UVic KNOWLEDGE
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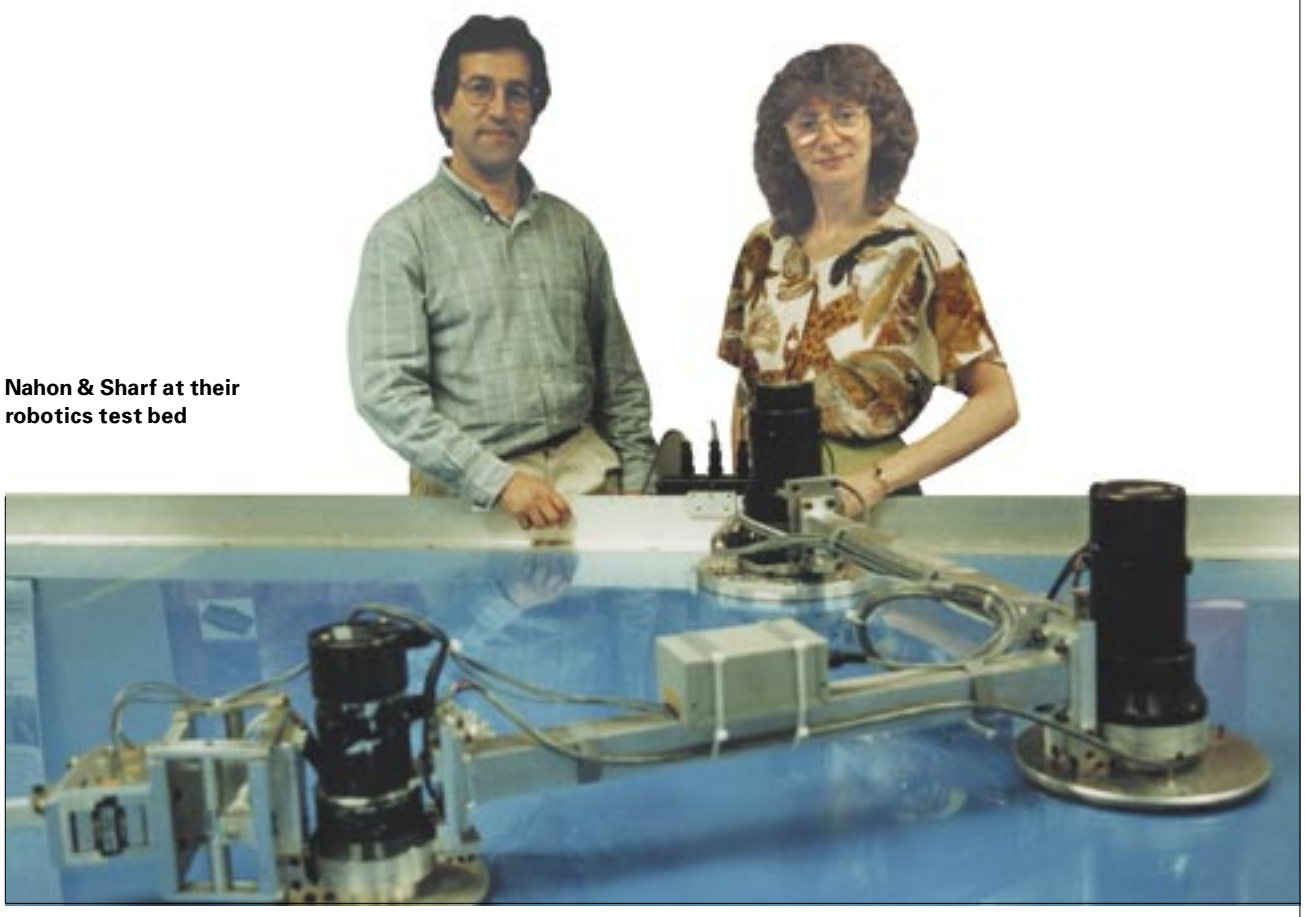
RESEARCH AND DISCOVERY AT THE UNIVERSITY OF VICTORIA

Developing robots for inner & outer space



Nahon & Sharf at their robotics test bed

by Kirsten Rodenhizer

What do the ocean — a watery world rich with life — and the cold, lifeless reaches of outer space have in common?

Both are airless, low-gravity environments into which it is dangerous and expensive to send humans. This similarity underlies the work done by mechanical engineering professors Inna Sharf and Meyer Nahon at UVic's Space and Subsea Robotics Lab.

Sharf administers space robotics, Nahon is in charge of undersea robotics, and both do some work in aeronautics. The two, a married couple, came to UVic in 1991.

The subsea studies include research and development of remotely operated underwater vehicles (ROVs) — which perform such underwater tasks as offshore oil platform inspection, cable repair and scientific exploration — and autonomous underwater vehicles (AUVs), which have no cables connecting them to the operator.

Sharf and her students recently completed a project for MDR (previously known as SPAR Aerospace), the company that built the space shuttle Canadarm. Systems like the Canadarm are designed for use in zero-gravity conditions and, on earth, they can't even support their own weight, much less move. Because of this, they can only be tested by simulation. MDR developed computer simulations to test how its systems will work in space, and the UVic lab's job was to test the computer simulations to find out how accurately they represent real motion.

Sharf and her students use a robotics test bed to create various types of motion, comparing their data with those produced by MDR's software simulations. So far, the lab has tested the program's ability to simulate contact tasks — jobs that require a robot to touch things.

"We have found that, overall, the agreement is very good," she says.

Nahon also works extensively with computer simulations. He and some of his students are developing a simulation facility for the design and control of AUVs. It will enable designers to test the stability of a proposed vehicle before building a prototype model.

"It allows designers of a real undersea vehicle to change their configurations, and then simulate flying it to see what happens," says undergraduate student Curran Crawford, who integrated a joystick with the program, enabling users to pilot the simulated vehicle in a realistic way. The simulation may eventually be used in conjunction with real AUVs, so that operators can "see" what is going on as they control the vehicles from above water.

"It gives you a much more hands-on feel of how the vehicle is operating," says Nahon.

Another of Nahon's projects involves ROV slack cables, which transmit power and information to the vehicles when they are underwater. These cables often get caught or tangled.

"We are trying to simulate what is happening with the cable so operators can keep track of what it is doing and predict what it is going to do while it is trailing behind the ROV," says Nahon.

Nahon and his students test their simulations against real-world conditions using a mini slack-cable ROV in UVic's McKinnon pool. This allows them to see whether their simulations represent the motion of the cable accurately.

Both Nahon and Sharf receive a large portion of their funding from the Natural Sciences and Engineering Research Council of Canada (NSERC). This funding has helped pay for general operations, equipment and the hiring of students.

EDGE/WISE Reading, 'riting & robotics

UVic students play an important role in the work of the Space and Subsea Robotics Lab, gaining valuable experience while participating in cutting-edge research in this growing field. Currently six graduate students are conducting research in association with the lab, and a further nine students have completed their studies and established careers teaching at university or doing robotics work in the private sector.

Even undergraduate students make important contributions to the lab's endeavors. Students in the third-year mechanical engineering design course last year created an underwater glider and went on to develop it further for International Submarine Ltd. (ISE) of Port Coquitlam. ISE is a leading producer of underwater robotic research devices and an industrial partner of the UVic lab. The lab is now working on a revised, smaller prototype of the underwater glider.

Students Nolan Sackney and Charles Humphrey with the underwater glider their team developed as a design class project.

FACTS FROM THE EDGE

- Sharf is project leader for a new Experimental Laboratory for Instrument Development in Astrophysics, which recently was awarded $711,080 in the Canada Foundation for Innovation grants competition. The lab will test instruments for future generations of ground-based and space optical and radio telescopes.
- Nahon is involved in an associated project, the Large Adaptive Reflector, a giant steerable radiotelescope (**http://www.drao.nrc.ca/science/ska/**).
- Sharf is working with universities in Canada and Europe to establish a virtual laboratory that will enable users from partner institutions to access her robotics facility remotely over the Internet.

SHARPEN YOUR KNOWLEDGE

- The Web site for the Space and Subsea Robotics Lab (**http://subspace.me.uvic.ca/index.html**) contains a wealth of information about robotics.
- Information on space robotics in Canada and the Canadarm (including videos) is available on Spacenet (**http://www.spacenet.eybe.edu.on.ca/index2.html**), on the MDR Web site (**http://www.mdrobotics.ca/canaframe.htm**), and on the IEEE Canada site (**http://204.225.143.1/millennium/canadarm/canadarm_home. html**).
- Information on underwater robotics in Canada and the Remotely Operated Platform for Ocean Science (ROPOS) is available on the Canadian Scientific Submersible Facility Web site (**http://www.ropos.com/**). ROPOS, Canada's only deep-sea remotely operated research vehicle, is based at the Institute for Ocean Sciences in Sidney, B.C.

ON THE EDGE OF YOUR SEAT

2000 Olympics Athletics Trials and National Championships
Aug. 11 to 13, Centennial Stadium
Competition begins Aug. 11 at 6 p.m.; Aug. 12 10:30 a.m. to 2:30 p.m.; Aug. 13 race walk 7 a.m., next events run 11:30 a.m. to 2:30 p.m.
Tickets: Weekend pass $15 adults/$10 youth; day passes range from $5 to $10. Available at McKinnon Complex Monday to Friday during office hours or through Pacific Sport at 744-1366.

Canada's National Basketball Team vs Nicholls State (NCAA)
Aug. 12, McKinnon Gym, 7:30 p.m.
Tickets are $5 to $10 at Braefoot Centre. Call 721-2244 for further info.

President's Distinguished Lecture: Dr. Jeremiah Ostriker, Princeton University
August 25, 7:30 p.m. University Centre, Farquhar Auditorium.
Dr. Ostriker is Provost of Princeton University and former director of the Princeton Observatory. He is considered one of the world's leading theoretical astrophysicists and co-authored the first study to advance the theory of "dark matter," now a major topic in cosmology. Free, but limited seating. Info: 721-7700.

Kirsten Rodenhizer is a UVic writing grad. She wrote this story as a participant in the SPARK program (Students Promoting Awareness of Research Knowledge), funded by the Natural Sciences and Engineering Research Council of Canada.