SRF Mapper and SRF Simulator

Justin Bishop (jdkb2@cam.ac.uk)
Centre for Sustainable Road Freight
University of Cambridge

The Centre for Sustainable Road Freight (SRF) Mapper and SRF Simulator comprise part of a decision-making toolbox for road freight operators wishing to quantify the impact on fuel use from technology interventions and changes to driver behaviour and logistic operation.

These tools use data provided by the Android-based SRF Logger which connects to the vehicle Fleet Management System (FMS) port via Bluetooth. Data is transferred to remote servers continuously over the mobile phone network. The Logger is more flexible than a conventional telematics system because it logs data at the speed reported by the vehicle (at least 1 Hz) and can exploit the large Bluetooth capacity of the phone to connect to other sensors around the vehicle.

The SRF Mapper employs a data-driven approach to extract the likely vehicle configuration, such as effective drag (C_dA) and rolling resistance, and transmission control. This includes the effective gear ratio (mapping of engine speed to wheel speed) and the engine speeds at which each gear shifts up and down. Engine maps of fuel use and emissions are synthesised from the observed FMS data. For example, Figure 1 shows the vehicle model reproduces fuel use accurately on a per second basis, resulting in simulated cumulative fuel within 7.3% of the observed value.

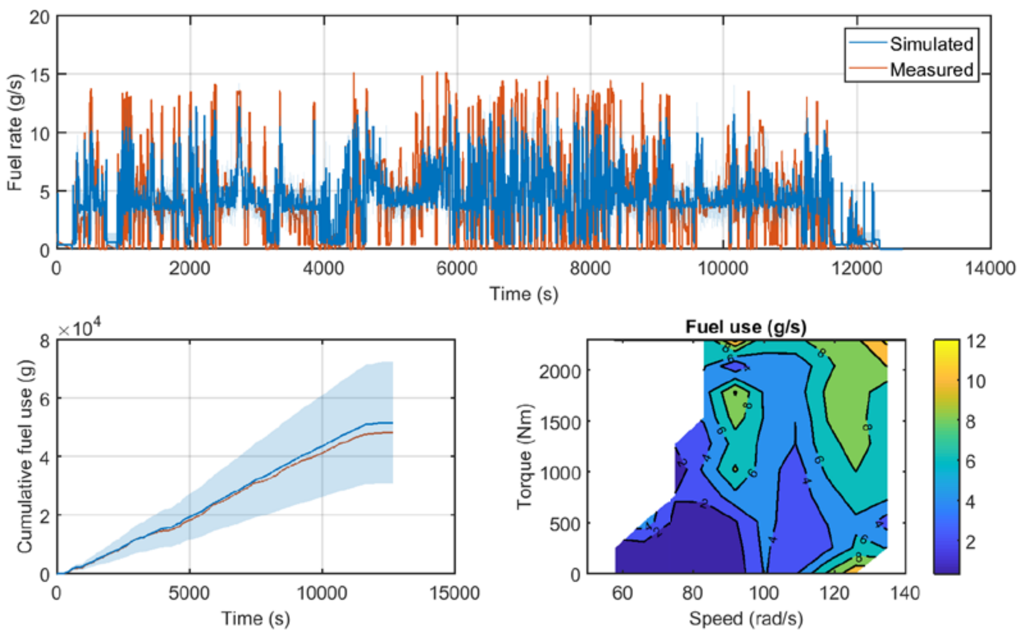

Figure 1: Validation of vehicle model of DAF Euro 6 articulated lorry at 28.7 t. Top subplot: simulated (blue) and observed (orange) fuel use per second. Bottom left subplot: cumulative simulated and observed fuel use. Bottom right subplot: engine map of fuel use.

These components form the basis of the SRF Simulator, a powertrain simulation model which allows freight operators to quantify the fuel use of their own vehicles within their own logistic operations. The SRF Simulator is the framework in which the impact of technological, behavioural and logistics interventions can be quantified.

Technology interventions include lower rolling resistance tyres or improved aerodynamics through side skirts or teardrop trailers. The influence of the driving style can be quantified by comparing the engine speeds at which upshifts occur. For example, Figure 2 illustrates late gear shifts used 2.3% more fuel than the base case, while 1.9% less fuel was used with early shifts. Wider impacts on the logistic operation include changes to the driving cycle, representing a different route, introduction of multiple drops or a shift in the time of day of operation.

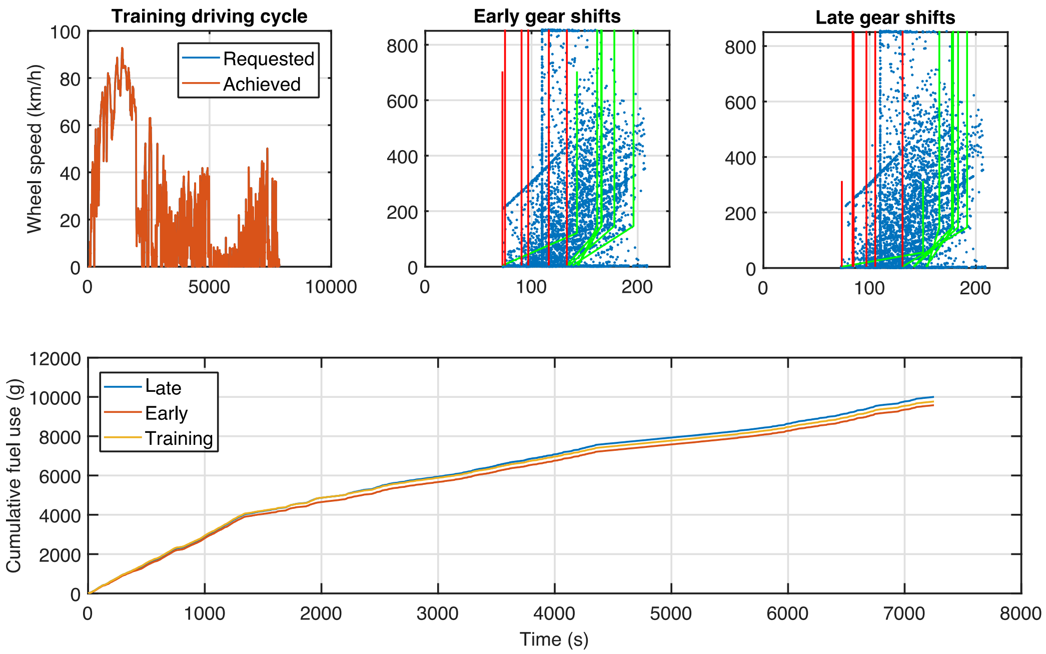

Figure 2: Quantifying influence of driver behaviour on fuel use of DAF Euro 6 rigid lorry at 11.2 t. Top left subplot: target (blue) and achieved (orange) speed over the requested driving cycle. Top middle subplot: Gear shift envelopes for each gear with early shifting, where green lines represent the engine speed to shift up, red lines represent the engine speed to shift down and blue dots are the observed data from the SRF Logger. Top right subplot: Gear shift envelopes for late shifts. Bottom subplot: cumulative fuel use under early, late and base case shift regimes.