ACTIVE ROLL CONTROL OF ARTICULATED HEAVY VEHICLES

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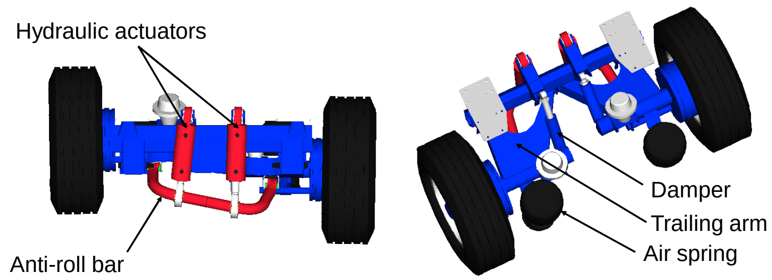
INTRODUCTION

Heavy articulated vehicles, with high centres of gravity and relatively small track width, are prone to roll-over during cornering. The cost of rollover accidents in the UK has been estimated as £40-£60 million per year. Most roll-over accidents cannot be prevented by driver action alone, hence the need for an active safety system. The Cambridge Vehicle Dynamics Consortium has developed an experimental articulated vehicle with active roll control which tilts the vehicle into the corner to increase rollover threshold.

ACTIVE ANTI-ROLL HARDWARE

The active anti-roll system on the trailer consists on each axle of an anti-roll bar mounted between the trailing arms of the suspension and two hydraulic actuators controlled by two servo-valves. By extending one actuator and retracting the other one, the anti-roll bar is twisted and applies an active roll moment to the vehicle. Hydraulic accumulators store oil at high pressure in order to provide the large flow rates required for severe transient manoeuvres.

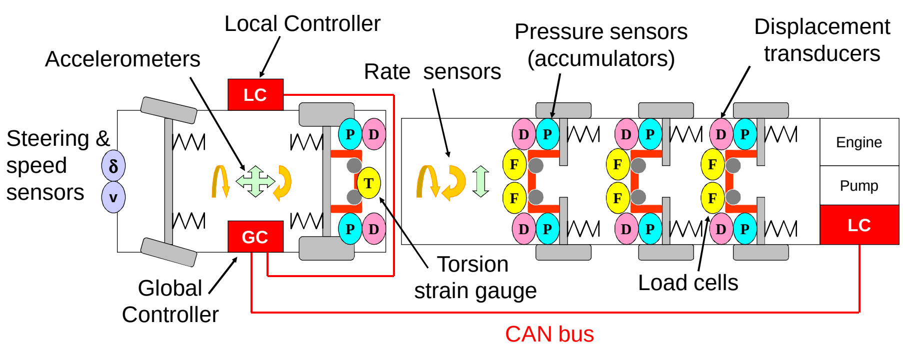


CAD model of trailer suspension showing active anti-roll bar and hydraulic actuators.

EXPERIMENTAL VEHICLE

The experimental vehicle has been instrumented with several sensors to quantify the performance of the active roll control system: suspension roll angle, active anti-roll moment, roll rate, yaw rate, lateral acceleration, etc…

The control architecture on the experimental vehicle is distributed between 2 Local Controllers which perform the local actuator control and a Global Controller which oversees and monitors the overall control of the vehicle.



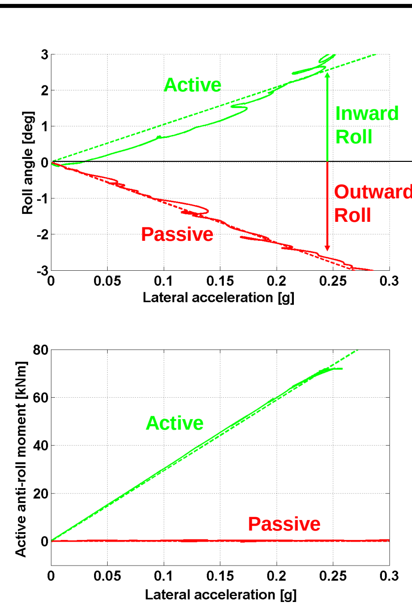
Instrumentation and control systems on experimental vehicle.

RESULTS

One control strategy is to demand an active roll moment proportional to lateral acceleration and choose the gain so that at maximum lateral acceleration, there is maximum roll inwards.

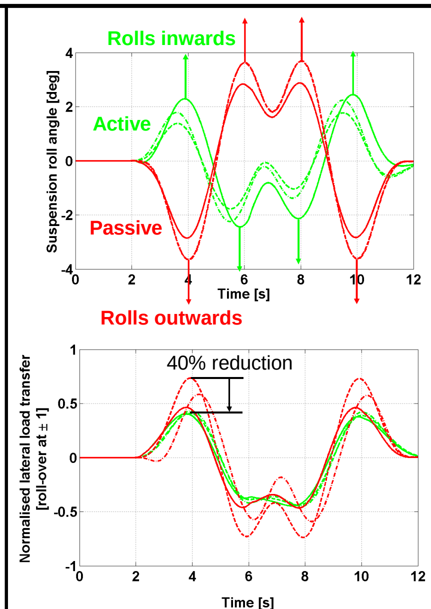
Another possibility is to use optimal control to equalise the load transfer on all critical axles while providing maximum roll inwards. Up to 40% reduction in peak normalised lateral load transfer can be achieved.

CVDC computer-controlled experimental vehicle.



Steady state performance of active roll control using lateral acceleration feedback:

——— *Experimental data*
- - - - - *Theoretical prediction*



Theoretical transient performance of active roll control using optimal control:

——— *Tractor steer axle*
- - - - - *Tractor drive axle*
- · - · - *Trailer axles*

CONCLUSIONS

Substantial reductions in normalised lateral load transfers can be achieved and roll-over accidents avoided by rolling the vehicle into the corner. The CVDC computer-controlled experimental vehicle paves the way for future commercial systems such as semi-active roll control.

Cambridge Vehicle Dynamics Consortium

University of Cambridge	General Trailers	Mektronika Systems Ltd	Shell UK
ArvinMeritor	Haldex Brake Systems Division	MIRA Ltd	Tinsley Bridge Ltd
Fluid Power Design Ltd	Koni BV	QinetiQ Ltd	Volvo Global Trucks

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