RESEARCH NOTES
TRAFFIC OPERATIONS RESEARCH
Task Order 4203
September 2006

Control of Heavy-Duty Vehicles Environmental & Fuel Economy Considerations

Why Was This Research Undertaken?

This research was undertaken to study the impact of heavy-duty vehicle controllers on fuel economy and air pollution as well as on the stability of traffic flow and capacity during vehicle following that involves truck and passenger vehicles. The evaluations performed under this contract will lead to modifications or new designs, which along with stability and good vehicle following properties will also guarantee good fuel economy and low air pollution especially in the presence of traffic disturbances.

What Was Done?

A longitudinal vehicle following control system was designed. Previous developed models under other PATH Memorandum of Understandings were refined and used in the development of environmentally efficient controllers. Testing was performed using 3 vehicles (one was a truck) in order to conduct vehicle following maneuvers at different acceleration and with different drivers. The results of these tests were then compared and validated using an emission and fuel consumption model previously developed (by Dr. Barth). The vehicle following properties of mixed traffic vehicle from the point of view of stability, environment and fuel economy were then examined.

What Can Be Concluded From The Research?

From the results of the research, it can be concluded that sluggish dynamics of trucks, due to limited acceleration and speed capabilities, make their response to disturbances caused by lead passenger vehicles smooth. When there is cut-ins from neighboring lane vehicles, additional disturbances are created with negative effects on fuel economy and pollution. The behavior of trucks in mixed traffic on the macroscopic level has been found to depend on a particular number that characterizes the ratio of the time headway used by trucks versus that of the passenger vehicles. The use of Adaptive Cruise Control (ACC) will reduce this ratio and improve the traffic flow characteristics.

The fuel consumption and emission results for heavy trucks in these simulations and the data are presented in Table 1. The ACC trucks lead to better fuel consumption and emission results compared to the manually driven truck. However, there is little difference among the four different ACC trucks. The benefits are small due to low level of disturbance.

Table 1.

	Manual Truck	ACC_N	ACC_Q	ACC_C	ACC_NEW
Fuel (g)	0% (594.8)	5.8%	6.0%	5.4%	6.6%
CO_2 (g)	0% (1901)	5.9%	6.0%	5.4%	6.5%
CO (g)	0% (5.27)	5.3%	5.3%	5.1%	6.0%
HC (g)	0% (0.26)	≈ 0	≈ 0	≈ 0	≈ 0
NO_x (g)	0% (12.42)	4.8%	4.8%	4.2%	5.4%

What Do Researchers Recommend?

Researchers recommend further research with additional experiments of larger scale in order to validate the results of the emission models as well as some of the macroscopic phenomena predicted by simulations and the fundamental diagram conducted under this contract.

Implementation Strategies

The results of the research can best be used to further research the results of the emission models with experiments on a large scale, as well as some of the macroscopic phenomena predicted by simulations and the fundamental diagram conducted under this contract.

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