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New technology offers arborists a noninvasive look

by Patrick White

If you go to the doctor complaining that your leg is sore, he or she isn't likely to pull out a scalpel. Instead, your physician will likely use medical technology—MRIs, ultrasounds, X-rays—to look deep inside your leg without the need to guess or to make a damaging incision for a first-hand look.

Why, then, would a tree care professional pull out a drill or boring device to check on the health status of a prized tree? Tony Mucciardi wondered the same thing, and from his questioning, TreeRadar (www.treeradar.com) was born.



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The TRU scans trunks—no matter how large—for signs of decay by simply placing the device on the trunk and walking in circles around the tree.

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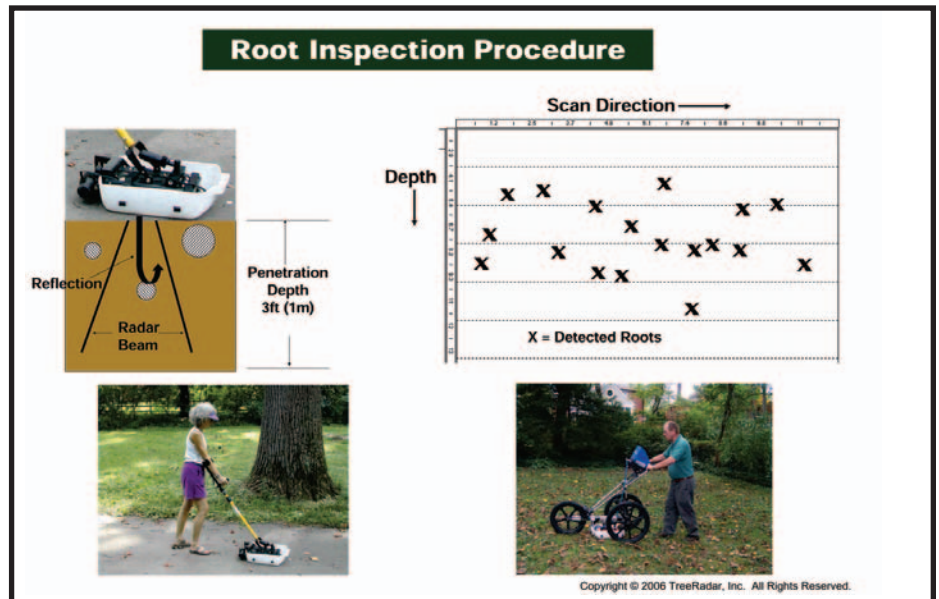
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Mucciardi had no background in arboriculture when he began experimenting with the technology seven years ago. "I knew that trees have leaves," he jokes of his knowledge base when he got started, but he was an engineer with vast experience in nondestructive testing technology, such as ultrasound. His specialty was signal analysis—determining what the signals that were being generated meant. Along the way, he realized that this type of technology might be able to be used in the tree care profession, and in 1999 he decided to make that a reality. After about five years of development, the TreeRadar Unit (TRU) came to the market in 2005.

Mucciardi began with a technology called ground penetrating radar (GPR), and worked to develop specialized sensors that would work on and through the bark of tree trunks. "Ground penetrating radar is a mature technology. It's been used for about 30 years for use in inspection through concrete and elsewhere," he explains. "TreeRadar is a novel application—novel enough that we got a patent—of that technology to provide a noninvasive way of looking into the tree trunk for internal decay and below ground for mapping of roots."

In the early stages of his work, he



A diagram of TRU root inspection procedure.

focused only on analyzing the tree trunk with his TRU, a focus he attributes to his lack of knowledge in tree care. "Of course I focused on the trunk, who would care about what's happening under the tree," he laughs now.

He credits the assistance of Maryland-National Park and Planning Commission

in Montgomery County for help in testing and providing feedback on the TRU concept. "I talked to one of the arborists there early on, Eugene Rose, and he was very interested. So, they provided some test beds that we could use for calibration," says Mucciardi. He explains that the challenge

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TreeRadar also scans below ground to examine the number, location, length and density of tree roots, and can also detect underground utilities or signs of past trenching that can weaken the tree from below.

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in developing the TRU was almost entirely an issue with accurately processing the signals with software. “The GPR equipment is standard equipment. It’s been modified for our needs. The tricky stuff is the interpretation, because when you’re looking at concrete, you know what you’re looking for—rebar or pipes—but with trees, it’s more difficult to tell what you’re looking at inside. There’s no two trees that are the same.”

He began developing a massive software package that continues to be refined and improved on a regular basis, but arborists who purchase the TRU system don’t need to worry about the complexities of the software that processes the signal. Instead, they only need to learn how to operate the equipment—training is provided at a two-day workshop in Maryland for those who buy the unit. When they return home, all the information they collect in the field with the TRU is sent to Mucciardi and the staff at TreeRadar, who analyze and interpret the data and send back a detailed, professional report, complete with photos.

“We do the analysis. We’re like the blood lab. Your physician extracts a sample and sends it off to the lab, who sends back a report. Then, the physician can decide on the best treatment,” says Mucciardi. (The TreeRadar company will also travel to sites to handle the data collection for those who don’t want to purchase and/or learn to use the system and may only need a single site scanned.)

At the training session, arborists learn how to properly use the TRU, how to upload the information to TreeRadar’s Web site and how to interpret the reports that they receive back. It takes just a few days to create what Mucciardi calls “a very professional looking report.” Photos, supplied by the arborist, are included on the cover and in



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the report, increasing the professional appearance and helping arborists present the information to home owners in a visual way.

Separate reports are provided for the tree trunks and roots, depending on which was scanned by the arborist. There are graphical results showing, in essence, “a virtual saw cut. It’s as if you had cut the tree at that location and were looking at the cross section,” says Mucciardi.

Trunk data is collected by holding a TRU to the tree trunk and walking in a circle around the tree. “You scan a trunk at multiple elevations—say 6 feet, 5 feet, 4 feet and 3 feet—off the ground. Data are automatically taken every 2/10 of an inch. Every time you walk around the tree at a given elevation, you close that file and open another one. It takes only as long as it takes to walk around the tree,” Mucciardi explains. Each elevation scanned appears on a separate page in the report; combining the information obtained from various elevations provides a realistic look at any decay that might be present.

The scanning procedure for roots below ground is just as easy, but the setup is a bit more involved. “At our training we spend

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TreeRadar provides a noninvasive way to detect signs of decay or other tree health issues that may pose safety concerns—especially important in urban environments.

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the majority of time teaching how to scan roots" Mucciardi explains. "You can do it a number of different ways. The ideal way is if you can walk in concentric circles. We use a very high-tech approach where we just put a rope around the tree like a lasso and then walk. It's simple, but if you keep the rope taut, you're walking along a constant radius. That's the best way to do it, because for the most part, the roots grow radially out from the tree and you're transecting them at right angles. But, in urban settings, you often can't do that because trees are planted along curbs or houses, so in those situations, you walk parallel line scans.

"The unit will self-calibrate to the soil—the soil consistency, hardness, composition, wetness. The antenna that comes with the unit will penetrate down to 1 meter, which will pretty much cover any roots. If you suspect the roots are really deep, we have an optional antenna that will penetrate down to 9 to 12 feet."

In the case of urban trees, the equipment easily penetrates through concrete, brick, asphalt or any other type of hardscape. "During our training course, we train arborists on grass, very compacted soils, concrete and so on." Knowing how the signals look with various types of soil can help arborists determine on-site if a given area has been trenched (the soil has been disturbed and is no longer in layers) or if utilities are in that location.

Just as the software produces a virtual saw cut from the data generated by scanning trunks, it produces a "virtual trench" with the ground scan data. "Just like if you had a backhoe and you dug a trench where you walked. If you then jumped down in the trench

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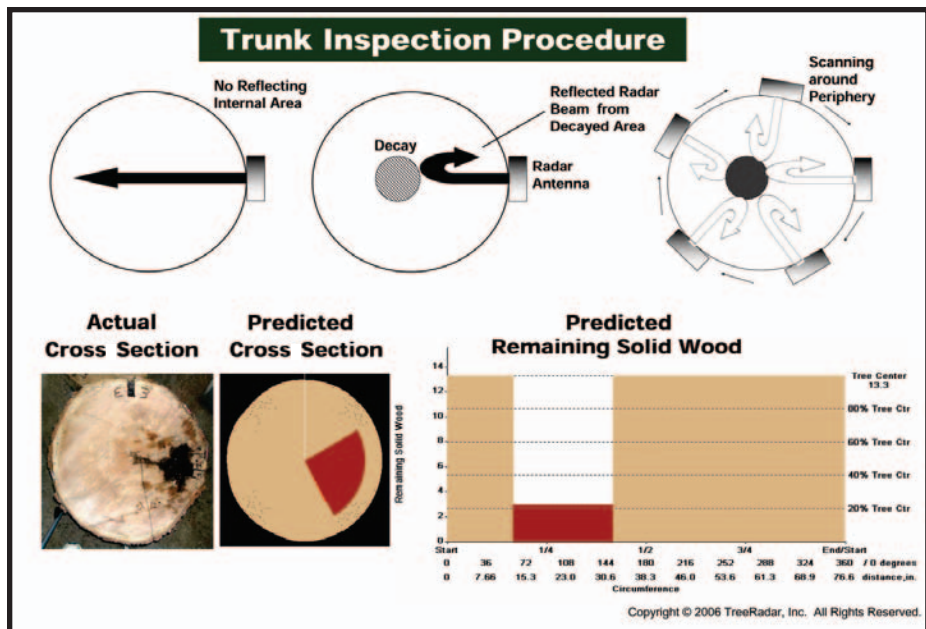
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and looked at the wall, what you'd see are the severed roots at various depths and at various places along the length of the trench. That's the information you get back in the report."

In the report, tree roots are color-coded by depth; a new feature showing the roots in 3-D fashion has just been added, according to Mucciardi. Knowing the number, density, length and location of tree roots can help arborists determine the health of the tree, as well as identify hazards such as stability and the threat of uprooting/blowdowns. Like with the trunk scan, this information is obtained without any potentially injurious invasion whatsoever.

Mucciardi emphasizes that while TreeRadar takes in the data, analyses and issues reports for both the trunk and root scans, it is up to the tree care professional—the arborists—to interpret those reports and, with their client, come up with the preferred treatment plan for the condition that's been diagnosed. "We provide the results for noninvasive trunk and root scans and let the professionals decide," he says.

Phil Wade, an arborist with Fujikura Europe Limited, which distributes the TRU in England, admits that some "potential



The diagram at top shows how the TreeRadar trunk scan technology works; at bottom is the type of information included in the report prepared by TreeRadar, as well as a photo showing how the technology can accurately detect tree decay.

customers do not like the idea of having to send TRU data off for analysis, particularly when all other high-tech devices used in arboriculture offer on-site results." He adds that the price of the unit represents a

significant investment for arborists, and therefore demand is just starting to build. At the moment, he says, demand is coming mainly from developers and others who

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contract with his firm to conduct root location mappings. "There is no doubt that there is a need for the TRU in the U.K.," he says. With other, less expensive tree stem decay detection devices on the market, like resistographs, which albeit are invasive, he's seeing less demand for that type of service.

Dave Gunter, an arborist in Australia, says he's been using the TRU system frequently for about 15 months. "During this time I have used the equipment in both its roles, as root location device and for decay detection," he explains. "I've found the equipment to be easy to set up and use, and the analysis reports are informative and easy to read and interpret. I have used the equipment from a rope and harness, from an elevated work platform and from the ground."

Gunter says TRU is valuable not simply for determining if decay is present in a tree—that is sometimes obvious—but in actually establishing the level of decay, which can be critical in deciding whether a tree presents a safety hazard and should be removed. He cites a tree he recently scanned, with the results showing that the decay was not as advanced as earlier thought, allowing a valuable tree to remain and receive appropriate care.

He says TRU is more likely to gain a foothold with open-minded arborists, than with those who are less open to new technology. He's excited about future advances and what additional features the technology might provide. "The TRU is still a work in progress, and we all still have much to learn." Even now, Gunter adds, "there is so much that we can do which was simply not possible prior to the introduction of this system."

Mucciardi says that the future will certainly hold new advancements for TRU. Not only will new features be added to the system, but the data currently being obtained may be able to be used in new ways. For example, he says, "Right now, when it comes to tree trunks and decay, there's already lots of science out there about what's good and what's bad, but there's very little for root density. We're currently computing root density at different depths and including this data in our report. We tell arborists to remember that they now have that data; someday it may be meaningful. Now that there's a tool for noninvasively determining root density, more research may be spurred to see, for

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Tony Mucciardi had a background in noninvasive testing, and used that knowledge—along with ground penetrating radar technology—to give arborists a high-tech new tool.

example, if trees are prone to falling down if root density drops below a certain number.”

If scanning is repeated at regular intervals—say every five years—it becomes possible to watch the tree’s health progress, or regress, over time. This can help determine what treatment techniques are working, or when a danger point has been reached.

The key, Mucciardi says, is that all of this information is obtained without injuring the tree, or possibly spreading disease by drilling or cutting into the trunk or root system. With trees prized for their shade and stature by home owners and municipalities, being able to diagnose health problems and safety threats without harming the valuable specimens should help arborists separate themselves from the competition.

“It’s interesting to note,” he concludes, “that the reports help to remove a lot of the emotion from the equation. The results are the results. Once you’ve got an internal picture of a tree that’s got decay almost all the way through it, it’s much easier to recognize the safety risk and make the decision to remove it. Or the tree may be in good health, and then everyone can breathe easier.”

Patrick White is a freelance writer and editor who is always on the lookout for interesting stories. He can be reached at pwhitevt@aol.com.

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