Summary

The focus is on minimal fuel consumption in heavy trucks. Information integration and modeling techniques permit optimized control of braking, acceleration and gear shifting. On-road tests show substantial reduction in fuel consumption.

Look-ahead Control

Since the road slope is a function of the position $s$, a position-variant control law $u = u(x, s)$ is expected. The approach taken here is to repeatedly calculate the fuel-optimal control on line.

A drive mission is defined by the position $s \in [0, s_f]$. The look-ahead horizon is defined by $s \in [0, s_h]$ where $s_h < s_f$. The general problem is

$$ J = \min_{u(s)} \left\{ \phi(x(s_f)) + \int_0^{s_f} L(x(s), u(s), s) \right\} $$

where $L$ measures fuel and time use. However,

$$ J \approx \min_{u(s)} \left\{ \tilde{R} + \int_0^{s_h} L(x(s), u(s), s) \right\} $$

is solved on line where $\tilde{R}$ is an approximation, obtained off line, of the residual cost.

A tailored dynamic programming algorithm is currently used for the optimization. On the standard portable computer used in the experiments, tenths of a second are needed to calculate a solution for a typical horizon of 30 steps of 50 m that gives 1.5 km look ahead.

Status

A demonstrator vehicle has been developed in collaboration with SCANIA. Experiments have been performed on a 120 km segment of a Swedish highway with a tractor and trailer combination that have a gross weight of 40 tonnes. In average, the fuel consumption is decreased about 3.5% without increasing the trip time and the number of gear shifts is decreased by 42% traveling back and forth, compared to the standard cruise controller. The work is reported in detail in [1, 2, 3]. The project milestone has been achieved.

Publications


http://www.moviii.liu.se/