The Netherlands
Research School for
Transport, Infrastructure
and Logistics

TRAIL

Longitudinal Driving Behavior Under Adverse Conditions

Adaptation Effects, Parameter Value Changes and Model Performance
In case of Fog

Introduction

Adverse weather conditions have a substantial impact on traffic flow operations like for example freeway capacity reductions in case of fog around 10 to 12%.
It is however unclear which adaptation effects in actual longitudinal driving behavior underlie this impact. Furthermore it is unclear to what extent current mathematical models of car-following behavior are adequate in incorporating these adaptation effects.

Research methodology

A driving simulator study with a RM design was performed intending to investigate experimentally which adaptation effects in driving behavior can be observed in case of fog as well as to what extent current models of car-following models, represented by the Helly model and the Intelligent Driver Model, are adequate in incorporating these adaptation effects. In this regard a new calibration for joint estimation was applied (Hoogendoorn & Hoogendoorn, 2010).

Observed adaptation effects

The results indicate a significant decrease in mean speed in case of fog (M=54.68, SD=1.48) compared to the normal visibility condition (M=77.68, SD=1.48), $t(18)$=10.01, p<.05). Furthermore a significant decrease in mean acceleration was observed $t(18)$=2.10, p<.05 as well as a significant increase in mean distance to the lead vehicle, $t(18)$=9.32, p<.05.

Parameter estimation results and model performance

The Helly model is expressed in the equations:

$$a_i(t)=\alpha\Delta v_i(t-T_r)+\gamma(x_i(t-T_r)-S_i)$$
$$S_i=s_0+h_{min}v_i$$

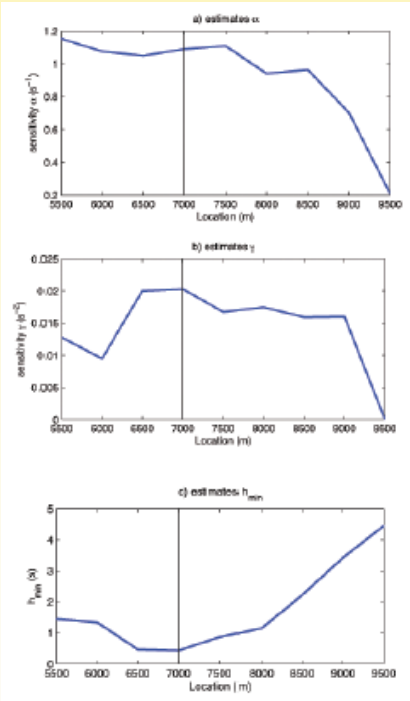
The results indicate a substantial decrease in the sensitivity parameters α and γ. Most striking is the increase in h_{min}, indicating a substantial change in longitudinal driving behavior.

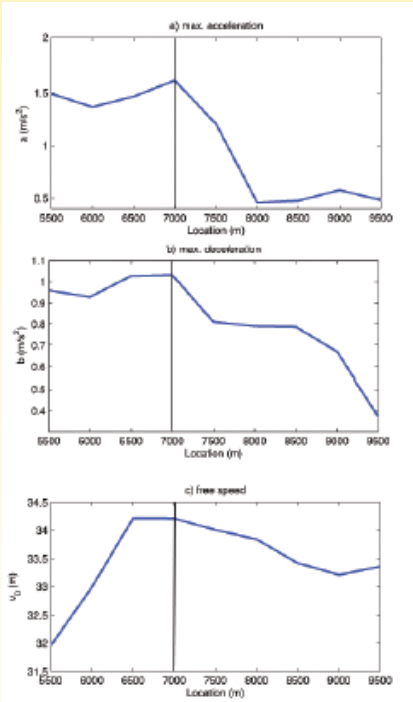
The Intelligent Driver Model is expressed in the equations:

$$d/dt\ v_i=a(v_i/v_0)^4-(s^*(v_i,\Delta v_i)/(s_i-1)^2)$$
$$s^*(v_i,\Delta v_i)=s_0+Tv_i-((v_i\Delta v_i)/(2\sqrt{}\ ab)^2)$$

Here the results indicate a substantial decrease in a and b as well as a substantial increase in T.

Also the results indicate a decrease of performance of the models. It is recommended to develop models adequately incorporating adaptation effects under adverse conditions.





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