The Computer Museum NEWS

Summer 1992

Silicon Sailing

Members Priority 10AM-NOON Sundays in August

> "Technology is the key to the America's Cup race. You can't win with a slow boat, and the only way to get a fast boat is to use the best technology available [with] the best computers and software."
>
> *Bill Koch, America³ Skipper*

Photograph: ©1992 Ralph Dormitzer

The America³ Foundation test-runs one of their racing yachts, designed and tested with the help of computers.

Silicon Sailing, an interactive display exploring the computer technology behind the new 1992 America's Cup Defender, America³, is now on exhibit at the Museum through Labor Day, September 7, 1992.

The exhibit enables visitors to design and race their own boat against other visitors' designs in a simulated competition under existing weather conditions. *Silicon Sailing* features three interactive DECstation 5000 workstations for design of the boat and a DECstation 425 personal computer, on which the simulated race runs. Visitors design their boat by choosing from among nine hulls, four keels, and nine sails. The computer then statistically evaluates their selection for performance against a benchmark racing yacht. If the performance is unacceptable, they can redesign their boat.

Then, the race begins! Visitors "sail" their boats on a simulation of the America's Cup course, using the actual winds outside the Museum, which have been measured by a wind detector on the roof. "The America's Cup is a dramatic example of the importance of computers in solving complex physical problems," says Director of Exhibits Gregory Welch. "Computers play a critical role in gaining that fractional percentage of performance advantage that is the difference between winning and losing."

The new Cup Defender, America³, is one of four 75-foot, 11-story high sloops built by scientist-sailor-businessman Bill Koch, 51, in his campaign to defeat veteran America's Cup contender Dennis Conner. Koch went on in May to defend the America's Cup successfully against the challenge from Italy's Il Moro di Venezia.

In pursuit of sailing's oldest trophy, Koch's syndicate, the America³ Foundation, used $500,000 worth of the latest computer equipment and services, donated by Digital Equipment Corporation, and a Digital VAX 9000 mainframe at MIT to prepare for the race.

Silicon Sailing is based on an interactive exhibit Digital created for DECWORLD, the company's annual display of products, after consulting with the Museum. "I'd never done an interactive demo and I needed help to make it user-friendly," explains Ivan Kristoffy, the Digital engineer, who with Ralph Dormitzer and Gwyn Thakur at Digital was responsible for the demo.

Kristoffy, whose son Andy had worked at the Museum when it was in Marlboro and later in Boston, sought the advice of Museum staff. "They showed us the Museum's interactive exhibit on designing a car. 'That's it exactly,' " thought Kristoffy.

Greg Welch then worked with Digital and America³ over six to eight weeks to define the architecture of the display. According to Kristoffy, it was a great success. "While people quietly explored one of Koch's boats that was also on display, the computer exhibit was where the action was. People were really excited to be able to design a boat and then see on a big computer screen how it actually sailed," he said.

Continued on P.2

HOW COMPUTERS HELPED WIN THE AMERICA'S CUP

Design Analysis

In designing the keel—the most secret physical component of the America's Cup contenders—Koch's design team at MIT performed numerical hydrodynamics analysis —a form of computational fluid dynamics (CFD)—on a VAX 9000 computer equipped with two vector processors. This allowed analysis of the lift and drag forces exerted on sections of the hull/keel assembly under varying water and wind conditions. As many as 10 keels were tested at once.

A good keel is heavy enough to provide stability, yet small and sleek enough to minimize drag. Some designs provide better maneuverability; others, more straight line speed. A successful hull balances stability, weight and in-water drag and performance in a variety of wind and water conditions. The longer the hull, the less the drag, though short hulls do better in light winds and heavy hulls, in heavy winds.

America^3 analysts ran Finite Element Analysis (FEA) on a DEC Station 5000 to determine the strongest and stiffest design at the lowest weight. This testing helped designers maximize strength and minimize weight, while conforming to America's Cup rules. FEA software simulated rig forces, mast compression, keel torque, and wave (hydrostatic) pressure effects, offering key data for placement and structural attachment of the keel. Computers made it possible to test over 20 keel designs in only two months.

Mast-top mounted cameras videotaped sails. The images of sail shapes were then digitized into PC-screen images. Personal computers equipped with color graphics hardware and special digital signal processing circuits used the images to measure sail shape changes exactly. This enabled analysts to correlate sail shape with boat speed to determine if and how sails should be recut.

Performance Analysis

The effect of hull, keel and sail on real world performance was computed by America^3's Velocity Prediction Program (VPP). This powerful modeling program "sailed" the hypothetical boat in various wind and wave conditions, analyzing design choices in search of the fastest boat. Running on personal computers and Digital workstations, VPP calculated performance based on hull shape and size, sail shape and size, wind speed and direction, and crew weight.

Via networking, test results in San Diego could be sent to MIT for overnight processing by VPP. Analysts in San Diego often worked at personal computers and used Ethernet-attached workstations as servers. This reduced the design test cycle time.

Race Management

During the race, Matasail, a powerful race management program running on a DECstation 425 personal computer below deck, tracked the boat's exact position via satellite feeds, monitored wind and water conditions, and supplied data on boat performance. Updated every two seconds with data from the boat's 24 sensors, the program helped the crew make real-time tactical or sail-trimming decisions. Using a voice-recognition system, the navigator could input data, call up windows, and activate commands without a keypad or mouse that might get wet.