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Supercomputer Robot
Cluster Sails Into The Sunset

When I first interviewed Liquid Robotics CEO Bill Vass, I was very impressed by the company's energy harvesting navigation system and its embedded data acquisition capabilities. The autonomous system completed a record breaking 9000-mile journey across the Pacific using only the waves and solar panels to power itself. It gathered and transmitted data as it sailed and distributed it to the world as part of the PacX Challenge.

It's no speed demon, but the Wave Glider is efficient with an almost unlimited energy supply because there is always wave movement that it can harvest. It comprises a float and fins connected by an umbilical cord *(Fig. 1)*. The float rides on the surface. It houses the computers and sensors along with batteries, solar panels, and communication equipment.

The Wave Glider moves in the desired direction and speed by angling the rudder. The articulated fins are about 6 meters below the float and provide forward propulsion via wave action. Solar panels on the top of the float provide electricity for the batteries that power the onboard computers, sensor payloads, and communications.

The larger Wave Glider SV3 complements the smaller SV2 *(Fig. 2)*. By going large, Liquid Robotics can cram in a waterproof 8U rack that uses salt water cooling. The SV3 also can house Arm-based blades that are currently implemented using dual-issue Texas Instruments OMAP processors. The current system supports up to 24 sockets.

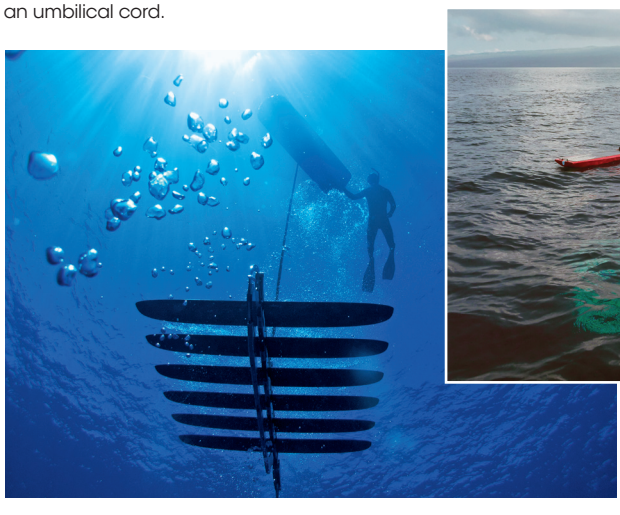
The blades are built on Liquid Robotics' own backplane, which incorporates CAN and Ethernet. CAN provides board and power management. Liquid Robotics found CAN more advantageous than I^2C with lower power requirements than Ethernet. CAN alone would probably be sufficient for navigation, most sensors, and system control, but the company has more ambitious plans for the Wave Glider.

Wireless communications can link a swarm of Wave Gliders. The group of computers provides a greater computational resource for the swarm, but Liquid Robotics has taken the idea much further with multiple core clusters in each robot. The clusters run Java virtual machines on top of Linux with a CORBA software backplane, forming a massive multitenancy system or a "cloud on the water."

The company looked at other robotic platforms but did not find one suitable for the dynamics of its environment, so it built its own cloud-based operating system named Regulus. The multitenancy, Java-based cloud approach brings a lot to the table. It allows more flexibility in terms of deployment, so a number of Wave Gliders could be equipped primarily with sensors while others provide number crunching. The computational power can be used for analysis, planning, or data reduction to minimize uploads.

Wave Gliders can handle tasks such as monitoring temperature and chemicals and tracking sharks. They can almost run forever. So if you see some flags floating by, it just might be a swarm of Wave Gliders. ed

1. The Wave Glider consists of a floating section near the surface and an energy harvesting and traction system that is connected by an umbilical cord.



2. The Liquid Robotics Wave Glider SV3 (left) joins its older but smaller sibling, the SV2 (right), for a swim.

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