Airflow Sciences Corporation

Helping Advance Ocean Research

Case Study

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Document A-52

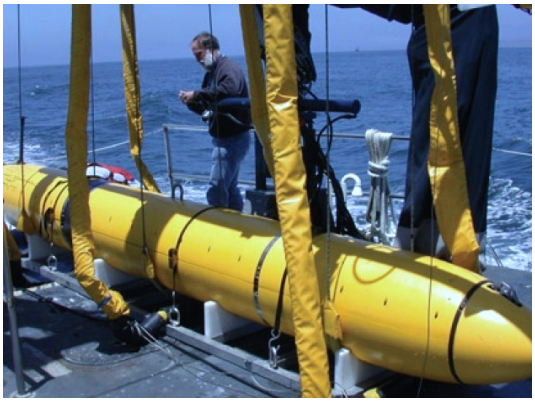

Figure 1 – The MBARI research team uses the AUV to collect and transmit data for ocean research.

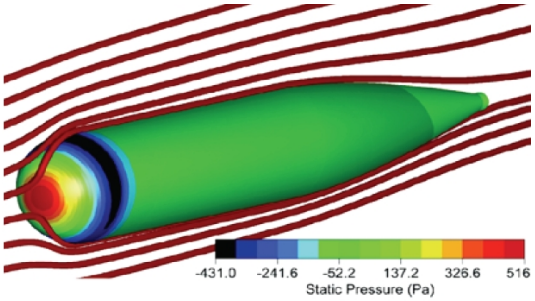

Figure 2 – ASC performed CFD simulations to optimize body design, minimize hydrodynamic drag, and allow the vehicle to travel further.

The Monterey Bay Aquarium Research Institute (MBARI) performs advanced ocean research in the areas of benthic processes, ocean observations and measurements, ocean biogeochemistry, CO_2 issues, submarine volcanism, marine ecology, sea floor imaging, and pH shifts in the upper ocean.

MBARI utilizes autonomous underwater vehicles (AUVs) to support its research programs. On-board computer controls allow vehicles to navigate the ocean for long periods of time, periodically surfacing to transmit acquired data via wireless telemetry.

The AUVs provide MBARI with an efficient and cost-effective alternative for performing deep water research. However, because these vehicles carry their own on-board power sources such as batteries and fuel cells, their travel range is limited. At this time, they cannot perform long-duration missions, such as wide ocean surveys or under-ice polar explorations.

During 2007, the MBARI development team began research into a long-range AUV (LR-AUV). The goal was to minimize hydrodynamic drag - allowing the vehicle to use the energy saved to travel further.

Initially, the project focused on use of modeling and simulation tools to determine whether a long-range, high speed vehicle was feasible based on current energy storage technology. They requested ASC perform CFD simulations to define body shapes exhibiting minimum drag over the range of expected vehicle speeds. This included an analysis of the boundary layer behavior along the length of the vehicle as well as the interaction of the flow with the aft-mounted propeller.

By modifying the shape of the vehicle's nose and after body regions, uniform flow conditions were achieved that minimized skin friction and form drag and presented the propeller with inlet conditions that improved its efficiency.

The project has been successful, and fabrication of the initial LR-AUV prototype was completed last summer. Jim Bellingham, MBARI's Chief Technologist stated "The ability to ask 'what if' questions with respect to the hydro dynamic performance of vehicle design has been immensely useful. Not only has it allowed us to expand vehicle diameter, simultaneously making packaging simpler and reducing drag, but it has also let us better optimize vehicle propulsion. CFD modeling is addictive."