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## Guardian ANGEL Watches Over Pipelines

ITT's leak-detection service uses differential absorption LIDAR to monitor natural-gas corridors.

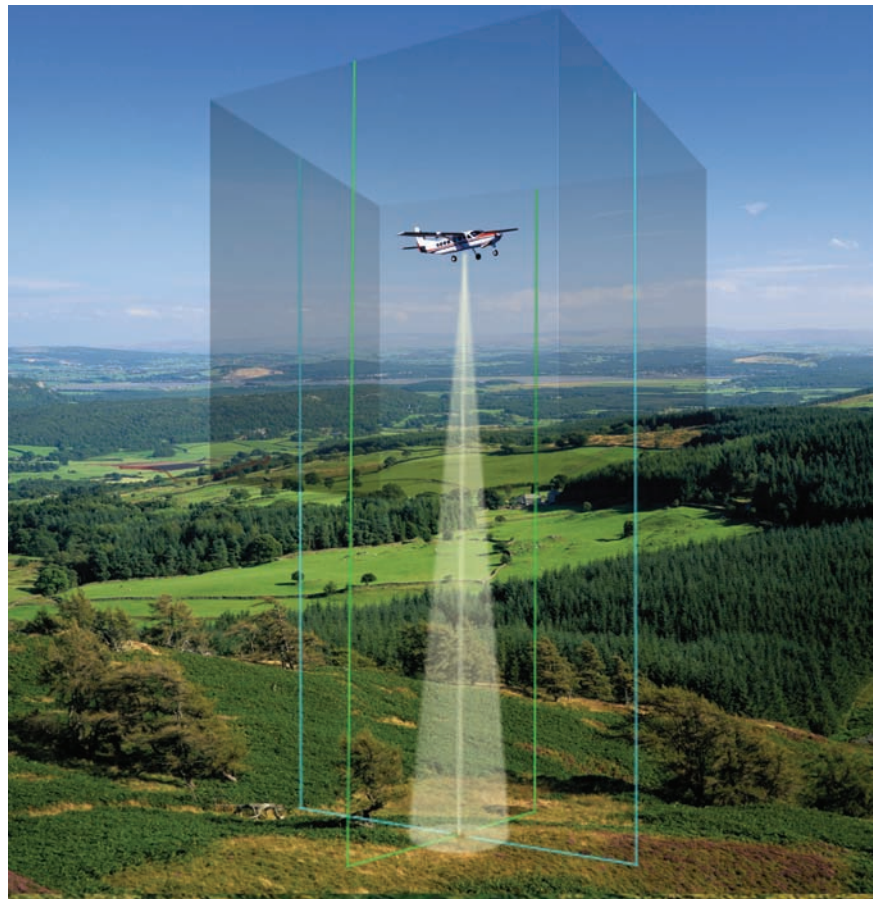
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**M**ore than 400,000 miles of transmission pipelines, many installed in the 1940s and '50s, crisscross North America. Although they're out of sight, underground pipelines must never be out of mind: even a tiny crack can cause big trouble. Methane, the primary component of natural gas, is an asphyxiant and a potent greenhouse gas — and it can explode. But because methane is colorless and odorless (until an odorant is added for safety), leaks are difficult to detect without technological assistance.

According to Dan Brake of ITT Corporation's Space Systems Division, the primary method of leak detection has been handheld gas "sniffers" that field workers carry down the length of the pipeline. Although there have been some improvements since the technology was developed a half-century ago, he noted, it's still "a very manual, labor-intensive process."

Now, there's a speedier option available to pipeline operators — ITT's ANGEL (Airborne Natural Gas Emission Lidar) Service. "We can do in a day what takes a walking crew three months to accomplish," said Brake, the director of ANGEL Service.



To collect data about gas leaks and other conditions affecting the pipeline right-of-way (ROW), the service employs a differential absorption LIDAR (DIAL) system, a digital mapping camera, a georeferenced color digital video system, and an optical guidance system that keeps the DIAL lasers

pointed at the centerline of the buried pipe. That adds up to nearly 2,000 pounds of equipment on board the fixed-wing Cessna Caravan 208B, which flies at 100-125 mph and 750-1,000 feet above the ROW.

While the plane follows the pipeline's path, the DIAL system emits some

3,000 laser pulses each second, covering a swath about 100 feet wide. Unlike LIDAR, Brake explained, DIAL doesn't measure the amount of time those pulses take to return; instead, it determines how much of the specially tuned laser light is absorbed. The more methane present, the less light returns to the plane. The system uses this information to generate concentration contours, which help pinpoint the gas plume's origin.

At the same time, a medium-format digital mapping system collects imagery of the ROW. Pipeline operators are interested in what's happening in the corridor and surrounding areas, said Brake; they're concerned about encroachment of pools, sheds, or other buildings. In addition, the imagery serves as a backdrop for the DIAL data, showing customers whether a particular leak is located near populated areas, road systems, or a processing facility.

The video offers a view of the corridor that can be streamed over the Internet. "[The customer] can get a view of the right-of-way without being a sophisticated GIS user," said Brake. Because each frame of the video is GPS-encoded, any potential problems — fallen trees, a washout in a road crossing — can be precisely located.

The system components may seem



impressive, but they would be useless if naturally occurring amounts of methane registered as pipeline problems. Algorithms that ITT developed enable the system to distinguish between the two, said Brake, yielding a low rate of false positives while maintaining the sensitivity required to minimize false negatives.

The company is currently exploring other applications of the ANGEL Service, such as finding natural gas seeps

that indicate good drilling sites, helping landfill operators monitor methane emissions, and surveying disaster areas after an earthquake or landslide to locate pipeline damage. The DIAL technology isn't limited to methane, Brake noted; the laser emissions can be tuned to detect other chemicals, including diesel and propane. In the future, hazardous-liquid pipelines may routinely be monitored from far above — out of harm's way.



For more information on ANGEL Service,  
please call (585) 269-5121 or visit <http://www.ssd.itt.com/angel>