New smart tire senses damage, increases safety

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Gary Krutz, director of Purdue's Electrohydraulic Center, and graduate research assistants Timu Gallien and Alyssa Brune conduct research on a "smart" tire designed to sense tread damage before the tire goes flat or experiences tread loss. The research also will help detect possible tire defects in the manufacturing process. The technology is being developed through the Purdue Research Foundation Office of Technology Commercialization.

A new type of "smart" tire developed by a Purdue University professor is able to sense damage when a tire goes flat or loses treads, making it safer for road travel.

The tire's technology also can be used to detect impending defects before a tire is mass produced.

A team led by Gary W. Krutz, director of Purdue's Electrohydraulic

Center and a professor of agricultural and biological engineering, has developed a tire system that senses failures in real time. The concept behind the technology is that the entire tire acts as a sensor that sends information to onboard computers.

"I became interested in this after I had to replace all the tires on my daughter's and son-in-law's car after just 10,000 miles and suspected problems after seeing dozens of truck retreads along interstates," said Krutz, who earned his undergraduate degree in mechanical engineering. "This motivated me to do some research and find a way to improve tire safety. Our prototypes were tested, and the results showed significant damage can be quickly detected."

Tires are consistently subjected to harsh and unpredictable conditions. Because of this, they become particularly susceptible to external damage.

"Some tire damage is not easily detected or prevented, even with proper maintenance and inspection," Krutz said. "Occasionally failures occur because of gap damage within the tread, and this type of damage is a particular hazard on all steel-belted tires.

"Tire damage on the road creates situations that are inconvenient and, more importantly, hazardous for drivers."

Krutz's research led to the development of a sensing system that can respond to significant changes in a rubber research tire. The prototype system was designed by determining critical aspects of tire design and performance.

Sensors that can alert operators when a tire condition has degraded can save time and effort in repairing or changing the tire. The sensors also can notify drivers of low air pressure or unbalanced air pressure between tires, which can prolong the operable life of a tire.

"However, there are external injuries that can occur in tires that are not always propagated or affected by improper inflation, such as a road hazard like a rock or loose concrete, that can do damage to a tire without actually causing it to go flat," Krutz said. "This sensor technology searches for these types of problems as well."

Measurements on the tread, which includes the outermost layer of the tire and the layers beneath it, can be used to determine greater susceptibility to tire degradation. Examples of tire problems include cuts, punctures, manufacturing quality, imbalance, impact, rubber hardening or degradation, or improper mounting or repair.

"Beyond the importance of safety, an added bonus to this sensor technology is that drivers can get their tires repaired before the condition has degraded to the point of where it needs to be replaced," he said. "This can save time and effort in repairing or changing the tire during a highway emergency."

The sensor technology developed by Krutz works for all rubber tires, such as those on passenger cars, trucks, construction equipment, lawn and garden equipment, mining vehicles, and airplanes. The technology has been tested on other components and can be used in rubber products such as vehicle isolators, door and automotive seals, and orthopedic devices.

"It also can be used on most polymers, such as airplane wing composites, boat hulls and sporting goods," Krutz said. "We've tested this technology on more than 100 different products from shoes to accumulators."

The patented technology is available through the Purdue Research Foundation's Office of Technology Commercialization.

Source: Purdue University