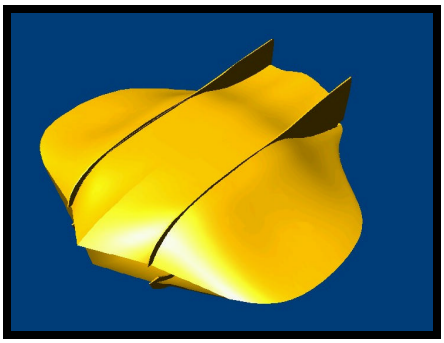
MACHINE INTELLIGENCE LABORATORY

Department of Electrical and Computer Engineering
University of Florida



MIL's sub design.

The 2004 International Autonomous Underwater Vehicle Competition

The International Autonomous Underwater Vehicle Competition is an annual event that allows engineering students to experience real-world design constraints and limitations. Teams from around the world gather for one week to discuss the design of their submarines and meet industry and military leaders. The fundamental requirement for an entrant is that their submarine must navigate through an undersea environment without human intervention by processing visual and acoustic information; the submarine must make command decisions and corrections that are subject to the imagination and ingenuity of the designers.

The complete system must be designed, engineered, fabricated, tested and launched by the engineering students on the team – an integrated systems challenge requiring every skill in the Electrical and Computer Engineering disciplines and an innovative and interdisciplinary design approach

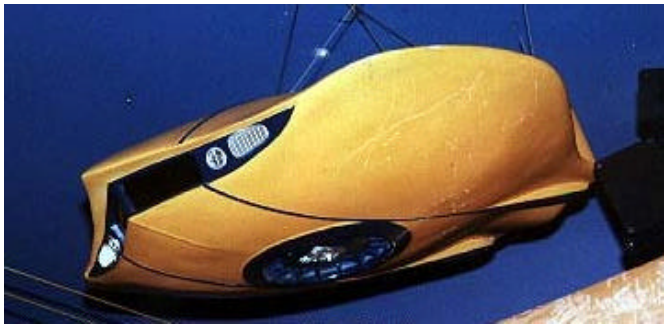
The University of Florida's Machine Intelligence Lab (MIL) is aggressively shaping the future of underwater vehicles

For the 2004 competition, the Machine Intelligence Lab is venturing down a path few are willing to trek. Keying off the graceful and articulate lines of a stingray, the University of Florida's design goes beyond the traditional submarine technology. Preconceived notions have been shed to take advantage of rules that stipulate the submarine must fit within a 3'x 3'x 6' box and weigh less than half of last year's vehicle weight. New weight requirements were also considered in the new design. Blending composite materials with a wet hull design, team members are aiming for a compact package that weighs less than seventy pounds.

The new sub must be able to navigate through an underwater gate, receive and correctly interpret a visual navigation signal underwater, and then proceed on a search pattern to approach within visual detection range of a small LED display. At the display, the autonomous vehicle must then engage two specified target receptacles, successfully loading these with special 1.5 pound marker modules, and returning to base, all within the specified time.

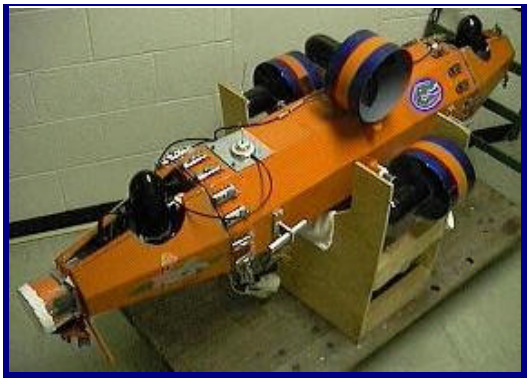
Where Science Meets Fiction

Science fiction fans of the 1960's may recognize the new design as it is founded on the *Flying Sub* from the television series *Voyage to the Bottom of the Sea*. As today's cell phones mimic the communicator in *Star Trek*, UF is opening new areas of research for tomorrows' submarine. As shown below, three-dimensional Computer Aided Design models have been created and given enough time, fluid dynamic tests could be simulated. The design is moving forward based predominantly on experience and educated guesses.

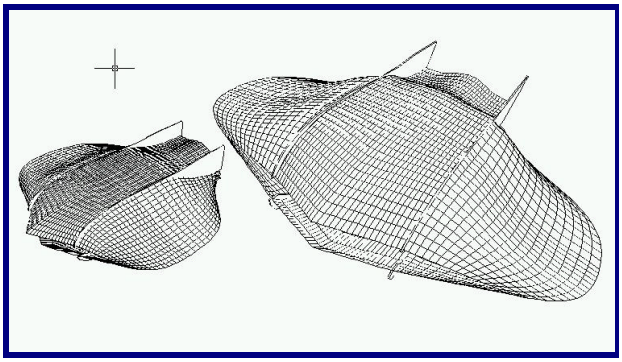


The *Flying Sub* from the 1960's television series *Voyage to the Bottom of the Sea.*

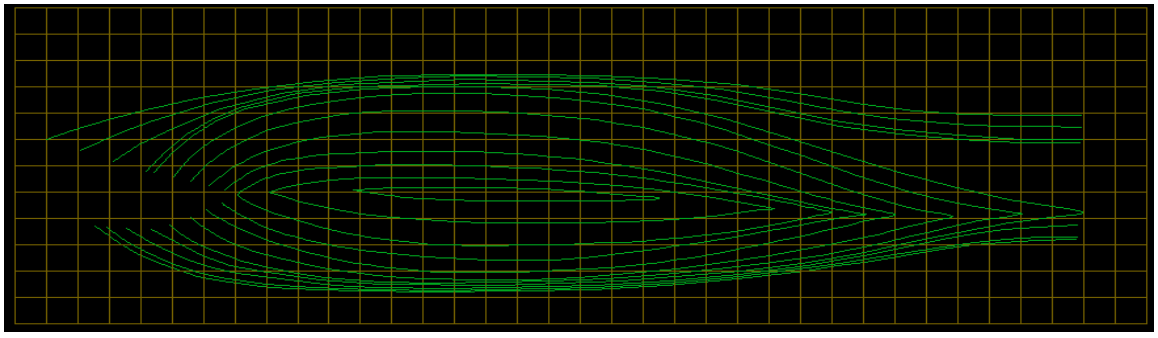
Research and experimentation form the foundation for an advancing society and nowhere is that more evident than in the Machine Intelligence Lab at the University of Florida. The directors of the Machine Intelligence Lab are aggressively pushing their students to go beyond the traditional and boldly try new approaches and designs.



MIL's sub 2003 submarine.



MIL's 2004 sub contour mesh



MIL's 2004 sub streamlined computer model contour mesh

Construction and Design

The new submarine will be a combination of composite materials and aluminum. The hull construction combines fiberglass and carbon fiber with an epoxy resin. The wet-hull design offers numerous benefits, one of which is minimal ribbing. The modeling and construction technique is shown below.

Construction technique for MIL's 2004 autonomous submarine

On Board Systems:

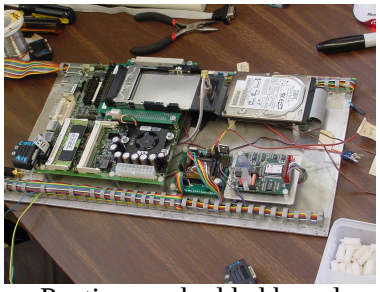
Mission important capabilities from previous entries are being enhanced for the new hull. Four propulsion motors will be used in the 2004 sub along with hydrophones for sensing an underwater 'pinger'; vision for navigation and locating the target; a 3-axis compass to determine yaw, pitch, and roll; and a depth sensor.

Power Management:

This year's design has the goal of reducing power consumption, since battery weight was a major drawback of the previous design. We are concentrating on selecting batteries that will provide enough power to run the sub for an adequate length of time without having to change either the propulsion or the computer/electronics' batteries.

Mechanical:

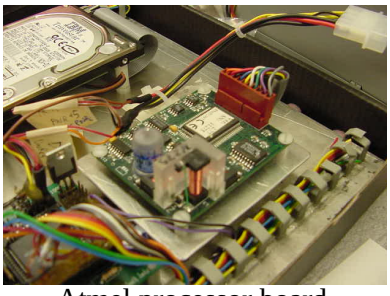
There were two goals that needed to be addressed with the new body. The first was a tighter electronics package; the second was smaller and lighter batteries. Symmetrically located external batteries allow for better weight distribution and a smaller housing for the electronics.



Pentium embedded board

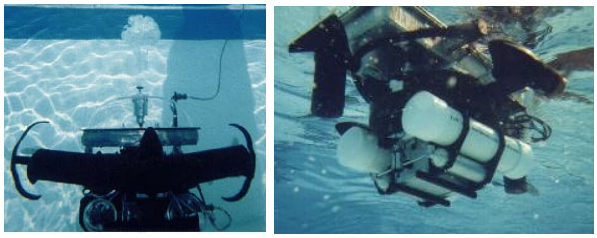
Computing

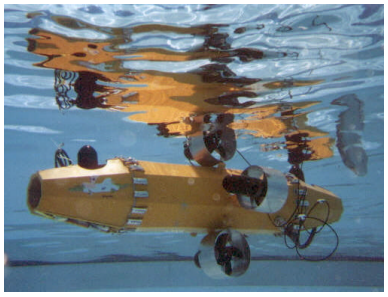
This year's submarine uses a Pentium-3 700MHz embedded processor system. This is the workhorse for our vision processing system. An Atmel Mega128 processor is also used to provide control signals for the motors. We are also design a new controller board which will include a large Altera FPGA for fast computations.



Atmel processor board

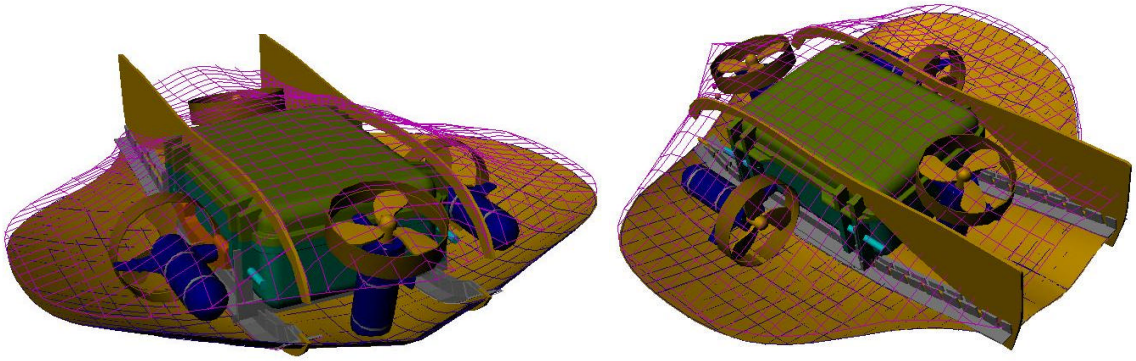
Past Entries





Past three MIL designs

The 2004 Entry



Two CAD drawings of our new sub, now in the production phase.

Major Sponsors

We wish to thank Harris Corporation for their continued financial support of the SubjuGator project and for their support the Machine Intelligence Laboratory. We would also like to thank UF's Electrical and Computer Engineering Department and the College of Engineering (Gator Engineering) for their continuing support.

Other Sponsors

Lockheed Martin has also helped to financially support the SubjuGator project over the last two years. We also want to that Atmel Corporation, who has been contributing parts for our SubjuGator (and other MIL projects) over the last several years.