How to avoid jack-knifing your truck

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Jack-knifing is a major cause of devastation in a road traffic accident involving articulated trucks. Researchers in Greece have now designed a device to prevent this often lethal action of such vehicles. Writing in the *International Journal of Vehicle Systems Modelling and Testing*, the team describes the modelling and testing of a sliding kingpin device that allows the so-called kingpin junction between the front "tractor" and the trailer to slide along the rear tractor axle and preclude the jack-knifing motion of the trailer relative to the tractor.

Nick Koussoulas and Stamatis Manesis in the Department of Electrical and Computer Engineering, at the University of Patras, in Rio Patras, Greece, explain how a significant proportion of goods transported over land are now carried by heavy vehicles, especially combination trucks, which have a tractor vehicle pulling a semi-trailer. These are commonly referred to as "18-wheelers" in the USA and "articulated lorries" in the UK. Anti-lock braking system (ABS) that reduce the loss of traction during emergency breaking have reduced the number of direct collisions and other accidents.

However, "jack-knifing" in which an instability often associated with an empty, or low-weight trailer being towed on a slippery road leads to catastrophic articulation of the joint between tractor and trailer. Jack-knifing is one of the most significant problems facing truck drivers and a major cause of traffic pile-ups and other multiple-vehicle accidents on major roads.

Engineers and designers have attempted to design technologies to

prevent jack-knifing among them independent or speed-dependent angle limiters, independent trailer brakes that are operated before the tractor brakes and load-sensing brake pressure regulators. Unfortunately, success has been very limited and no system is commonly used. Koussoulas and Manesis hope to change that situation and eradicate the articulated vehicle jack-knifing risk from our roads through their design of a sliding kingpin system. The design is currently wending its way through the patents system.

In current articulated vehicles, the tractor and semi-trailer combination are hitched together via a mechanical junction – the kingpin – which is static. The team's sliding kingpin system is servo-driven, as is the "fifth" wheel, and this allows the kingpin to slide in a linear fashion along a direction parallel to the rear axle of the tractor. This allows the mechanism to compensate for inordinate movements of the semi-trailer relative to the tractor, especially during hard braking so reduce, or potentially eliminate the possibility of the adverse trailer swing that would otherwise lead to jack-knifing.

As with ABS, the sliding kingpin system only comes into play in an emergency situation and does not otherwise interfere with the handling of the vehicle. "The sliding mechanism and the semi-trailer act as a planar but horizontal inverted pendulum and these movements of the kingpin permit the stabilisation of the semi-trailer," the team explains. Modelling suggests that the system is capable of keeping the articulated vehicle in line and constraining jack-knifing to very low limits for a wide range of vehicle loading and road conditions, the team concludes.

More information: "Modelling and control of the sliding kingpin anti-jackknife device" in *Int. J. Vehicle Systems Modelling and Testing*, 2012, 7, 105-233

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