Road Trains For Europe?

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Benefits of Long Combination Vehicles (LCVs)

Use of longer vehicle combinations offers significant fuel saving benefits, and allows greater road occupancy by saving on the additional vehicle mass and road-space associated with multiple smaller vehicles.

Woodrooffe and Ash (2001) conducted a study in Canada to quantify the benefits of using multiple trailer vehicles over single trailer combinations – the results are shown in table 1.

Unlike many environmentally friendly schemes, the cost of using these 'greener' vehicles is less than using the existing vehicle types; paid for in savings of fuel and drivers.

Figure 1: Double-trailer vehicles (B-Doubles and A-Doubles) are used widely in Australia, New Zealand, South Africa, Canada and the USA.

Reduction due to LCVs	
Truck-kms (Congestion)	44%
Shipping costs	29%
CO_2 output	32%
Road wear	30%

Table 1: Summary of benefits for LCVs from Economic Efficiency of Long Combination Transport Vehicles in Alberta, Woodrooffe, J. and L. Ash, 2001.

Why aren't LCVs used in Europe?

LCV's are not currently legal in Europe and are unable to negotiate UK roundabouts. Figure 2 shows a tractor – semi-trailer of the maximum length allowed in the UK. The vehicle just stays between the yellow outer and inner markings of the roundabout.

Figure 3 shows a two trailer LCV, of the type used outside Europe, in the same manoeuvre. However, the second trailer fails to negotiate the roundabout.

Figure 4 shows a two trailer LCV, but with steering axles fitted to both trailers. This steering makes the trailers track the path of the tractor unit. With this 'enabling' steering technology fitted, the vehicle is able to negotiate the roundabout.

Roundabout regulations

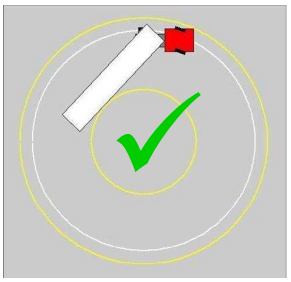

Figure 2: Diagram showing standard, non-steered trailer can <u>just</u> traverse UK roundabouts

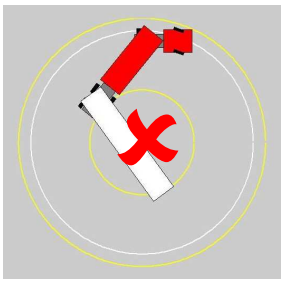

Figure 3: Diagram showing the Australian Style B-double cannot negotiate UK roundabouts

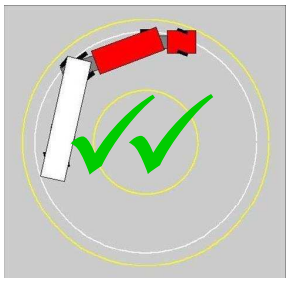

Figure 4: Diagram showing effect of adding active steering to a long combination vehicle.

Project Aims

- **Develop control strategies for:**
  - Slow speed manoeuvring in forwards and reverse directions
  - High speed stability in transient manoeuvres (e.g. lane change)
- **Benefit/Cost analysis**
  - To operators from more efficient vehicles with larger volumetric payload
  - To the public from reduced CO2 and reduced goods shipping cost
- **Build and test the following :**
  - 'Mk2' steering hardware capable of high speed steering with built in hardware and software safety systems (e.g. self-centering).
  - B-double vehicle using existing active steered semitrailer and new actively steered two axle link trailer (figure 5).
  - EMS combination vehicle (figure 6) using demountable two-axle dolly from rear of the new link trailer. Dolly can also be used to test actively steered A-double combinations.

Figure 5: Active steered (6 of 7 axles) B-double vehicle combination. Rear of link trailer demountable to form dolly

Figure 6: Actively steered (7 of 8 axles) EMS combination with Truck-Dolly-Semitrailer. Dolly demounted from link trailer

Sample results:

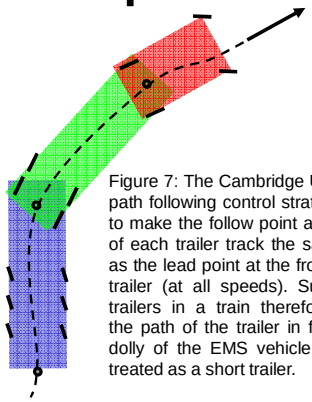

Figure 7: The Cambridge University path following control strategy aims to make the follow point at the rear of each trailer track the same path as the lead point at the front of that trailer (at all speeds). Successive trailers in a train therefore follow the path of the trailer in front. The dolly of the EMS vehicle (fig.6) is treated as a short trailer.

Low speed

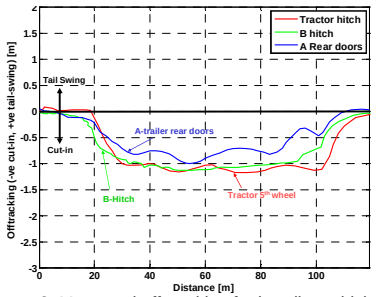

Figure 8: Measured off-tracking for b-trailer vehicle on standard UK roundabout (fig.4) using CVDC path following controller (fig.7). Off-tracking of >6m (fig.3) is reduced to <1m without the dangerous entry tail-swing common in current steering systems.

High speed

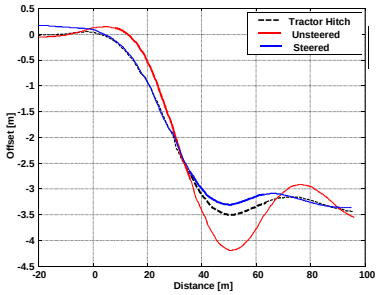

Figure 9: Trailer rear off-tracking for EMS vehicle (figure 6) during 80kph 3.5m offset lane change. Steering eliminates path overshoot seen for unsteered trailer, and reduces lateral acceleration.

ACTIVE STEERING

Cambridge Vehicle Dynamics Consortium

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