SPOTLIGHT on stability

Improving vehicle stability beyond the capabilities of ESC systems is being achieved by rethinking some basic technologies, not just reprogramming. John Kendall reports

The European Parliament transport committee recently voted to allow longer truck cabs, with the aim of improving aerodynamics around the vehicle as well as safety. The move had seemed likely since last year, and some estimates suggest that fuel consumption could be reduced by 7–10%, compared with today's trucks. Better aerodynamics should also bring better straight-line stability.

However, design changes are going to take some years to work their way through to production vehicles. Cabs have a design life of around 20 years, because they are the most expensive aspect of any new truck. So, since the Euro 6 engine emissions diktat prompted significant facelifts over the last two years, truck manufacturers won't be queuing up to replace them anytime soon – certainly not before the costs have been amortised.

By the time new designs do appear, trucks will have been fitted with many more on-board systems designed to assist drivers and make vehicles safer. They need to. At a recent driver CPC training session with training company CRYdel, the company's Dean Jordan suggested that truck rollovers have been on the increase in the UK: 700–1,200 per year now, compared with 300–700 at the turn of the century. Several factors have contributed to the increase, suggests Jordan, including the switch to tri-axle tractor units, a higher number of double-deck trailers and more powerful engines.

Volvo's research

Why? Quite simply because: tri-axle tractors feel more stable, so drivers can be lulled into a false sense of security; double-deck trailers have a higher centre of gravity, so loading incorrectly (more weight on the upper deck) compromises stability; and greater power gives drivers the opportunity to run at higher speeds. At the same time, there are obvious benefits to running at 44-tonnes gcw, operating double-deck trailers hauled by vehicles with more horsepower. Turning the clock back is not an option.

Volvo Trucks recently researched accidents involving trucks in Western Europe. Volvo's analysis suggests that some 55–65% of people killed or seriously injured in heavy truck accidents are car occupants, while 15–25% are unprotected road users – meaning pedestrians, cyclists and motorcyclists. Worryingly, 45% of these accidents involved a truck rollover.

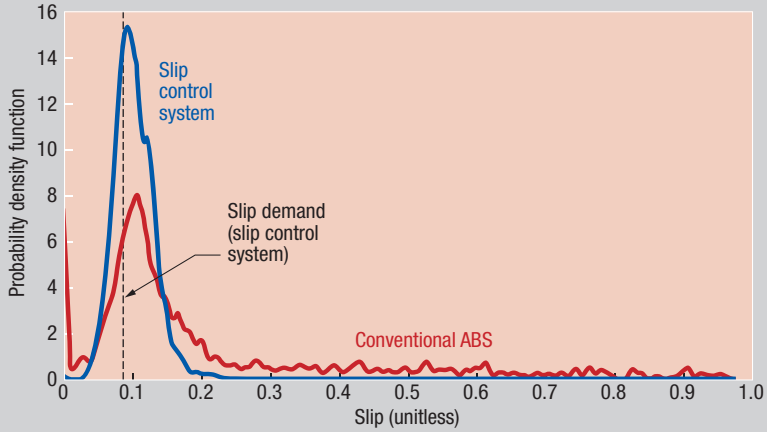
Volvo introduced its 'Stretch Brake' some two years ago on its FH drawbar to address exactly this kind of problem – in particular, low-speed instability on downhill slippery surfaces where there is a risk of trailer swing. The system uses the vehicle's ESC (electronic stability control) brakes and – although the driver has to activate it manually – it then pulses the trailer brakes independently of the tractor every time he or she lifts off the accelerator at speeds below 25mph. Applying braking force to the trailer wheels helps to ensure that the trailer stays where it should be – behind the towing vehicle. Volvo says it will introduce the system for tractor/semi-trailer combinations this autumn.

Backtracking a moment, heavy vehicle braking

developments were helped by the launch of EBS (electronic braking systems) at the end of the 1990s. These saw electronically-controlled valves introduced into the pneumatic braking circuits. One of the benefits was improved braking response, because the new valves could react much faster than older air pressure-operated valves, so contributing to shorter braking distances. But EBS could also be interfaced with others systems, opening up opportunities such as ESC.

But more recently, speeding up valve response times is bringing new potential. Camcon Automotive, for example, has been involved in the Cambridge Vehicle Dynamics Consortium (CVDC), a programme being run by Cambridge University,

Slip tracking performance – wet asphalt



Testing results – all surfaces

Friction level	Metric	Conventional ABS	Slip control system	
Wet asphalt (μ_{max} = 0.6)	Stopping distance	28.9m	25.4	(-12%)
	Air use	0.049kg	0.035kg	(-29%)
	Mean slip error	0.20	0.06	(-64%)
Wet pebble (μ_{max} = 0.3)	Stopping distance	54m	45m	(-16%)
	Air use	0.073kg	0.041kg	(-44%)
	Mean slip error	0.20	0.07	(-65%)
Wet basalt (μ_{max} = 0.12)	Stopping distance	129m	109m	(-16%)
	Air use	0.13kg	0.051kg	(-61%)
	Mean slip error	0.23	0.07	(-70%)

with Haldex, Volvo Trucks, Goodyear, Firestone and others. Camcon focuses on valves using binary actuator technology (BAT), instead of conventional electromechanical systems or solenoid-operated valves. Each is based on a permanent magnet, mounted on a spindle, with two sets of electromagnets. When in contact with either set, the permanent magnet requires no power to maintain position.

The advantages: they're simple, bi-stable, fast and low power. That makes them attractive for valve actuation, for example, on light diesel engines – for doing away with the camshaft. Valves can be opened and closed electronically, potentially cutting CO_2 emissions by 15–20%. BAT can also be used to switch between two- and four-wheel drive in a transmission system, or to engage and disengage a freewheel.

However, for pneumatic braking systems, a redeveloped BAT actuator with a small leaf spring brings other advantages. "The spring is bi-stable in the up and down position," explains David Cebon, director of CVDC, which redeveloped the technology for advanced braking applications and implemented a new controller for test vehicles. "In each, it switches the flow of air. So, instead of having actuators mounted centrally on a vehicle, we've sited them by the brakes. What's more, they switch about 10 times faster than conventional units – in about three milliseconds.

"By moving the actuator on to the wheel and getting rid of the lag you get from a conventional reservoir and pipe run, we can now control [braking] very accurately. Compared with a vehicle using conventional EBS, we have reduced stopping distances by almost 20%. We've also reduced the amount of air used by about 50%," he adds.

Ready to roll

Other benefits: a smaller compressor or reservoir can be fitted, resulting in a small improvement in fuel consumption. More importantly, improving the switching speed of the actuators also improves the effectiveness of ESC systems, by helping to speed up response times to counter yaw. Cambridge and Haldex have now developed improvements, which include new control algorithms, safety systems and associated instrumentation.

In a separate move, Haldex recently unveiled EB+ Load Transfer to address the problem of drive axle overloading with diminishing loads on tri-axle semi-trailers – another contributor to vehicle instability. Haldex's solution is to link the EBS, air suspension and lift axle valve systems to help balance a vehicle's axle loads.

With power on, the system analyses axle weights and calculates the load reserve for the first and second axles on the semi-trailer bogie. Air pressure in the rear axle air suspension can be controlled independently of the other two, to the point of lifting the axle, if permissible. The system then redistributes suspension air pressure to the forward two trailer axles, within permitted limits, to alter the weight distribution.

This is achieved by reducing the air pressure in the rear axle, thereby initiating an effect similar to shortening the trailer wheelbase – so moving the centre of gravity further back. It then varies pressure in the forward two axles, according to monitored conditions, to produce the optimum weight distribution. Haldex claims its system can improve cornering and reduce tyre wear, especially on the third axle. TE