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## Robots — the new inspection frontier

Inspections of the many structures we build are fairly straightforward. Structural engineers send their staff people on walkarounds, looking for visible signs of potential trouble spots. Sometimes binoculars are used; sometimes photos are taken. Sometimes problems are found; sometimes they remain undiscovered.

There are limits, of course, to that kind of inspection. That's why, more and more, sensors are used in conjunction with wireless data loggers.

On large structures, like hydro dams, scaffolding is used, or workers rappel, like mountain climbers, down the face of the dam to do their inspections. But such methods are slow, cumbersome and expensive. There's also an element of danger involved.

There's got to be a better, safer way.

Now, the Electric Power Research Institute — EPRI — plans to integrate inspection techniques with climbing robots, which will move around on the face of a dam using a variety of inspection devices to detect different types of flaws.

The machine, called a "crawler bot," has a motor which creates a vacuum that holds the bot to the wall while it moves along on soft foam tracks. It's a customized version of a commercially available robot by International Climbing Machines, of Ithaca, N.Y. The vacuum is strong enough to allow the bot to carry up to 20 kilograms while scaling the wall, navigating its way over nuts and bolts and other rough patches.

The crawler bot was selected after researchers, led by Maria Guimaraes, senior project manager for EPRI, looked at what other industries, both in the United States and abroad, to see what robots were being used. But having selected the right machine didn't end their searching. Their bot of choice doesn't come with a positioning system or a nondestructive examination device for testing concrete.

Another search led them to SLAM — the Simultaneous Mapping and Location System, developed by the Technical University of Darmstadt, in Germany.

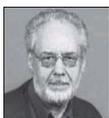
Researchers from several universities and research groups, including EPRI, had a hand in retrofitting the crawler bot with the SLAM and an acoustic sensor. Then, with the co-operation of the New York Power Authority, the crawler bot was tried out on the authority's Robert Moses dam in Niagara Falls, N.Y.

The acoustic sensor checked for delamination, and found some, which will be checked when the authority's repair teams works on the dam this coming summer. In future tests, researchers plan to fit the robot with other sensors to check the integrity of the concrete's reinforcement and the level of moisture within the dam's wall.

The work on robotic detection of flaws is especially important just now because many of the 100plus nuclear reactors in the United States are reaching the halfway point in their design life, and their containment domes need to be inspected. Using robots would greatly simplify that task. As well, the American Society of Civil Engineers says that many dams in the U.S. have reached the end of their design life, and frequent inspection will be necessary to maintain safety.

The work is important in Canada, too, as we look for ways to do a better job of managing our infrastructure, and inspection is an integral part of that.

Meanwhile, EPRI will continue development of its crawler bot. Part of that will be the development of a software controller to replace the commercial controller presently in use. The new software would run on an iPad, which would mean, says Guimaraes, that "users will be able to control all aspects of the crawler from a single interface."



A fully functional first-generation prototype of the crawler will be built and evaluated in a number of settings this year. More refinements and tests will eventually lead to specifications for a commercial inspection robot that ought to be ready for market in 2016.

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