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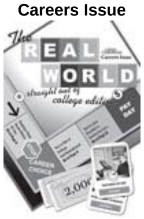

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Scientists Develop New Wireless Sensors

Wireless Strain Sensors May Be Used To Build Safer Cars

BY SHARON TANG-QUAN
Contributing Writer
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When shopping for a car, it's likely that your mother will choose the safest car in the lot, regardless of how much you cringe out of embarrassment. Fortunately for you, UC Berkeley engineers are developing wireless strain sensors that may someday be bonded to any steel structure, and can be used in cars to monitor performance.

"Essentially, bonding a strain gauge to steel substrate enables you to monitor the behavior and state of a solid in real time," said UC Berkeley mechanical engineering graduate student Babak Jamshidi.

Researchers at the the Berkeley Sensor & Actuator Center (BSAC) chose micro-electromechanical (MEMS) resonant sensors for their greater sensitivity to changes in their length, or strain, compared to other types of sensors.

The strain sensor works by detecting the change in gauge factor when the sensor is compressed or elongated due to an applied strain.

The gauge factor is the change in resonant frequency, which can indicate how much a wire is being strained.

"This is similar to a violin string in that if you tighten the string and then pluck it you notice the tone you hear increases in frequency. Similarly if you loosen it the tone decreases in frequency," said UC Berkeley electrical engineering and computer sciences graduate student Ken Wojciechowski.

Jamshidi notes that the high resolution and small size of the sensor enables it to contribute to a broad range of academic and industrial applications. Among these potential applications are vehicle traction and stability systems, which would provide better safety and smoother operation.

"Shafts and spindles can be used to predict the fractures within automobiles and machinery," said Liwei Lin, UC Berkeley mechanical engineering professor and primary investigator of the study.

If embedded throughout the vehicle, the sensors could be used to more accurately track the loss of traction.

"The sensors could be used to

monitor stresses in components prone to fatigue failure, potentially enabling the car to alert the owner to perform preventive maintenance-before he or she is stranded on the side of the road," said UC Berkeley electrical engineering and computer sciences graduate student Robert Azevedo.

Two designs for the strain gauge continue to attract the researchers' attention. Jamshidi is focusing on the capacitive strain gauge, which has two electrode plates with a very small gap size between them.

"The applied strain changes the gap size which affects the electric field between electrodes," Jamshidi said.

Wojciechowski concentrates on the resonant strain gauge, which he says is based on tuning fork-like tines.

One of the main challenges comes in the form of packaging the gauge. The gauge needs protection from the environment, but does not need to be so sheltered that the protection blocks out the external forces that the gauge needs to measure. Researchers are also searching for a way to bond the sensor to steel.

Wojciechowski adds that the biggest challenge for the resonant sensor was getting it to work at atmospheric pressure.

"It is very difficult to get MEMS resonators to oscillate due to air damping," Wojciechowski said. "Placing these sensors in a vacuum increases the complexity of the process used to build the sensor."

Though the obstacles are evident, the researchers are tackling the project's challenges. Once the bonding technique is complete, it can be applied bridges, underground pipes, or even the wings of airplanes.

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