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Effect of Aerodynamic and Lightweight Double-Deck Trailers on HGV Fuel Consumption

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Introduction

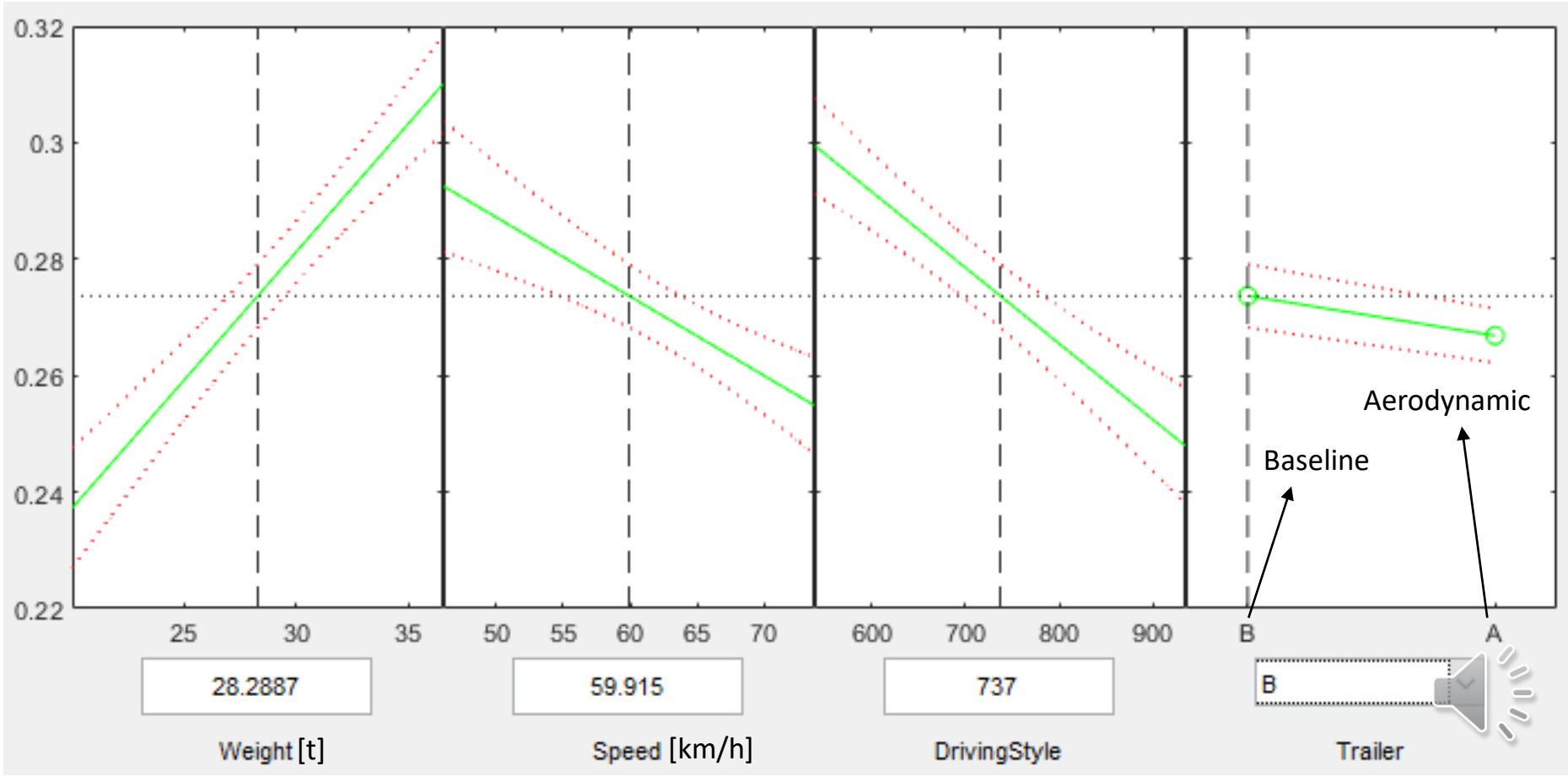
- In-service evaluation
- Coast-down tests
- Model-based evaluation
- Conclusions

In-Service Data

- Two aerodynamic HGVs and a baseline HGV
- Daily telematics data
- 5 months

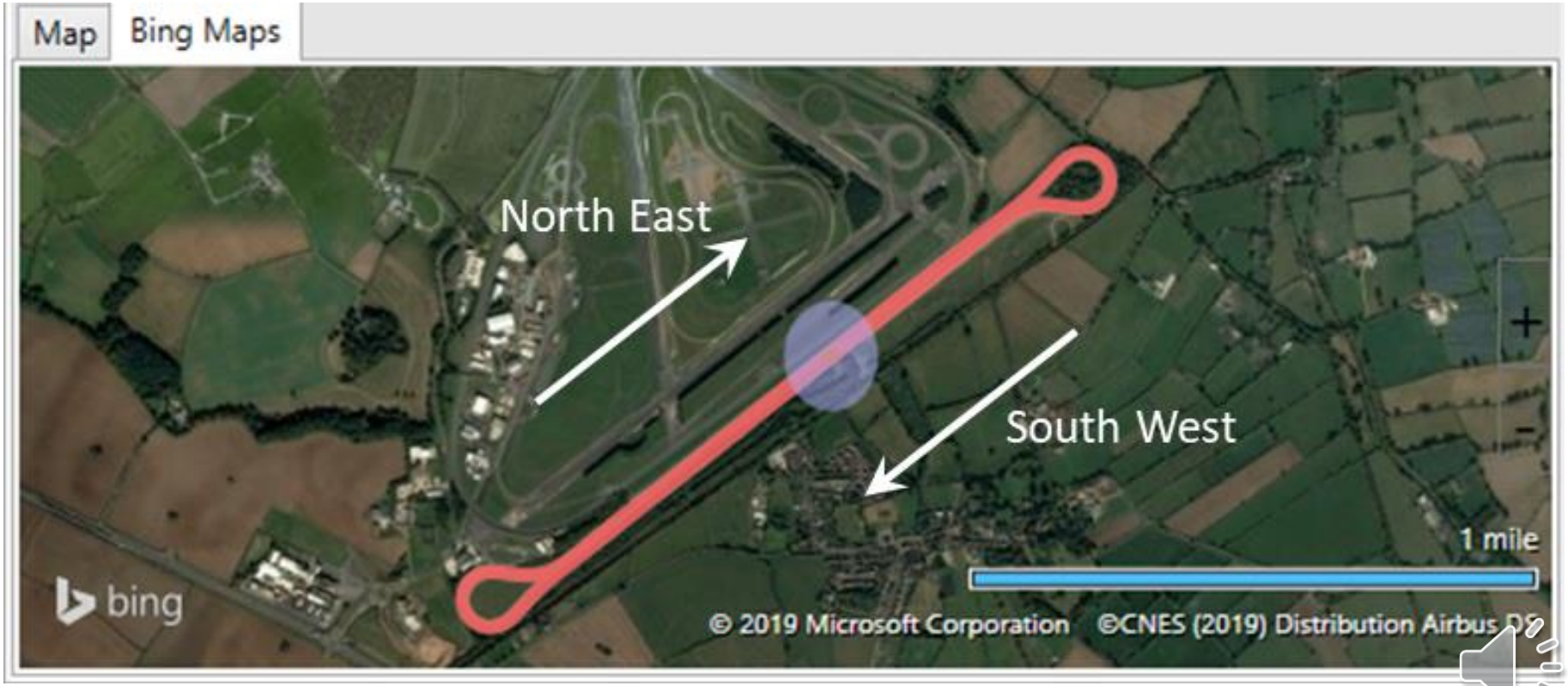
In-Service Data

- Regression model: $f = \beta_0 + \beta_1 m + \beta_2 v + \beta_3 s + \beta_4 T$
- *Trailer type* has statistically significant effect on *fuel consumption*
- ~2.5% lower *fuel consumption* and emissions for the aerodynamic HGV



Coast-Down Tests

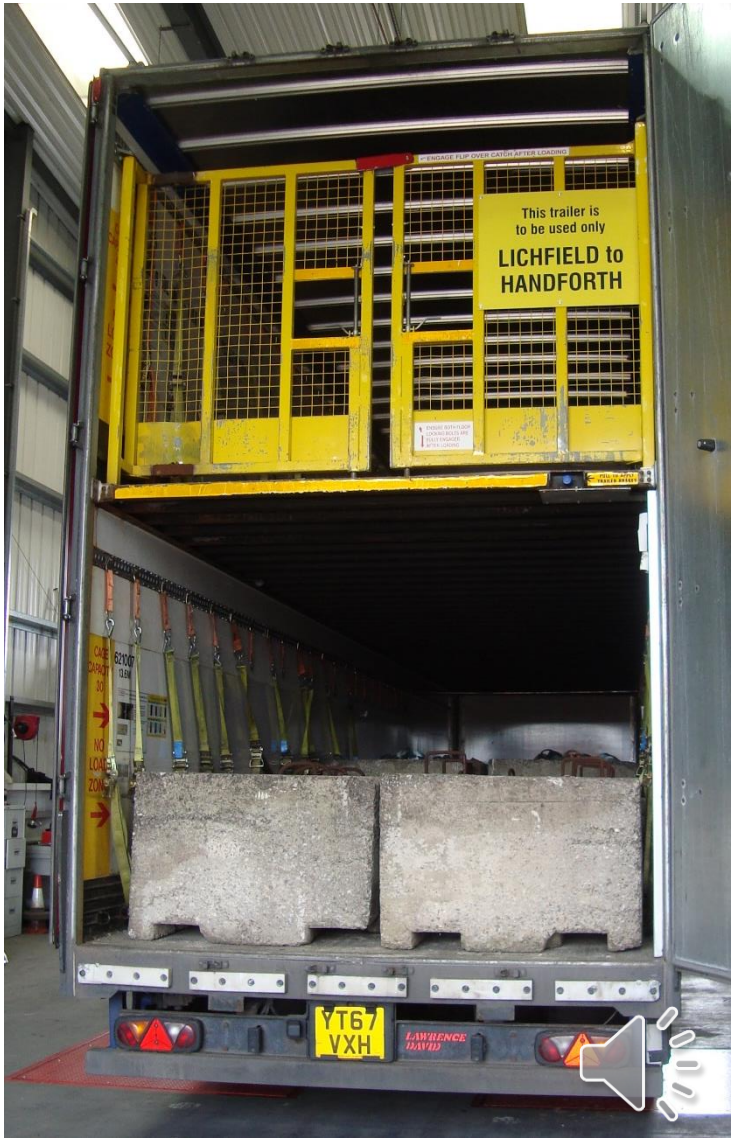
- 6 tests at Mira-Horiba Ltd, UK



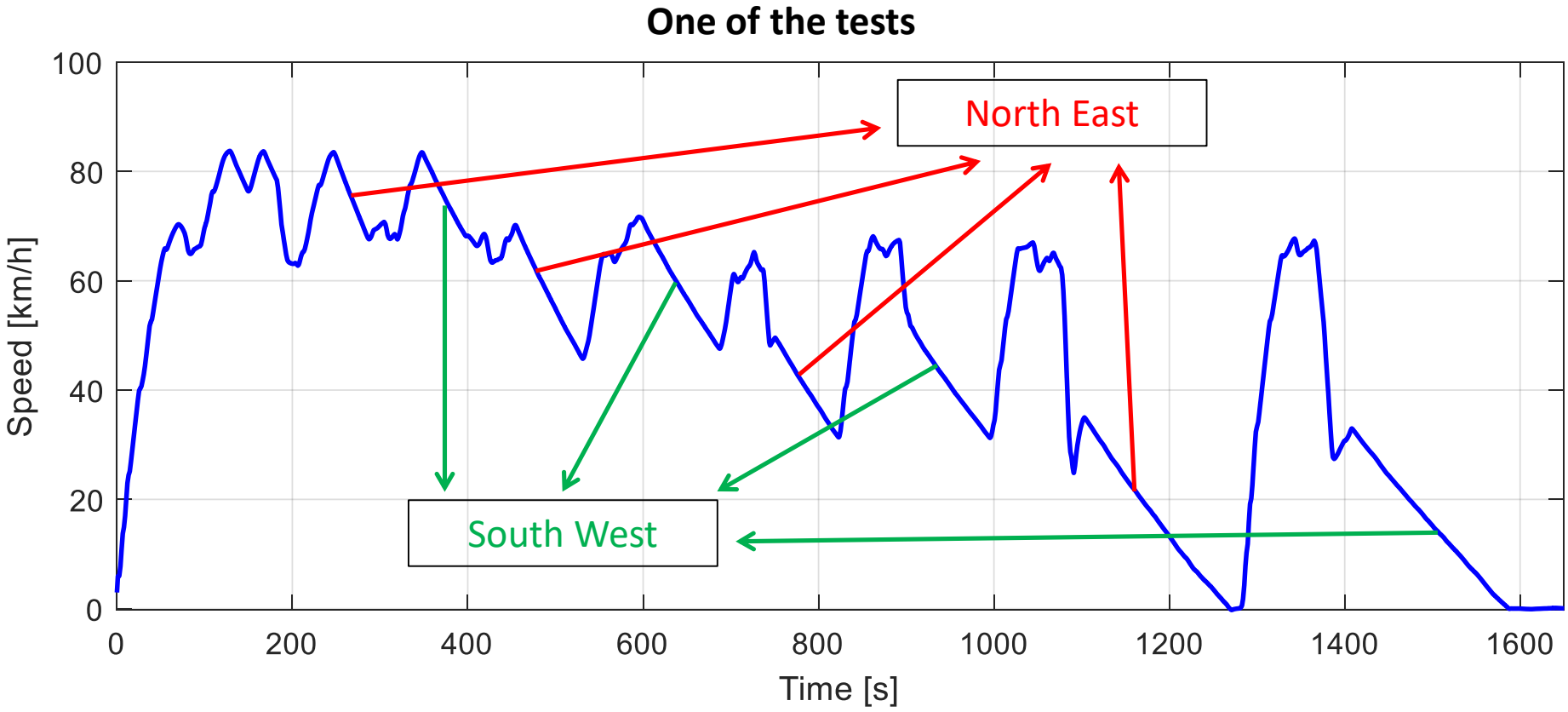
Coast-Down Tests

	Right side weight	Left side weight
Axle 1 (tractor) *Including driver*	3246 kg	3424 kg
Axle 2 (tractor)	3172 kg	3574 kg
Axle 3 (trailer)	5144 kg	4762 kg
Axle 4 (trailer)	4860 kg	5140 kg
Axle 5 (trailer)	4826 kg	5012 kg

Passenger 1	**90 kg**
Passenger 2	70 kg
Gross Vehicle Weight	**43320 kg**

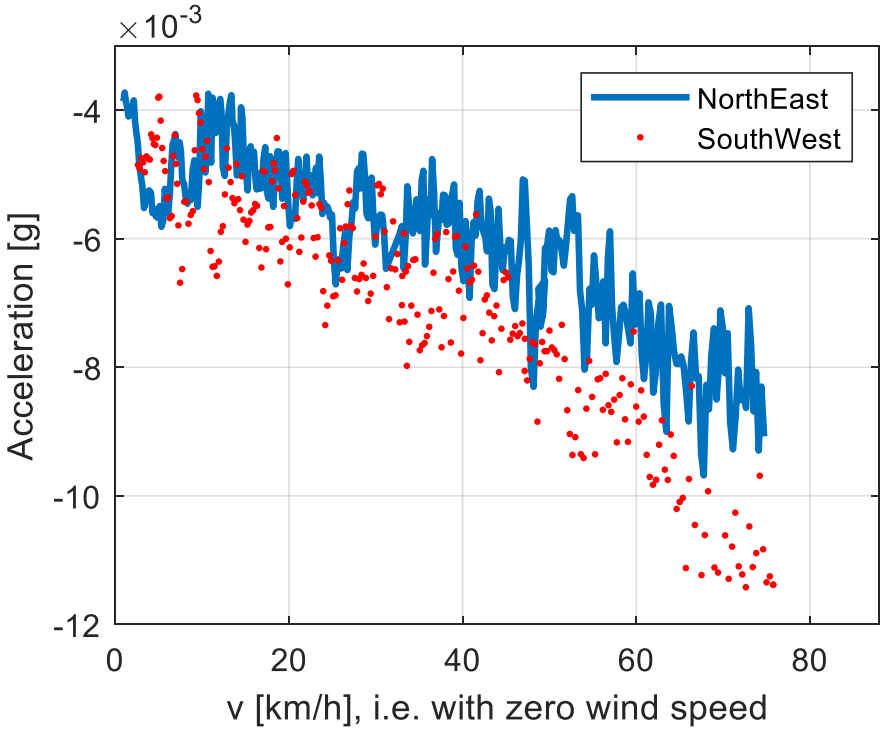


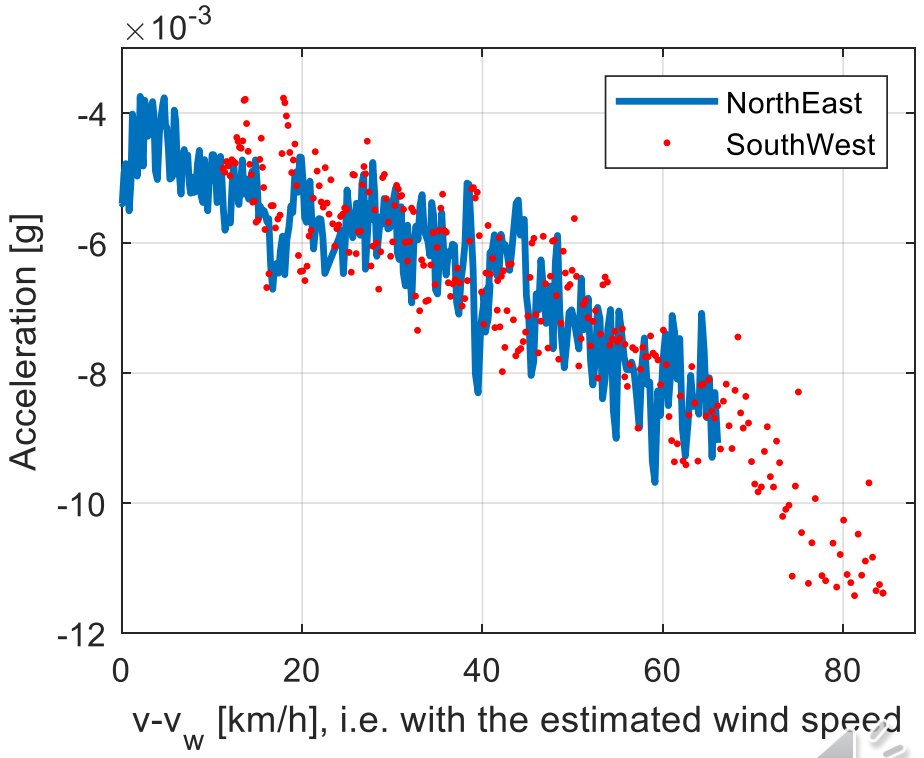
Coast-Down Tests



Coast-Down Tests

- Step 1: Wind speed estimation





Coast-Down Tests

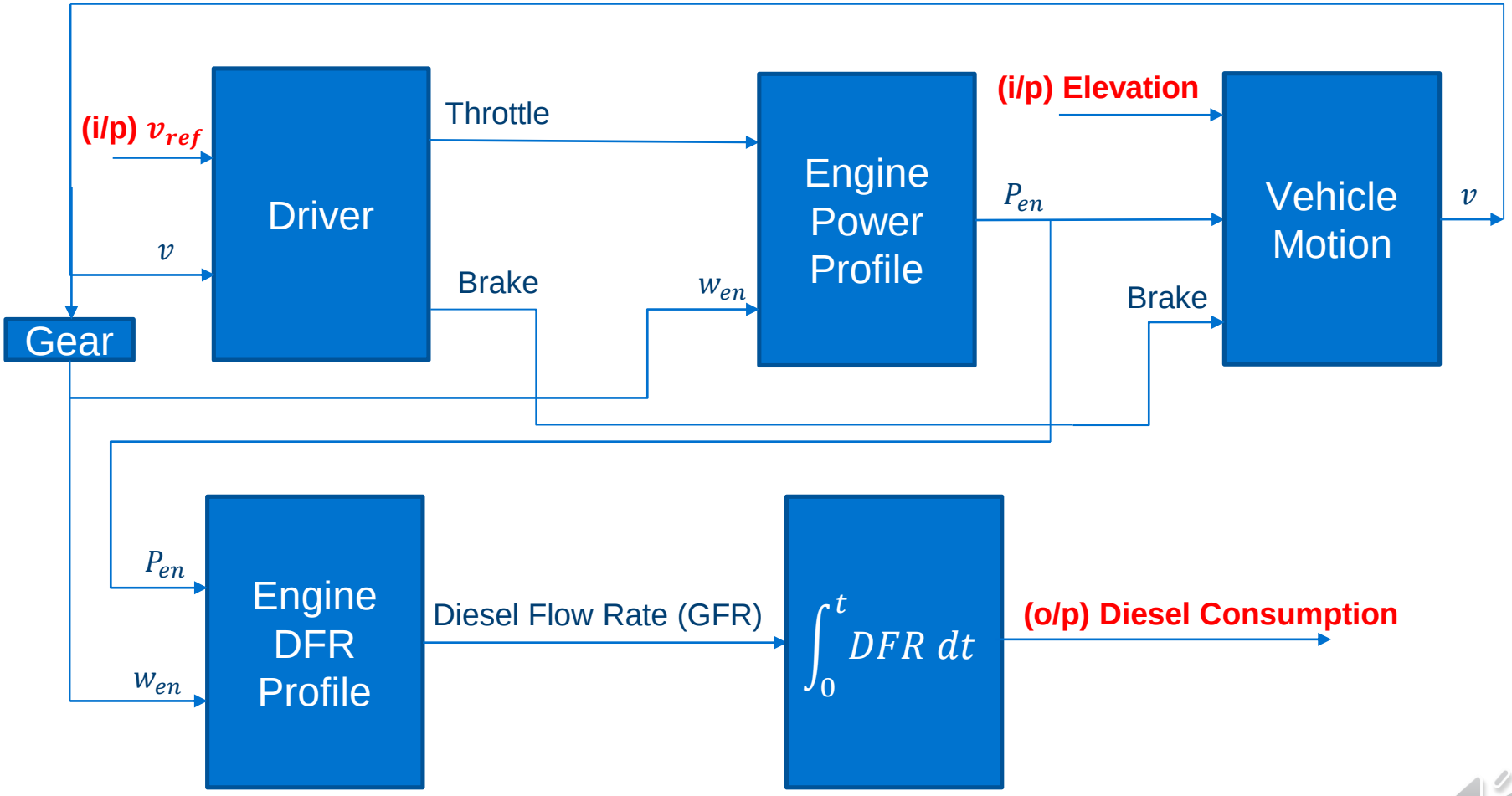
- Step 2: Estimation of the coefficients

Test	$C_dA\ [m^2]$ Baseline	$C_dA\ [m^2]$ Aerodynamic Lightweight	C_r Baseline	C_r Aerodynamic Lightweight
Test 1 Southwest	8.41	7.79	0.0052	0.0047
Test 1 Northeast	8.51	7.88	0.0051	0.0045
Test 2 Southwest	8.54	7.95	0.0049	0.0045
Test 2 Northeast	8.43	7.77	0.0048	0.0044
Test 3 Southwest	8.38	7.81	0.0051	0.0046
Test 3 Northeast	8.41	7.85	0.0046	0.0041
Mean $\pm$ SD	8.45 ± 0.06	7.84 ± 0.07	0.0050 ± 0.00023	0.0045 ± 0.00021

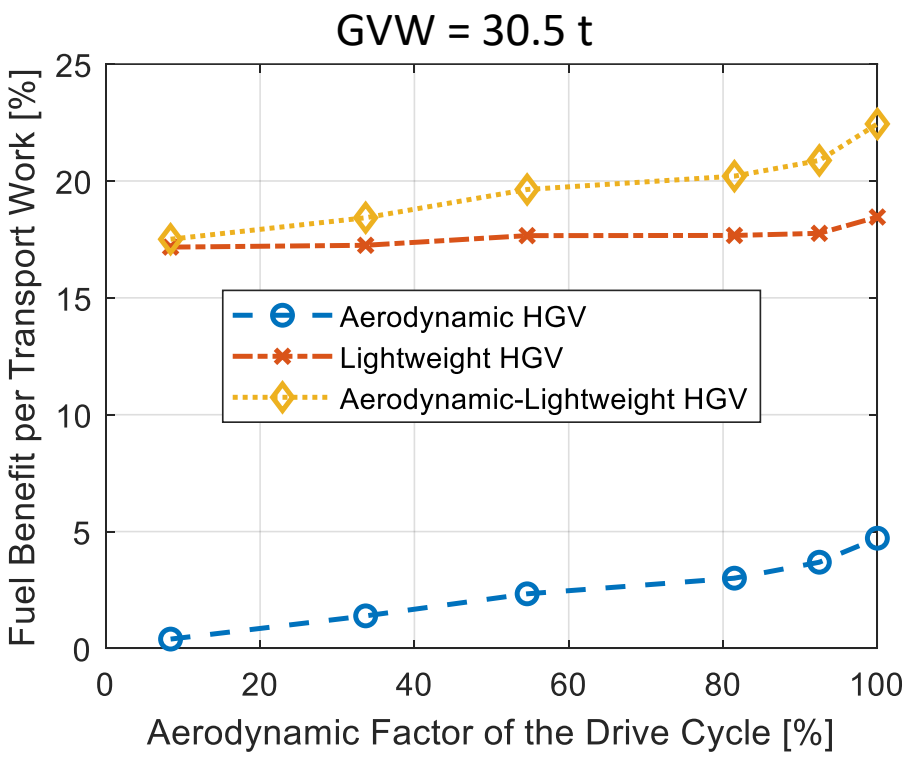
7.2% lower than the baseline

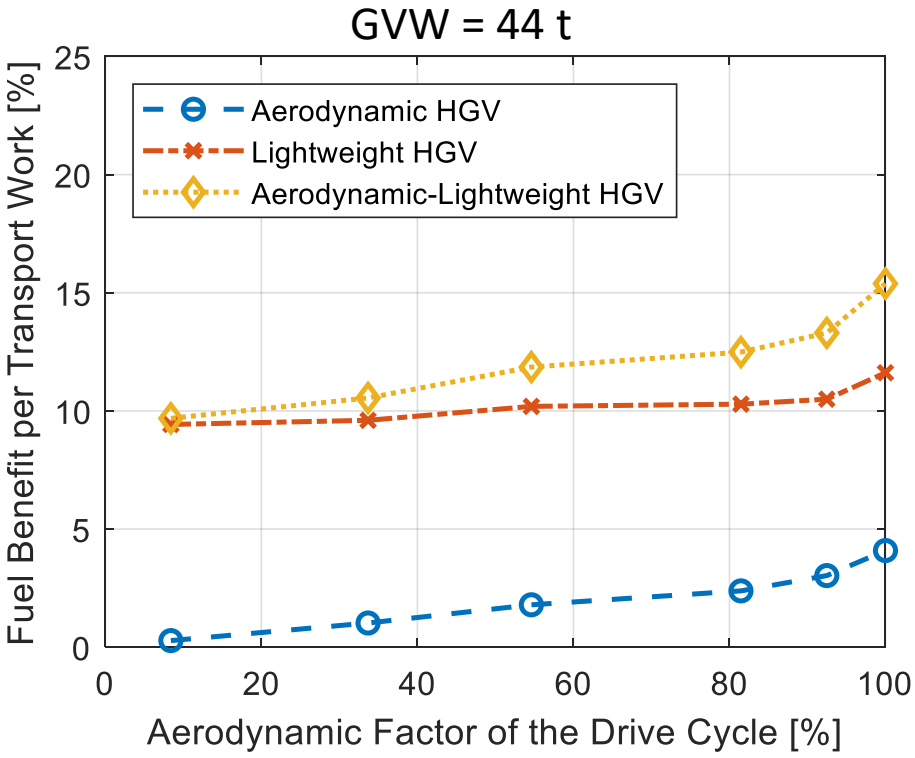
10% lower than the baseline

Simulation Model



Evaluation using Simulation Models





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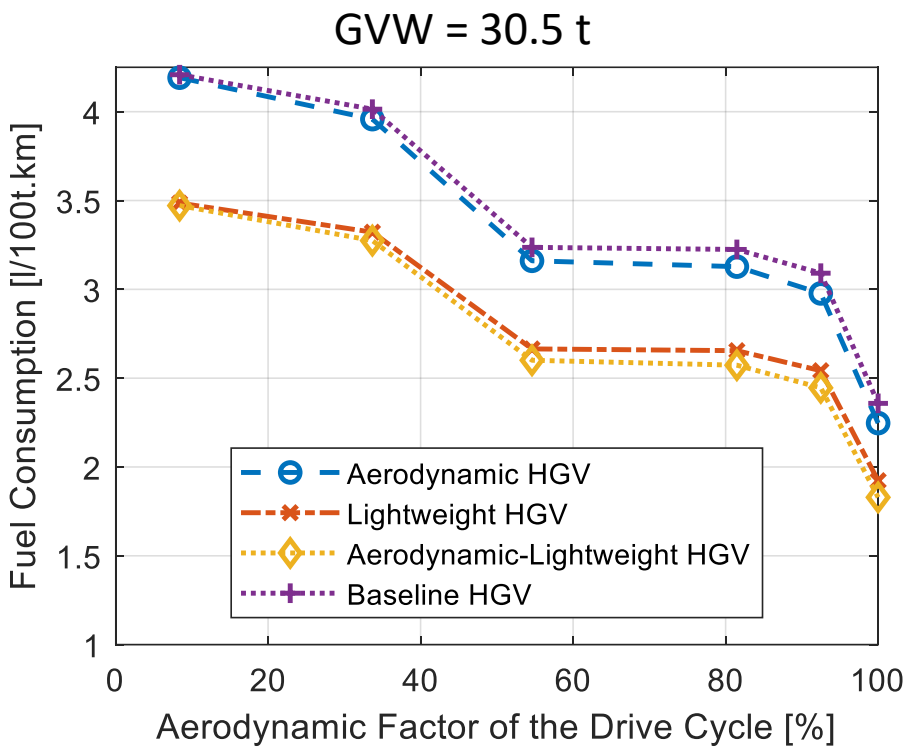

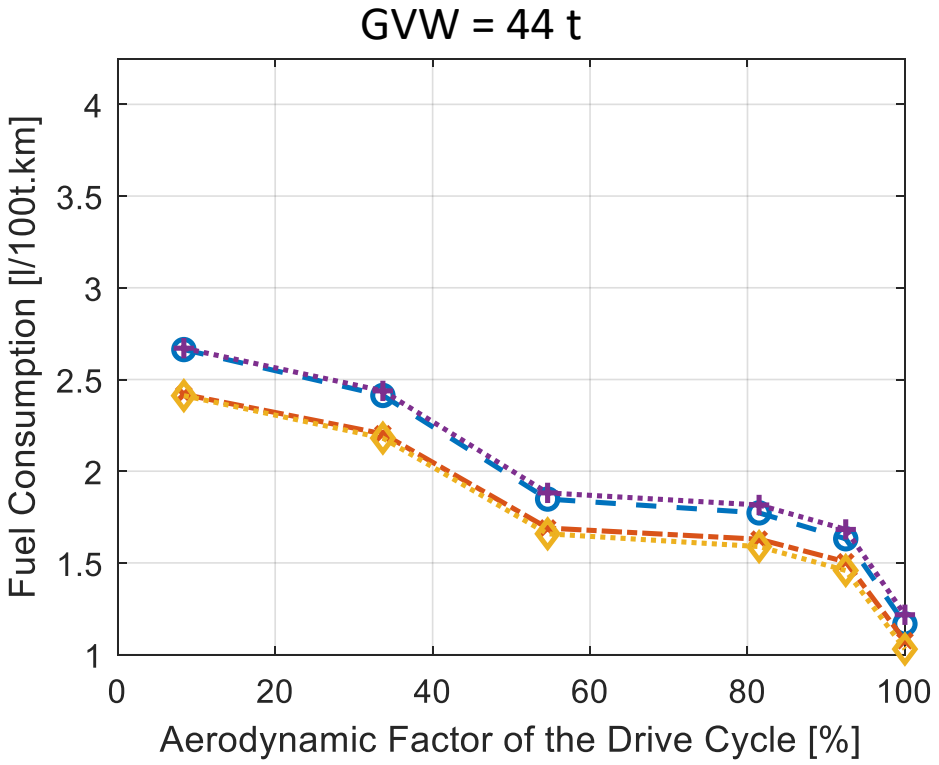

Conclusions

- ✓ Evaluated two aerodynamic trailers using in-service data:
  - Statistically significant effect on fuel consumption
  - 2.5% Fuel benefit
- ✓ Performed cost-down tests
- ✓ Estimated Aerodynamic Drag and Rolling Resistance Coefficients
- ✓ Evaluated different trailer configurations using simulation models:
  - Aerodynamic HGV's fuel benefit:
    - Motorway Cruising (84 km/h): 4.7%
    - LowCVP Long Haul: 3.0%
  - Lightweight HGV's fuel benefit:
    - Motorway Cruising (84 km/h): 18.5%
    - LowCVP Long Haul: 17.7%
  - Aerodynamic-Lightweight HGV's fuel benefit:
    - Motorway Cruising (84 km/h): 22.4%
    - LowCVP Long Haul: 20.2%