

New ultrasonic technology could help prevent train derailments

August 22 2006



UCSD researchers in March 2006 successfully detected internal defects and surface cuts with a prototype vehicle at a test track in Gettysburg, PA. Credit: UCSD Jacobs School of Engineering

Researchers at the University of California, San Diego have developed a new technique they said is better able than currently used technology to find defects in steel railroad tracks, including hard-to-find internal cracks that can break under the weight of passing trains. Track defects account for about one-third of the 2,200 annual train derailments in the U.S., according to the Federal Railroad Administration (FRA), the federal agency charged with enforcing rail safety regulations.

A team led by UCSD structural engineering professor Francesco Lanza di Scalea describes in the Aug. 22 issue of the *Journal of Sound and*

Vibration a defect-detection technique that uses laser beam pulses to gently "tap" on steel rails. Each laser tap sends ultrasonic waves traveling 1,800 miles per second along the steel rails. Downward facing microphones are positioned a few inches above the rail and 12 inches from the downward pointed laser beam. As the prototype vehicle rolls down the test track delivering laser beams taps at one-foot intervals, the microphones detect any telltale reductions in the strength of the ultrasonic signals, pinpointing surface cuts, internal cracks, and other defects.

In March 2006, Lanza di Scalea, project scientist Piervincenzo Rizzo and doctoral students Stefano Coccia and Ivan Bartoli tested a prototype vehicle equipped with the UCSD technology at a test track in Gettysburg, PA. The researchers detected 76.9 to 100 percent of internal defects and 61.5 to 90 percent of surface cuts in dry and wet conditions, respectively.

The UCSD team was supported by ENSCO, Inc., an engineering and technology company headquartered in Falls Church, VA, that develops inspection technologies for the Department of Transportation and other government agencies.

Lanza di Scalea and his team will test an improved design of their technology this fall in Gettysburg as part of an ongoing study funded by the FRA.

"Some of the worst derailments in this country have occurred on tracks recently inspected by the current generation of technology, which often doesn't detect interior cracks in rails that happen to lie under areas of superficial cracking," said Lanza di Scalea. "Our technique is much better able to find such defects, and it can work under varying weather conditions while the inspection vehicle is zipping along a track at speeds of up to 70 mph."

Rail carriers moved 42 percent of America's total coal, chemicals, minerals, food and other goods shipped in 2005, according to the U.S. Department of Transportation. Track-related damage from derailments and other incidents doubled from \$55 million in 1993 to \$111 million in 2000, and the trend toward longer trains pulling heavier cars at higher speeds creates the potential for even greater losses.

The current generation of track-inspection technologies relies on a variety of techniques, including water-filled wheels or sleds that move over track surfaces at roughly 30 mph while sending ultrasonic pulses downward into the track. The inaudible ultrasonic pulses reflect back as echoes when they encounter cracks. Unfortunately, the signals are routinely blocked by superficial surface cracks from detecting more dangerous internal cracks.

Surface cracking does not interfere with the movement of ultrasonic pulses in the UCSD technology. "The ultrasonic sound we use doesn't come from the top of the rail, but instead travels along the rail," said Lanza di Scalea. "Our pulsed-laser technique, combined with ultrasonic microphones positioned a few inches above the rails and sophisticated software that filters out noise and other sources of variability is potentially very effective at finding internal rail defects."

Source: University of California - San Diego

Citation: New ultrasonic technology could help prevent train derailments (2006, August 22)
retrieved 20 April 2024 from
<https://phys.org/news/2006-08-ultrasonic-technology-derailments.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.