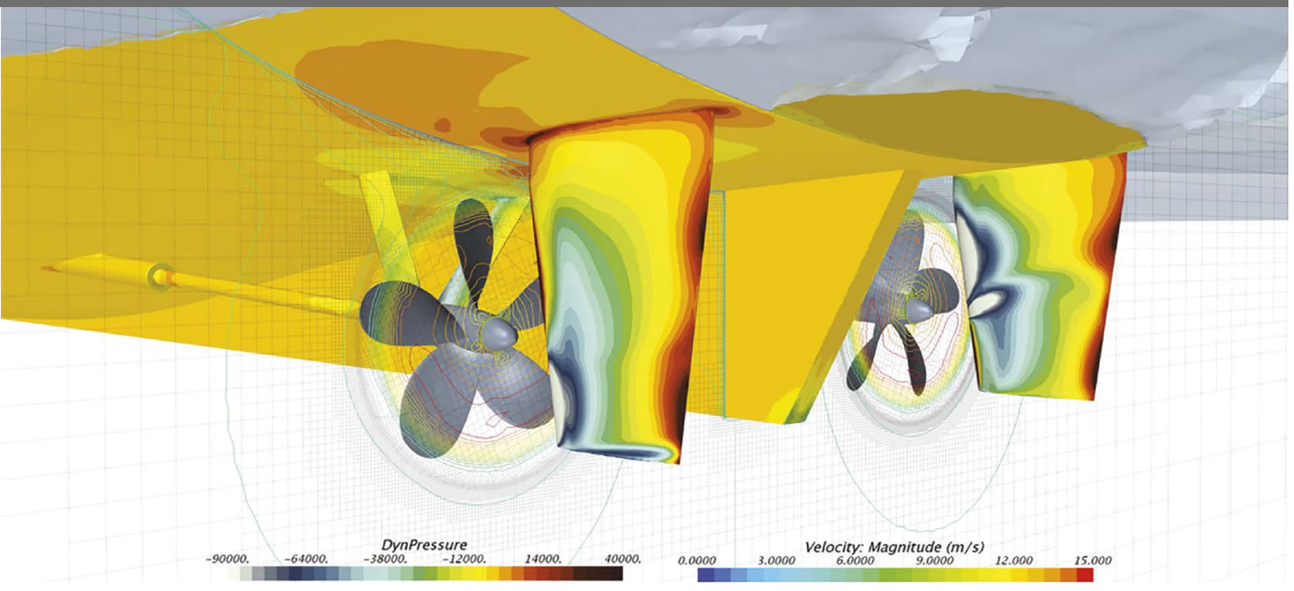
Seakeeping analysis of 60ft chase boat

Multi Degree-of-Freedom simulation in waves are performed to assess comfort and safety. The full scale Fleming 85 yacht,fully appended with rudders, propeller shafts and brackets, anti-roll fins, bow and stern thrusters, and stern platform is free to heave, pitch, roll and surge in following waves.

Innovative and highly efficient hull forms were analysed for performance, comfort, stability and safety. Propulsion from high-performance electric drives provides a sustainable alternative to conventional motor yachts using fossil fuels.

SEE CASE STUDY

Electric propulsion design studies



Enhancing the energy efficiency through three primary mechansims

Design exploration and optimisation using a simulation driven approach

Large parts of the workflow are automated which reduces analysis time significantly. We can run around 50 calm water simulations per day, which coupled with the fact that CFD allows for rapid geometry changes, means that several design candidates can be evaluated in a small time frame. At its lowest level this makes it very fast to compare multiple prospective design. Changes can be manually implemented by the naval architects based upon the hydro results and the new design can be quickly evaluated. It is also possible to focus on a single element of the hull. For example, the performance gains from adding a bulbous bow can be determined and then compared to a number of different bulbs. At its highest level this allows fully automated optimisations to take place. The CFD simulation can be paired with an optimisation algorithm and a parametric model in an automated loop effectively exploring the whole design space.

WATCH SIMULATIONS

Investigation of novel ideas and technologies implemented in a short time frame

Utilising our CFD technology removes the constraints of traditional model testing. Elaborate test rigs do not need to be devised and complicated scaling issues are no longer required as the energy saving devices can be modelled in full scale. The post processing capabilities of CFD are immense. Forces can be decomposed into the shear and pressure components, and quantified for the different surfaces. Pressure fields can be plotted and streamlines can be used to visualise the flow, allowing a far more detailed understanding of what is actually happening to be developed. Advanced visualising scenes allowing users to interact and explore the solution, viewing it from any perspective. These operations come together and form an environment in which new ideas can be tested and examined, with a very thorough understanding being developed so that they may be fully exploited.

A holistic, integrated design process

Ship design traditionally follows a design spiral approach, which is functional and logical yet can be restrictive and inefficient. It is made up of several steps, involving different teams, each using different tools and data sets. New tools such as CFD, FEA and 1D system simulation software may be incorporated into this, leading to improvements, however the real advantage of these tools is that they facilitate a move to an integrated digital approach. Moving all the design processes into one single, centralized environment increases a projects efficiency and collaboration while driving innovation. This digital twin methodology can enhance a vessels energy efficiency by facilitating a multi-domain design space exploration.

Areas where we can help...

* Energy Efficiency Existing Ship Index (EEXI)
* Energy Efficiency Design Index (EEDI)
* Performance of Energy Saving Devices (ESD)
* Performance of Wind Assisted Ship Propulsion Devices (WASP)
* Hull and appendages performance and optimisation
* Propulsion, propeller selection, fuel consumption and delivered power
* Propeller induced pressure pulses for vibration analysis
* Propeller cavitation analysis
* Manoeuvring coefficients according to ITTC procedures
* Station keeping analysis
* Appendage torque and bending moments
* Seakeeping analysis, added resistance, motions and accelerations
* Roll damping, performance of fin stabilisers
* Slamming loads, water on deck and sloshing
* Performance analysis of high-speed vessels
* Effects of hull steps, trim tabs and interceptors
* Fully foiling and foil assisted vessels
* Cavitation on hydrofoils and 2D foil section optimisation
* Fluid Structure Interaction (FSI) of appendages and sails
* Passenger safety and comfort including local wind effects and exhaust propagation
* Windage and structural wind loads on superstructures
* Engine room and cargo hold and cabin ventilation
* Ship Helicopter Operating Limits (SHOL)
* Damage stability, ship launching and lifeboat launching

Why outsource CFD?

Many naval architects and racing teams invest in their own in-house CFD capabilities but when performance is crucial, it pays to outsource to specialists. If you're serious about winning races, achieving the highest performance, and keen to avoid expensive mistakes, you need the best CFD team.

Outsourcing CFD is more cost effective compared to in-house CFD. A specialist CFD company with established best practices will guarantee that resources and software licenses are used efficiently and effectively, ensuring that there are no unnecessary overheads for the client. Whilst some software vendors may provide unrealistic expectations of what is easily achievable using their product, a dedicated CFD company will have the experience to utilise the software to its highest potential and provide confidence in the accuracy and quality of the results. Overall, a CFD consultancy will have relevant expertise and larger resources, allowing them to deliver the highest quality results in a shorter time frame, at a reduced cost.

Choosing a CFD provider

The CFD industry is a highly competitive environment in which reliable, high quality performance and experienced specialists are hard to come by. For this reason, it is crucial to choose a CFD provider that can guarantee the best service. One of the main concerns when choosing a CFD provider is ensuring that results are accurate and precise, not just impressive looking. Your CFD provider should have the relevant expertise, established work-flows and best practices in order to run simulations to the exact standards required.

Why choose Cape Horn Engineering?

At Cape Horn Engineering, our expertise is frequently sought after by top naval architects and designers to aid in their cutting edge projects. We pride ourselves on our unrivalled level of commitment, strong customer relations and drive to achieve the highest quality across the board. As specialists within the marine industry and leaders in flow analysis, we have expertise in aerodynamic and hydrodynamic performance. We use the best CFD package on the market; STAR-CCM+ from Siemens Digital Industries, and we are renowned for providing best-in-class services to all our clients around the world.

SEE CASE STUDY

Around-the-World Volvo Ocean Race

We are proud to assist some of the best companies within our industries.

We are also members of the following associations.