A Predictive Model for Prevention of Hydroplaning Related Car Crashes Using Piezoelectric Sensors and Autoencoder Neural Networks

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Today, when we drive cars there is no indication of dangerous road conditions that could cause issues such as hydroplaning. Rain is substantially more dangerous than the other conditions because of a phenomenon known as Hydroplaning, where a layer of water builds between the tire and the road. This layer causes the vehicles to lose traction and slip uncontrollably. Wet pavement has shown to be a major cause of car crashes in the world. Every year there are up to 800,000 crashes, 20,000 injuries, and 5000 deaths in the US due to wet pavement. My solution is split into 3 phases: sensor selection, rig testing, and road testing. In phase 0 I selected a piezoelectric sensor that gives pressure readings. In phase 1 I simulated a car using a rig on a treadmill and ran tests in different simulated weather conditions. The readings are put through an autoencoder Neural network that calculates the mean absolute error. This error is represented by the phrase MAE, and after the tests I was able to correlate MAE to loss of contact force. In phase 2, I created a trailer rig that connects to the back of a vehicle to get real time road data. After testing on real roads I found the correlation between loss of contact force and MAE held true in real road conditions. This correlation showed two significant aspects of cars hydroplaning. The build up of water underneath the tire and the point when the car slips. So with this information I used a regression prediction model to inform the driver one second in advance of hydroplaning with a 87% accuracy. Once the algorithm predicts a slip it will initiate the anti-lock break system and allow the driver to regain control.

Awards Won:

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