



SIMULATION LEADS THE FLEET

ALTAIR CFD AND STRUCTURAL ANALYSIS TAKES CENTER STAGE IN THE 37TH AMERICA'S CUP

Background Information

Dating back to 1851, the [America's Cup](#) is the oldest trophy in international sport and is the most difficult, most prestigious race in competitive sailing. Though sailing technology is ancient – possibly dating as far back as 5500 B.C.E. – modern competitive sailing vessels are a far cry from their leisurely ancestors. Today's cutting-edge craft, such as those featured in the America's Cup, can reach speeds of more than 55 mph in ideal conditions. To streamline development, test designs, and perfect performance, competing teams rely heavily on [structural analysis](#) and computational fluid dynamics (CFD) technology.

About the Customer

The [New York Yacht Club](#) (NYYC) is older than the [America's Cup](#) competition itself, boasting a 180-year history that stretches back to 1844. The NYYC is also the winningest team in America's Cup history with 25 titles to their name – far more than any other competing team. In the 37th America's Cup, taking place in Barcelona, Spain throughout the latter half of 2024, the NYYC's American Magic team is searching to add title number 26 to the organization's trophy case and etch their name into the history books once again.

Their Challenge

To compete against the other world-class teams, the American Magic team needed to design a highly specialized type of boat. The type of yacht to be used in the 37th America's Cup, the "AC75," is a 75-foot-long monohull yacht that features hydrofoils, a double-skinned soft sail, and an eight-person crew. The AC75 vessels, though still sailing in the traditional sense, look as if they're flying because of the hydrofoil; as a craft with hydrofoils gains speed, the hydrofoils lift the boat's hull

180 YEARS
AGE OF THE NYYC

25
AMERICA'S CUP
TITLES WON BY
THE NYYC SINCE 1851

ENABLED
7 MODELS
IN PARALLEL
30 MODELS
PER DAY

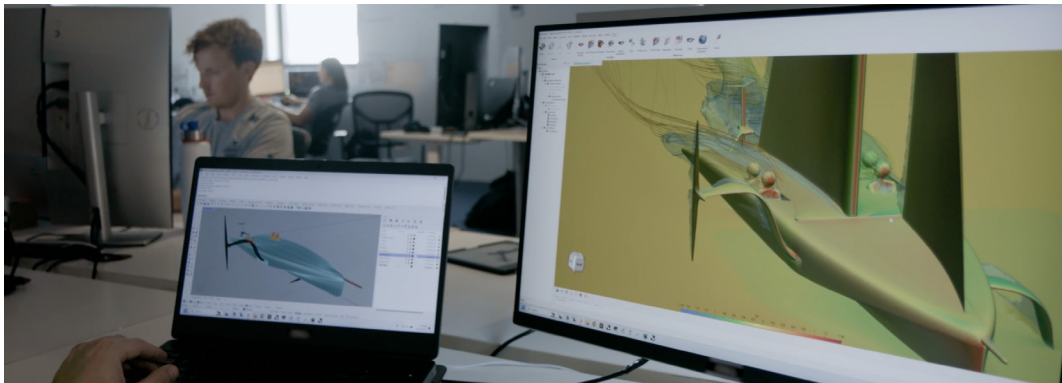
5,000
MONTHLY NODE
HOURS PROVIDED

out of the water. In the words of American Magic CFD Engineer Andrew Bloxom, “These aren’t your typical sailboats – they’re technological wonders.”

Naturally, creating these technological wonders is no small task. For one, America’s Cup teams must adhere to a myriad of design rules and limitations to ensure reasonable competitive parity. Most notably, teams are only allowed to build a single AC75 yacht for the entire three-year development cycle. They also have limits on how many components they can develop (hydrofoils, masts, sails, etc.). In addition, teams aren’t permitted to perform most types of physical testing at a scale beyond 20 feet, meaning they can’t use 1:1 physical testing environments like wind or water tunnels.

And secondly, top-tier competitive sailing yachts are just difficult to design in general. Creating a yacht that maximizes on-the-water performance while staying within the rulebook is a delicate, effort-intensive task. It’s a challenge American Magic’s Kurt Jordan, the team’s director of structural design and engineering, knows well. “Structural optimization isn’t the sexiest topic, but it’s crucial,” Jordan said. “Building these state-of-the-art yachts is a 10-month, 50,000 man-hour custom construction.”

To equip their experts with best-in-class [simulation](#) technology, NYYC and the American Magic team turned to [Altair](#), seeking especially to leverage Altair’s structural analysis and CFD solutions. Someone like Jordan knows that these solutions aren’t just nice to have – they’re a competitive necessity. “In the America’s Cup, you absolutely have to have the right tools and the right partners in place to maximize your time, effort, and investments.”



The Altair HyperWorks design and simulation platform helped the American Magic team build, test, and optimize the framework of their racing yachts.

Our Solution

Structural Analysis and Simulation

On the structural side, Altair’s technology – especially the [Altair® HyperWorks®](#) design and simulation platform – helped the American Magic team build, test, and optimize the literal framework of their racing yachts. Altair’s technology helped the American Magic team achieve their two main objectives on the structural side: minimize the yacht’s manufacturing phase (as opposed to the design/race phases), and create a yacht that’s as light, as fast, and as durable as possible.

“Our team used the optimizations Altair’s solutions offer up front, which is very powerful in the initial phases of design,” Jordan said. “After all, any weight we can take out of the structure is weight we can use elsewhere.” Jordan and his team used the Altair HyperWorks platform to design, test, and optimize the yacht’s key components, including the hull and hydrofoil structure. Moreover, they used Altair’s composite laminate optimization toolkit – including [Altair® HyperMesh®](#) and [Altair® OptiStruct®](#) – to compare structural layouts within the yacht and elsewhere, and utilized [Altair® Radioss®](#) for impact analysis.

And in addition to Altair HyperWorks’s capabilities, the American Magic team benefitted greatly from Altair’s industry-leading technical support. “Learning curves for technology like this can be very long,” Jordan said. “It takes up time you can’t really afford to lose during the racing cycle. But Altair has been on the spot throughout.”



The goal of modern development is to create workflows with minimal effort so you can run thousands of jobs within different conditions. That’s what Altair and its technology gave us the framework to do. These aren’t your typical sailboats – they’re technological wonders.

Andrew Bloxom,
CFD engineer,
NYYC American Magic

CFD

On the CFD side, Altair HyperWorks also allowed Bloxom and his team to test and optimize different aspects of the boat's performance that further informed design enhancements and better integrated the performance of the hull and sails. They used the platform to analyze air flows in and around the yacht – an especially vital component in a competition where calculating and minimizing aerodynamic drag is crucial since the yacht is mostly suspended out of the water by the hydrofoils. "We're always formulating the best guess of our craft's performance envelope using data from our simulation tools," Bloxom said. "Since so many components and systems change over the course of development, having a high-fidelity view of how these things interact is critical in ensuring we're making forward progress with our design decisions."

The team found [Altair® AcuSolve®](#) and the [Altair® Unlimited™ Virtual Appliance](#) particularly useful; they also utilized [Altair® PBS Professional®](#), part of the [Altair® HPCWorks™](#) HPC and cloud platform. "We used AcuSolve for basically everything above the water line," Bloxom said. "AcuSolve's history as a robust external aerodynamics tool and its scriptable workflows help us pinpoint causes and effects, better predict the yacht's interaction with the air, and generally give us a good view of its performance across a range of race conditions."

CFD capabilities are vital since the boat is, ideally, airborne during the entire race. Since teams can't use 1:1 physical prototyping (like wind or water tunnels), they must have powerful, accurate simulation tools at their disposal. And these tools must allow them to scale and perform a multitude of simulations. Altair's tools do just that. "What Altair's solutions really allow us to do is process a large amount of design variants in a short amount of time," Bloxom said. "The whole goal of modern development in the America's Cup is to create workflows with minimal effort so you can run thousands of jobs within different conditions. That's what Altair and its technology gave us the framework to do."

Results

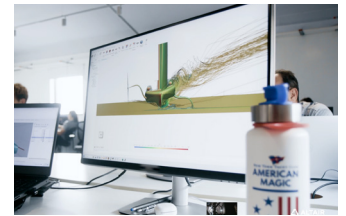
Using a combination of solutions from both the Altair HyperWorks and Altair HPCWorks platforms – and the Altair Unlimited Virtual Appliance, which provided them a modern, flexible "key-in-hand" licensing solution – the American Magic team was able to improve upon the yacht they used for the 36th America's Cup in 2021 to give its crew the best possible chance of lifting the trophy in Barcelona in 2024.

No matter what the American Magic team was looking to achieve, Altair's comprehensive tools gave the team the ability to run simulations at scales and speeds far beyond what was once possible. For example, Altair's tools drastically increased the American Magic team's throughput, giving them the ability to run up to seven models in parallel and up to 30 models per day. Monthly, Altair tools gave the team a throughput of around 5,000 node-hours. This computing power enabled them to run entire sets of design points (wind conditions, yacht velocity, height above water, etc.) in a quasi-automated way.

More broadly, Altair solutions and support empowered the American Magic team to improve sail interactions with the hull, the positioning of the crew within the cockpits, air flow around the hull, and more. This power and automation freed their teams to iterate more, design more, and save their time and effort for their most vital work – all while reducing the amount of people needed to complete everything.

The convergence of simulation, HPC, AI, and data analytics is the essence of what teams in the America's Cup – and beyond – need to gain an edge in today's hyperdigitalized world. No matter if you're on the water for the world's oldest sporting trophy or not, Altair can give your organization the tools it needs to succeed in a world defined by intense competition and thin margins.

To learn more, please visit altair.com/american-magic



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