



Slips, trips and falls are the leading cause of non-fatal injuries in US workplaces and cost companies there \$180 billion per year.
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A model for safer safety shoes

Researchers at the University of Pittsburgh have developed a new modelling system that they say can predict the traction performance of shoe treads and, therefore, help safety footwear brands design safer products. Interaction between a shoe and a floor surface is at the core of the researchers' work and they have concluded that safety shoes with softer soling materials and a wider, curved heel are likely to be better at preventing slips, trips and falls. Shoes that distribute a person's weight over a larger tread area can also improve traction.

Performance predictions

"Our modelling approach can predict the impact of new tread designs on traction performance," says Kurt Beschorner,

A research team has come up with a new model for constructing the soles of safety shoes, claiming the technology can help make shoes safer and prevent accidents.

associate professor of bioengineering at the University of Pittsburgh. "This can lead to shoe designs with better traction and to a more efficient design process." He and student researcher Seyed Moghaddam created the new model in the

university's Human Movement and Balance Laboratory, which focuses on solutions that will help prevent accidents from falling. It is one of the first labs to use computational modelling to study friction between shoes and floor surfaces, the university has said. The team will now begin working with footwear companies to help them design safer shoes using data from the modelling system.

The laboratory, located in the university's Swanson School of Engineering, has a motion-capture system built into a vinyl walkway that is eight metres long. It collects motion data for the person on the walkway and is able to examine exactly what goes on when someone slips and falls (there is a harness protection system in place to make sure no one taking part in the tests comes to any harm).

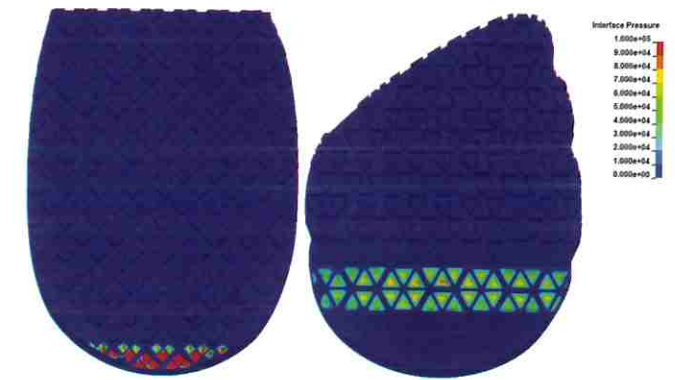
The cost of workplace falls

Preventing people from coming to harm is at the core of the work Dr Beschorner and Mr Moghaddam have been doing. Workplace fatalities have been on the rise in the US, reaching 5,190 in 2016, the first time the total has passed 5,000 since 2008. Slips and falls are some way behind other causes of these fatalities (transportation incidents are the most common reason for a workplace fatality), but fatal work injuries from falls, slips, or trips have continued a general upward trend that began in 2011, increasing by 6% to 849 in 2016 and by 25% overall since 2011. Roofers, carpenters, tree trimmers and tractor-trailer truck drivers are among those who appear most at risk according to official data from the US Bureau of Labor Statistics. It is also interesting to note that falls were the leading cause of non-fatal injuries between 2001 and 2014, with slipping accidents the cause of the fall in more than 50% of cases. Studies have shown that the financial impact of these accidents is \$180 billion per year in the US alone.

Frictional interaction

The Moghaddam-Beschorner research set out to find intelligent ways of making safety shoes safer by making accidental slips and falls less likely. It did this by studying in detail "the frictional interactions" between shoes and floors during walking, pointing out that this is critical to preventing slips and falls, particularly when contaminants are present, as they often can be in the workplace. The model they have developed takes into account the surface and material characteristics of the shoe and of the flooring and calculates a shoe-floor coefficient of friction (COF). They used the model to make a series of predictions and compared these predictions to results from physical COF testing.

Higher COF measurements indicate a lower risk of slipping and the research from Pittsburgh suggests that distributing contact pressures across key parts of the sole of the shoe is a good way to make the COF higher. Soling materials and soling treads matter too, of course, and the study showed that, overall, shoes with harder outsoles and texturing demonstrated lower COFs compared to other shoes used in the tests.



Two computerised simulations that show results when the shoes are at an angle of 14 degrees relative to the floor, which is the approximate angle when the shoe begins to slip. The shoe on the right is curved near the back of the heel and achieves a high contact area.

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When to buy new shoes

The main advantage of the modelling system, however, is that soling material developers and safety shoe brands should now be able to predict more accurately the COF they are likely to obtain with different combinations, taking into account the different flooring materials present in places of work too. And the more the model is used to make shoes for different environments, the more accurate these predictions will become. Other possibilities for the future include measuring the different COF readings that the same shoe might offer at different stages of its life, showing the difference in the measurement after six months', one year's or two years' wear, for example. This would help companies decide how frequently they need to provide workers with new safety footwear. 📌



Computational model results of the contact between boot tread and a floor surface. Green areas indicate that the tread is in contact with the floor, but at lower contact pressure. Green is good.

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