ADA Systems Application for Traffic Safety Improvement on Roadways

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Abstract— Compared to the motorway network, rural and urban roads are very unsafe. Advanced Driver Assistance Systems can be used to increase traffic safety, thereby improving the conditions for effective deployment of the underlying network for integrated traffic management. In this study, we have identified ADA systems that are expected to have a high impact on traffic safety by coupling characteristics of accidents to the functionality of different ADA systems. Based on the results of this study, Intelligent Speed Adaptation (ISA) and Intersection Crash Avoidance systems appeared most likely to substantially improve the safety on non-motorway roads. ISA was selected for further analysis due to the likelihood of its near future introduction. Microscopic simulation model was used to quantify the impacts on traffic safety for an urban highway with controlled intersections near the south of Tehran metropolitan. Depending on the penetration level, the results of the simulation study showed that the decrease in the total number of accidents ranges from 4% to 19%.

Keywords- ADA System, ITS, road networks, motorways, accident.

I. INTRODUCTION

Compared to the economical and societal cost of traffic congestion, the cost of traffic unsafety is very high. For example, in 2008 the cost for society of traffic congestion in the Iran was 280 milliard dollars; the costs due to accidents was much higher, namely 890 milliard dollars. Since most accidents do not occur on motorways but on the underlying traffic network, it seems logical to consider approaches to improve the traffic safety on urban and rural roads [1,2].

Although various alternatives can be chosen to improve traffic safety, this study focuses on the potential effects of Advanced Driver Assistance Systems (ADAS) on traffic safety. Many studies have focused on the impacts of ADAS on the motorway traffic network. Surprisingly, our analysis revealed that many of the accidents occur on urban and rural highways. Little is known about the ADAS impacts on these road types, justifying the research reported in this paper here. The approach taken in this paper is two-fold. At first, the safety potential of ADA is assessed by a detailed analysis of accident reports, focusing both on the so-called conflict maneuver level [3] and the accident cause level [4].

Both maneuvers and causes are then linked to the functionalities of the identified ADA systems, and combined afterwards to provide an overall ADA safety potential figure. A simulation study is subsequently performed to provide a more detailed analysis of the ADA system that turns out to have a high safety potential, namely Intelligent Speed Adaptation (ISA). The main research objective of this paper is “to assess the impact of ADAS on the safety on urban and rural highways for different types of ADAS”.

First phase of this paper entails making an inventory of unsafe situations, maneuvers and conflicts (safety analysis), as well as an overview of the different ADA systems. In the second phase, the results of the safety analysis are combined with the ADA system overview with the aim to provide a preliminary assessment of the potential ADA safety impacts. In this respect, safety potential is defined by the maximum attainable reduction in accident frequency under ideal circumstances, e.g. 100% ADAS penetration, faultless operation and use of ADAS, etc. The second phase will provide one or more ADA systems with a high safety potential for the urban and rural networks. In the third phase, the considered system(s) will be analyzed in more detail by a microscopic simulation study, in terms of safety impacts as well as impacts of network efficiency. The last phase entails a synthesis of the previous steps.

II. ACCIDENT ANALYSIS

In general, it was observed that more that half of all accidents occur on rural and urban highways. The absolute number of accidents in rural areas is much less than the number of accidents in urban areas. The accident risk,