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Escondido California

The first time that the University of Maine competed in the Human Powered Submarine competition ended with partially operational electronics and a mechanical failure. Not the expected outcome. The event was an educational success, even without an official time for the competition. The fly-by-wire control system on the submarine was the Achilles heel of the team and nearly led to a failure to post a time. However, even during the last run, the dive planes were still joystick controlled and a lot had been learned about controlling a submarine with electronics. The last two runs by the UMaine team made use of a cable system to turn the submarine with one of the two steering control surfaces. It was rapidly becoming evident that stability rather than responsiveness is needed in many of the submarines, not just the UMaine submarine. From the perspective of design objectives, this was a key finding for students on the competition trip.

The University of Maine Human Powered submarine was ready for their first run soon after the tank was opened in the morning. It was clear this was the end of the competition. The submarine was lowered in the tank as Chris prepared to breathe from Aaron's tank. Chris has to depend on Aaron to provide air as he climbs into the submarine. Watching the monitor the spectators could see the UMaine entry move off. It was obvious from the start of the run that the initial position of the dive planes was wrong. The first run was a scratch, missing the timing area by rising to the surface as in a previous run. However, time remained for a final run, the submarine was moved to the end of the tank and Chris climbed in, and ... nothing. Barely any motion of the hydrofoil system. The second run, after nearly an hour in the tank, and it was a scratch as well.

The problem, a cotter pin on the drive system had failed! Regardless of what failed, the drive system was lost. In a final attempt to get an official time, Texas A&M loaned the team some parts, but time was out. The competition organizers would not allow a final run.

The finale to the competition was a hurried trip to the airport for Aaron and Chris for them to get to their new jobs early Monday morning. Devon crated the boat to be shipped back to Maine and Zac shuttled folks to the airport.

No matter what came of the competition, the lessons were clear, practice, practice, practice and test, test, test.

And what about TU Delft? They left the competition with the Lexan nose of their submarine lost from a collision with a very unforgiving tank wall. Did they fly by wire? Yes, but not well. The challenges of orienting and controlling a submarine with computer are significant. The world record holding ETS team has in the past attributed their record to their control system. Seeing it is believing. The competition is one of electronics, control and stability, all in a waterproof case. And, even then, every cotter pin must be reliable or you still do not get a run. Now a cotter pin is clearly something that a group of world class mechanical engineers can analyze in the coming year. The

entire drive must not fail, and if it does, spare parts are key. The loading is complex, and corrosion is always a problem, but this is a solvable problem.

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And most of all congratulations to the team, Aaron Sutton, Chris Walker, Devon Gaudet, Ricky Powers, Will Darling, Jason Collins, Ian O'Neill, Dan Huber, Zac Ferry, Zack Weinman and Jason Cutter who built the submarine

and

Aaron Sutton, Chris Walker, Zac Ferry, and Devon Gaudet who raced the submarine.

A few more pictures are posted at:

[http://www.umaine.edu/MechEng/Peterson/Classes/Design/2005\\_6/HPS\\_Competition/2006\\_human\\_powered\\_submarine\\_com.htm](http://www.umaine.edu/MechEng/Peterson/Classes/Design/2005_6/HPS_Competition/2006_human_powered_submarine_com.htm)

Details of the technical portion of the project are available on the Mechanical Engineering Design Web Page:

[http://www.umaine.edu/MechEng/Peterson/Classes/Design/2005\\_6/Projects\\_overview.htm](http://www.umaine.edu/MechEng/Peterson/Classes/Design/2005_6/Projects_overview.htm)