

DEVELOPMENT AT ACCIDENT FORECASTING METHODOLOGY IN ROAD TRAFFIC

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Keywords: losses in road traffic, methodology of accident forecasting, accident losses, social constituent, forecasting methods

1. Introduction

This paper describes the main groups of the accident forecasting methods. It also contains the analysis for application in road traffic for estimation and forecasting accident rate on the conflict objects and roads. The article also includes recommendations for the development of the methods. It proposes the classification of the methods.

2. Problem Solution

Groups of accident forecasting methods

Accident forecasting is a content part of estimation of quality in road traffic works. To reduce accident losses it is necessary to evaluate and optimize each decision in traffic management in accordance with possible consequences, first of all with accident rate. But to meet this purpose one needs forecasting methods which could respond relevantly to any difference in traffic characteristics, not only in real but in designing object. It is impossible to optimize management and to reduce accident rate without reliable forecasting. Unfortunately today's forecasting methods do not allow solving practical tasks on optimization of the decisions on the stage of development and designing completely. A description of the situation formed in this area is regarded below.

There are four groups of forecasting methods: statistical, conflict situations, potential danger and expert. (Fig. 1).

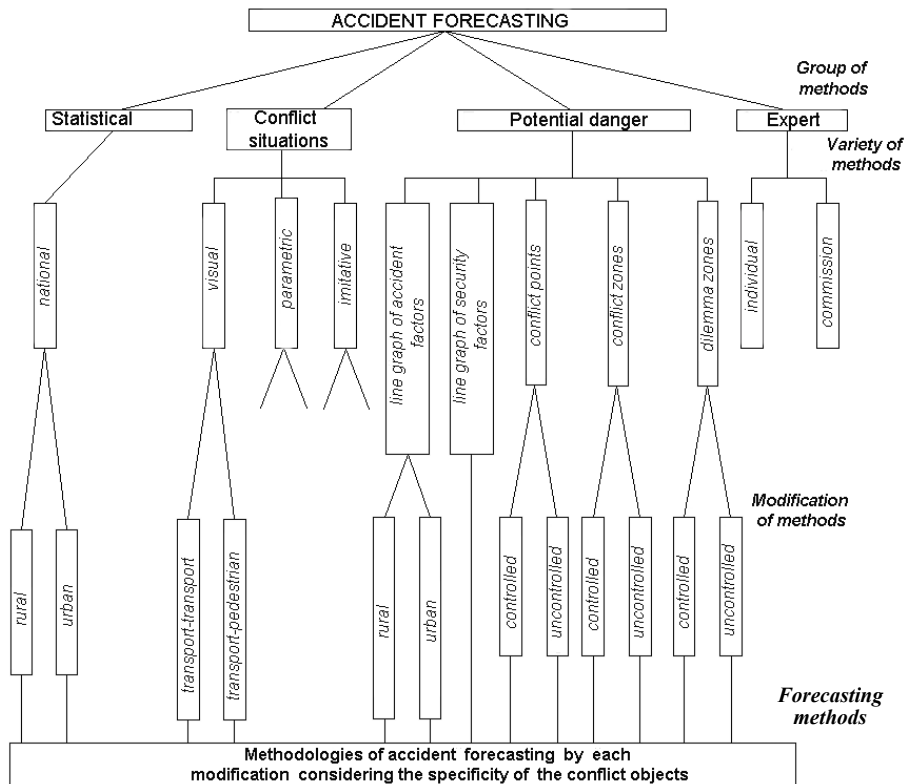


Fig. 1. Classification of the accident forecasting methods

As it was mentioned above there are different road traffic situations that mean typical state of moving process which is limited in space and in time. These situations can differ from each other both in possibility of conflict appearance and realization and in weight of consequences. Application fields of methods differ in accordance to road traffic situations.

Statistical group of methods

Statistical group of methods uses cumulative experience of different measures influence on accident rate and makes a forecast on the basis of accident data of the past period. It needs the presence of a real object (Fig. 2). In general these methods can be applied for the preliminary estimation of the efficiency of one or another measure which is implemented on the real object of road traffic.

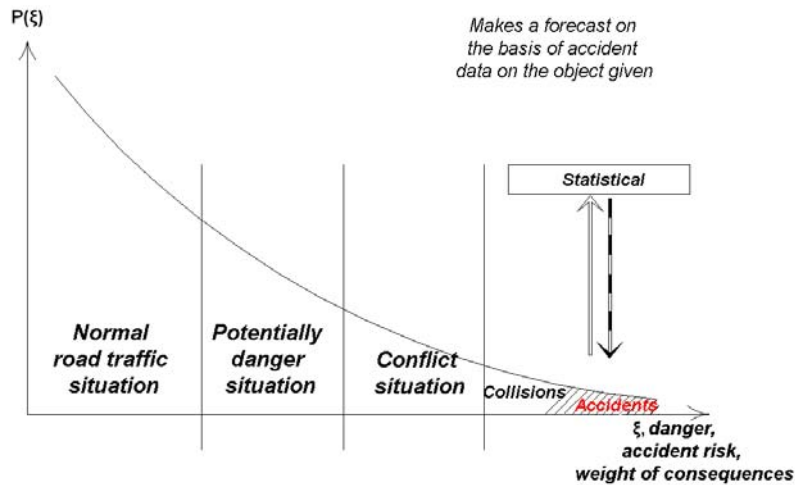


Fig. 2. Field of application for the group of statistical methods

The group of methods of conflict situations

The group of methods of conflict situations transfers the measured quantity of conflict (i.e. very danger, visible) situations in possible quantity of accidents and usually needs in the presence of a real object on which should measurement be made (Fig. 3). The methods allow quickly during some hours of observation finding the existing disadvantages which cause accidents and developing reliable measurements to their elimination. As a rule such methods are applied on new and reconstructed objects with the purpose of timely correction of the situations for designing road traffic and traffic management. Visual method of conflict situations needs in observation data (obtained directly by a specialist of the usage of video) in traffic and pedestrian conflict interactions and defining the conflict situation. Parametric method is based on the relation of one or another conflict situation to definite weight degree in dependence on critical deceleration (acceleration) of the vehicles during conflict interaction. Imitative method of conflict situations is based on mathematical modeling of conflict interactions of traffic and pedestrian flows on the object.

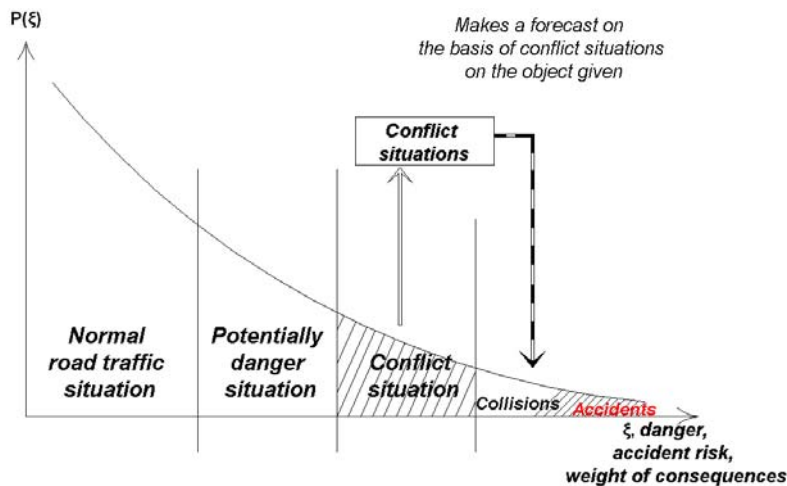


Fig. 3. Field of application for group of conflict situations methods

The group of potential danger methods

The group of potential danger methods needs neither real object nor accident data, but provides the forecast by aggregation of factors which influence the accident rate and could be measured on a real object or to be set in any combination while designing. (Fig. 4). That is why it can be applied for the optimization of the decisions both on the real object and on the stage of development and designing.

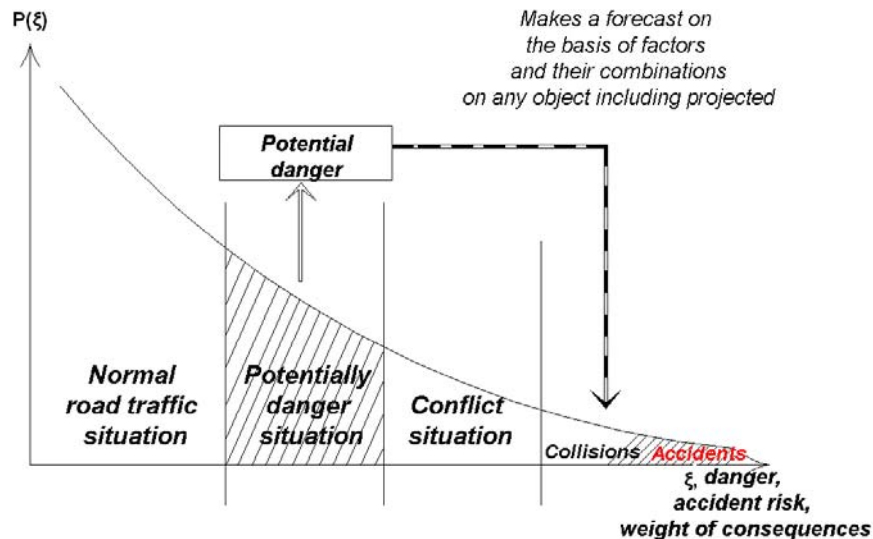


Fig. 4. Field of application for potential danger group of methods

Potential danger is invisible, hidden danger which is some difficult. It coded function on many factors and big quantity of their combinations - intensity, speed, management, road traffic conditions and etc. While it is not possible to encode this function totally the task is to select such reductive dependences which could give reliable by accuracy forecast. There are four methods in the group of potential danger methods – the method of line graph, the method of dilemma zones, the method of conflict points and the method of conflict zones.

The method of line graph, one of its founders was W.F. Babkov (Moscow), can be applied in accident forecasting for the rural roads and realized by two modifications. Modification of line graph of accident factors consists of the following. The road observed is divided into the homogenous parts, for which there are individual accident factors that could be chosen from special tables. These factors reflect the influence on the accident rate of definite parameters – traffic line width, turn radius, slipperiness etc. By multiplying these factors (their quantity is about 18) one can find the result factor which is necessary for estimation the possible accident rate on the object observed. In modification of line graph of security factors one defines the places of speed change from the faster to slower –and the more differences there exist, the more dangerous situations the object can be in.

The method of dilemma zones (U.A. Vruble, BNTU) provides the forecast of backup collisions and based on defining the parameters of so called dilemma zone in which the drivers can with the equal possibility take two alternative decisions – to go on movement or to stop. The possibility of accident depends on the sizes of dilemma zone, the distance between the zone and the obstacle appeared, expectedness of this obstacle, speed, traffic flow density etc.

The method of conflict points was initially proposed by G. Rappoport (Germany) and consists of calculating potential danger in every conflict point with the following cumulating in the area of junction. The method can be applied for the forecast of the conflict objects – junctions, pedestrian crossings etc. Initially, in the first methods, calculation of potential danger was made by the amount of possible points and the angle of trajectories of traffic users only. Then there were introduced traffic intensity of conflict flows and its irregularity etc.

The method of conflict zones. In BNTU (U.A. Vruble) other parameters (about 100) in the model of defining potential danger by conflict points were introduced. A conception of conflict zones, which consolidates groups of related conflict points, that fundamentally has changed the essence of forecast and has allowed getting quantitative and qualitative estimation of the accident forecasted are given. Modifications of the method of accident forecasting controlled uncontrolled junctions and pedestrian crossings were developed.

Expert group of methods

Expert group of methods is based on appliance of the experience of highly qualified in forecasting specialists (experts) (Fig. 5). These people can due to cumulative experience or natural inclinations predict the accident rate on the given object which they can observe personally or by means of draft. At special situation

several experts can take part in accident prediction. It must be mentioned that expert forecasting is very delicate and very approximate. There are unfortunately a little amount of real experts, who can closely predict accident rate. The most of the acting experts are almost not suitable for such work.

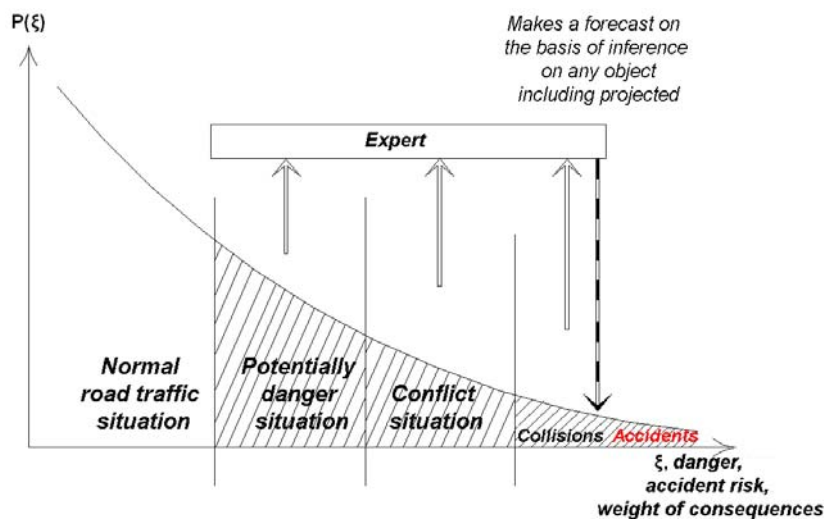


Fig. 5. Field of application of expert group of methods

Conclusion

As it was mentioned above accident rate - is one of the most vital and painful occasion in road traffic.

Total accident losses including social component reach almost 200 million US dollars annually. At the same time with automobilization growth losses will grow steadily. Reduction of accident losses in most degree is kept by absence of reliable method of accident forecasting.

There are four groups of forecasting methods : statistical, conflict situations, potential danger and expert. Statistical group of methods uses cumulative experience of different measures influence on accident rate and makes a forecast on the basis of accident data of the period past. It needs the presence of a real object. It is applied in general for the preliminary estimation of effectiveness these or those measurements, implemented in real object of road traffic.

The group of methods of conflict situations transfers the measured quantity of conflict situations (i.e. very danger, visible) situations in possible quantity of accidents and usually needs in the presence of a real object on which should measurement be made. The methods allow quickly during some hours of observation finding the existing disadvantages which cause accidents and developing reliable measurements to their elimination. As a rule such methods are applied on the new and reconstructed objects with the purpose of timely correcting the situations for designing road traffic and traffic management.

Expert group of methods. There are people who due to cumulative experience or natural inclinations can predict the accident rate on the given object which they can observe personally or by means of draft. At the special situation several experts can take part in accident prediction. It must be mentioned that expert forecasting is very delicate and very approximate. There are unfortunately a little amount of real experts, who can closely predict accident rate and most of acting experts are not suitable for such work.

Thus the groups of methods listed above work in general on the existing objects or on the basis of preliminary collected accident data.

The group of potential danger methods needs neither real object not accident data, but provides the forecast by aggregation of factors which influence the accident rate and could be measured on a real object or could be set in any combination while designing. That is why it can be applied for the optimization of the decisions both on the real object and on the stage of development and designing.

The most prospective method is the constantly perfected method of conflict zones which was developed by U.A. Vrubel. Practical works gave encouraging results on application of the method. But the work is far from its finish and demands the following analysis and search of possible ways of perfection of the existing accident rate forecasting methods and also its application for road traffic management optimization that allows reducing significantly accident losses. For the following perfection of conflict zones method it is essential to continue research of such conflict objects as pedestrian crossings, traffic light objects included in coordinated control, uncontrolled junctions, conflict objects with presence of tram ways. It is possible to research regularity of conflict zones forming more accurate and also to study physical essence of conflict districts interaction.