Dynamic evaluation of road safety on road networks – pilot study

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Abstract

The research project „dynamic evaluation of road safety on road networks – pilot study" (DVS Netz - Pilot) deals with the development of a dynamic traffic guidance and information system based on fuzzy logic modelling. Static and dynamic data is joined in the model to define the control mechanism for a traffic management system. Thus the quality of information regarding dangerous sections on road networks can be improved. The main improvement compared to current traffic control systems is the additional inclusion of static data for the proposed control mechanism. The dynamic traffic guidance and information system (DVS Netz - Pilot) is able to provide a realistic approach to detect danger zones. It can detect dangerous areas and propose reliable displays and warning messages as a function of the dynamic circumstances (environmental and traffic related) of road sections as well as their static circumstances (constructional conditions and accident history).

Keywords

incident, traffic guidance and information, control system, fuzzy logic,

Introduction

The research project „dynamic evaluation of road safety on road networks – pilot study" (DVS Netz – Pilot, financed within the framework of the 1st tender of the program i2v of the research and technology program iv2splus) deals with the development of a dynamic traffic guidance and information system based on fuzzy logic modelling.

Based on the feasibility study (2007) static and dynamic data is joined (see Figure 1) within the proposed model to define the control mechanism for the traffic management system. Thus the quality of information regarding dangerous sections on road networks can be improved. The aim of the project is especially the increase of the road safety. According to this the raising of the traffic network capacity (one of the aims of traffic guidance and information system) isn't included in this investigation.

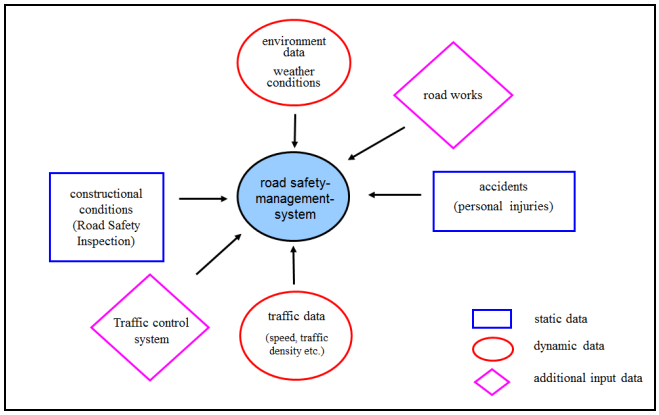

Figure – Involvement of static and dynamic data

The dynamic input data consists of traffic data (average speed, traffic density) and environmental data (water film thickness, precipitation and visibility) of the ASFiNAG Verkehrssteuerung which is also used for the current traffic control system of the ASFiNAG. Main improvement of DVS Netz - Pilot compared to current traffic control systems is the additional inclusion of static data for the proposed control mechanism. Static data that is used for the model contains e.g. historical accident data, constructional conditions and danger zones of road sections. The information is collected during a road safety inspection that is also conducted as part of the research project. The dynamic and static data is joined in the fuzzy logic model by defining decision criteria and control rules. The following figure shows characteristic functions with unsharp decomposition of the criteria visibility.

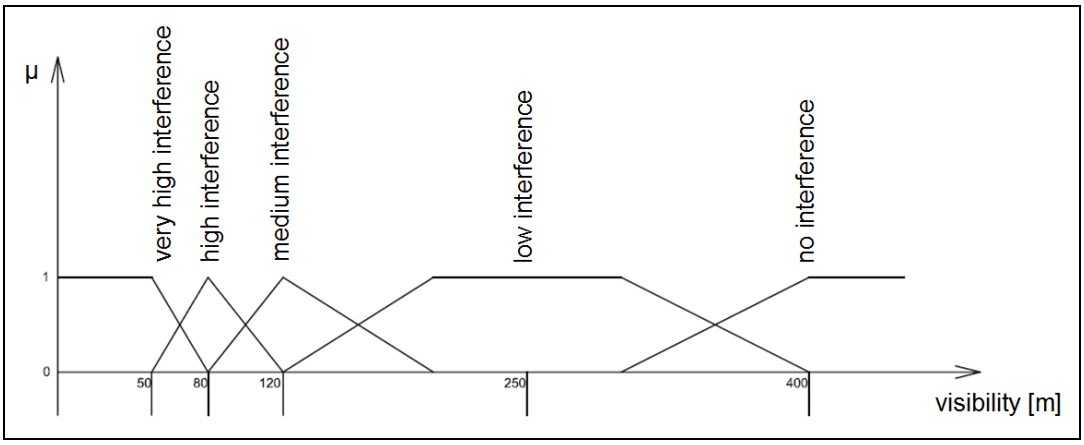

Figure - Example for definition of decision criteria in fuzzy logic

Advantage of the fuzzy logic model is the fact that no sharp boundaries are used between individual categories of the input data (for example speed or precipitation classification). Rather than using these category boundaries the control mechanism of the fuzzy logic model checks all different criteria/categories and chooses the display or warning message that shows the highest correlation with the specific criteria. In addition verbal described categories can be transformed into numeric ranges (fuzzy sets). After definition of the criteria for the control system of the fuzzy logic model the decision rules are defined. These rules are the basis for the selection for the speed limit and additional information (for example traffic jam, slip danger).

The decision rules are valid for all displays in the test section on the basis of the dynamic data. These are the information on the display based on road safety (reduced speed limit and slip danger because of a danger zone, black spots).

For testing purposes selected road sections on the A12 Inntal Autobahn and A13 Brenner Autobahn in Austria have been chosen. These sections are already controlled by the existing traffic control system of the ASFiNAG. During the project the ASFiNAG provided offline historical traffic and environmental data of the year 2008 for the blind test mode and online data (2011) for the pilot test mode.

In this project, the static data (accidents, etc.) is checked for all test section on the A12 Inntal motorway and A13 Brenner motorway and additional individual rules are established for specific displays according to the local situation (narrow bend, low sighting distance). This means that for black spots (accidents) or unfavourable constructional conditions specific rules for each display prior to the danger zone is developed for visualization of the road safety problem (for example increased danger of accident during slippery road conditions in curves). Therefore also a detailed accident investigation for the test sections (see figure 3) is carried out.

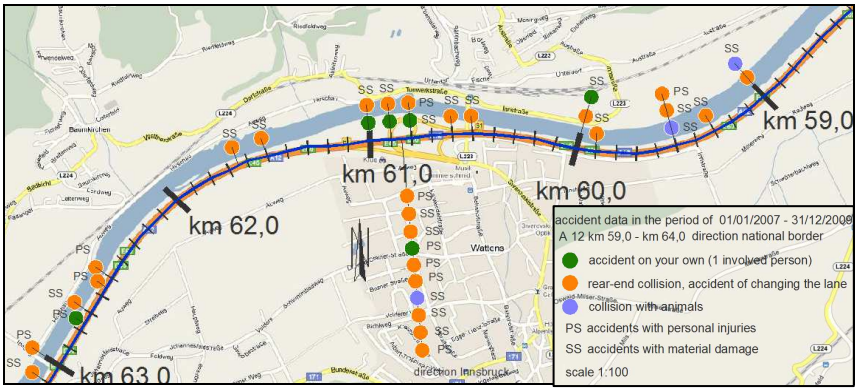

Figure – Detail of an accident map

The blind tests include historical data (one-minutes data) of the ASFINAG in the period of august 2008. Based on the results of the blind test mode some of the decision criteria and control rules are modified and adapted prior to the start of the pilot test mode. The following figure shows the display of the software DVS Netz – Pilot.

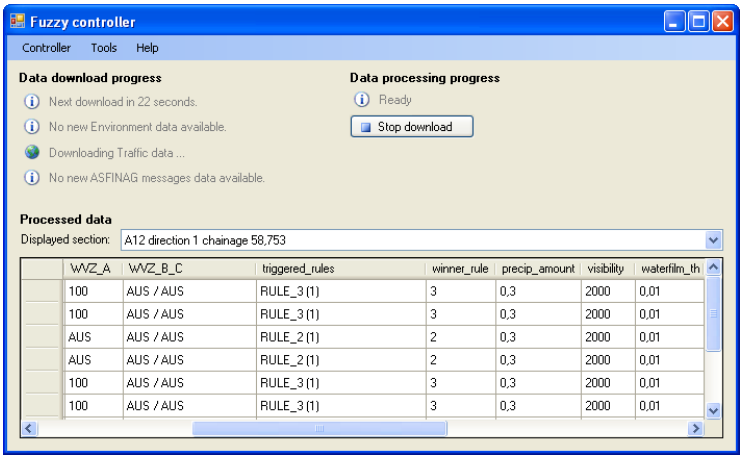

Figure - Screenshot of the program DVS Netz - Pilot

On basis of historical data the control display (see Figure above) in DVS Netz Pilot also includes minute wise speed alterations. Reason for those short time changes is that a smoothing of the data (for example it should shown 5 minutes the same display) is not implemented during the project. Therefore the smoothing is manually implemented in the pilot test.

The project DVS Pilot includes comprehensive input data. The combination of traffic data and weather conditions to be linked with constructional conditions (locality), historical accident data and additional information like road works provides the identification of danger zones.

Therefore the reliability of the information and displays of traffic guidance and information will be increased. The decision-making of critical situations by fuzzy logic model system presents a essential further development. In this project an approach is developed with defined boundary conditions between several test phases and program-modification to be applied for traffic guidance and information system as well as for individual safety information in vehicles.

Conclusion

The research project „dynamic evaluation of road safety on road networks – pilot study (short title: DVS Netz – Pilot)“ deals with the development of a dynamic traffic guidance and information system based on fuzzy logic modelling. In summary the proposed dynamic traffic guidance and information system based on fuzzy logic is able to provide a realistic approach to detect individual danger zones during certain road conditions. It can propose reliable displays and warning messages as function of the dynamic circumstances (environmental and traffic related) of road sections as well as their static circumstances (constructional conditions and accident history).

Acknowledgements

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