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Dancing to That Robotic Engineering Beat

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A MIND as supple and creative as Prof. Naomi Ehrich Leonard's, one that allows her to chart the patterns of schools of fish and then construct underwater gliders that mimic their movement, would seem to be at odds with her surroundings.

"Every wing is denoted with a letter," she said, walking down a dreary yellow cinder-block hallway where she works at Princeton University's engineering quadrangle. "But in case you forget the letter of your wing, each is painted in its own color."

Professor Leonard strode down the empty corridor. The rectangular outline of the cinder blocks, repeated throughout the complex, created a dull pattern of uniformity, broken only by the offices identified with small numbers and nameplates. She chatted about her children, her work, her plans for research, and the lilt of her voice somehow softened the narrow confines of the hallway.

She has been able to transcend the boundaries of her physical surroundings, as well as the traditional boundaries of her discipline, as a professor of mechanical and aerospace engineering. She has interwoven control theory, fluid mechanics, robotics, computer science, oceanography and biology.

Her work has shattered barriers and helped her design new sensing systems that replicate the coordinated behavior of flocks of birds and schools of fish. The advances she has made, which recently led to her being awarded a MacArthur fellowship worth

Laura Pedrick for The New York Times

"We saw a school of dolphins and someone spotted a blue whale. It was phenomenal." Naomi Ehrich Leonard

$500,000, have been found to apply far beyond robotics, extending control theory to all mechanical systems.

"It comes from having many interests," she said modestly.

Her work has wide uses, including allowing oceanographers to send out undersea robotic gliders that send back a constant stream of data on temperatures, currents and concentrations of phytoplankton. She held one of the white plastic gliders in her hands in her lab and spoke of it as if it were alive, a work not of mechanics, but of nature.

"We released little guys like these from a boat into Monterey Bay in California last summer," she said. "It was a calm, beautiful, sunny day. We pushed them gently off the back of the stern and waited 40 minutes to make sure they were functioning. We saw a school of dolphins and someone spotted a blue whale. It was phenomenal. You start to think about them as part of the natural world."

She has been able to develop the gliders and design their intricate motion by observing how fish and birds work as a group, what their traffic patterns are like and the techniques they use to blanket an area to search for food. The self-directed undersea robots she programs operate in a similar manner, moving in mechanical schools through the water to collect data for scientists.

Professor Leonard, 41, who has two daughters, ages 4 and 7, and whose husband, Tim Leonard, teaches economics at Princeton, grew up by the ocean in Marblehead, Mass. Her father, an engineer who designed jet engines for General Electric, used to write out math problems to amuse his daughter. She was on the high school math team, which, she admitted, "was not one of the coolest things."

"We would play math games while we waited to be served in a restaurant," she recalled.

But, not surprising, she said she was "one of those kids who liked a lot of things." She played the piano and was "a total dance fanatic."

She added: "I love dance. I watch performances and then go back to see them again. The beauty of the lines and forms and motion of dance remind me of the aesthetics of mathematics. It is abstract, yet well engineered. It is structured, yet original."

She danced ballet as a girl, and again as an undergraduate at Princeton. She has recently resumed taking ballet classes. "I am one of the old ladies now," she said, "but it is still fun."

She has also started playing the piano again, buying one last year as a gift to herself for her 40th birthday.

"Now that I have established my career and my children are older, I can bring back these other parts of my life," she said.

THE computers in her laboratory are named after choreographers like George Balanchine and Martha Graham, something she says she originally did for "creative inspiration."

"I thought this might also inspire some of my graduate students to see more dance," she said, laughing, "but this plan didn't work out too well."

She majored in mechanical engineering at Princeton and after graduation went to work

as an engineer for a company that "was small enough so I could do everything." She went back to school at the University of Maryland to get her doctorate in electrical engineering and became an assistant professor in 1994 and a full professor in 2003.

Professor Leonard's field is not one that has traditionally attracted women, something she is trying to change by helping Princeton recruit prospective engineers.

"People hear the term mechanical engineering and they think we wear jumpsuits, carry wrenches and fix cars," she said. "It is hard to enter a field where they are few other women, but once we get people to think beyond these old-fashioned labels, once we show people how engineering is interdisciplinary, how it can be a bridge even into the humanities, we will attract diverse students. We need people who think broadly and deeply."

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