Robotic crawler detects wear in power lines

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To your left runs a high-voltage power cable that is worn, but still physically sound. To your right runs a cable that looks identical, but damaged insulation means the cable is vulnerable to a short. Can you tell the difference?

Even most power companies don't know the weak points in their electrical grids. And although lights get turned on after a storm, the long-term effects of hurricanes, landslides or wind storms lie unnoticed. Now a robot can roll along the miles of cable, performing a utilities' equivalent of check-ups.

"This is the first robot built that can inspect power cables autonomously looking for incipient failures," says assistant professor of electrical engineering Alexander Mamishev. "It can find cables that may need repair, before they cause problems." He was in New Orleans earlier this week for the first field test, which took place Dec. 19 at Lockheed Martin's Michoud NASA Assembly Facility.

The prototype robot has been developed over the past five years and tested on underground power lines at the UW. New Orleans was chosen for the field test because of the widespread damage to the city's power system. More than a year after Hurricane Katrina, conditions in New Orleans are still unsafe, researchers say.

The high-voltage lines that this robot monitors carry electricity from the distribution plant to the substations. In New Orleans, these cables would normally run underground, researchers say, but because of the flooding

some of the three-inch wires are now strung from telephone poles. Saltwater absorbed during the storm can silently seep through electrical insulation until it suddenly penetrates and shorts the wire, they say.

UW's robot can pinpoint problem spots by using information from the surface of the cable to assess the condition of what's inside. The robot, which looks like an insect and can negotiate tight curves, rides along the insulated distribution cable scanning for internal damage. It uses three sensors: a heat sensor that detects heat dissipation; an acoustic sensor that listens for partial electrical discharge; and a sensor developed by Mamishev that detects "water trees," filaments of water that have seeped into the insulation. Engineers can monitor the robot via wireless connection and watch the robot's surroundings through a front-mounted video camera.

The team didn't necessarily expect to find damage at the Michoud facility. The plant builds the huge liquid fuel rockets used by NASA spaceships during takeoff and has high maintenance standards. Managers agreed to host the test to promote the use of similar robots in the power industry.

While the threat from damaged power lines is most acute after a natural disaster such as Hurricane Katrina, researchers say, the robot could also be used for regular maintenance.

"Right now power companies either let a cable age until it fails, or they take out the entire line after a set time period," says Luke Kearney, an electrical engineering undergraduate student working on the project. "Knowing whether the cable is starting to wear would save power companies a lot of money, and it would reduce the number of blackouts."

Some hand-held power cable sensors are now available. But sending a

person to monitor miles of cable by hand is tedious, costly and may be impractical for hanging or buried cables.

"Maintaining a distributed infrastructure – power systems, roads, bridges, tunnels, buildings – is a very large and costly endeavor. Over the years, maintenance costs more than construction," Mamishev says. "Our vision is that someday robots will accomplish the lion's share of maintenance tasks."

Source: University of Washington