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Decision-making model of roadside safety improvement on two-lane highway

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Abstract

In order to meet the needs of scientific decision-making of roadside safety improvement project, a decision-making model of two-lane highway roadside safety improvement is proposed which based on Game Theory analysis. Firstly, roadside safety level was divided by indicators which can reduce the probability of run-into-roadside or improve the safety of roadside objective characteristics, and each indicator safety classification standards was determined on the basis of certain statistics data. Then, countermeasures database of roadside safety improvement is established by summarize and refining the roadside safety conditions countermeasures based on the domestic and overseas research results. Finally, against Game problems for roadside safety improvement process, and carried out the analysis of conflict and cooperation about the Game problems, decision-making information fusion model of roadside safety improvement is proposed by Game Theory. The results can provide a decision-making method for roadside safety improvement program.

Keywords: two-lane highway; roadside; Game Theory; safety improvements; decision-making model

1. Introduction

Roadside accident is in about 30% of the highway traffic accident. In the three or more deaths of major accident, roadside accident account for about half the proportion of major accident, which caused by the vehicle runs off the road, falling cliffs or bridges (Zheng, 2008). Roadside safety research had been taken seriously in our country, such as roadside hazards classification (Gao, 2008; Zegeer, 2000; Li, 2004; You, 2010) and roadside safety improvement issues (Gao, 2008; Guo, 2012). At present, the qualitative research is the mainly method for roadside hazards classification. Zegeer et al (2000) divided roadside hazards into seven levels by roadside

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features, such as the clear zone, sideslope rate, surface roughness, guardrail setting mode and dangerous objects stiffness. The higher the level indicated that the more dangerous road side. Hailong Gao (2008) put forward four levels classification method based on foreign roadside hazards research. However, when faced with complicated roadside environment, the application of qualitative classification method is difficult to judge roadside hazards due to many influence indicators. In quantitative research, Heng Zheng et al (2008) used Bayesian network and Changcheng Li et al (2004) used gray clustering method to establish the roadside safety assessment model. However, the reliability of these models are bound to be affected because of the correlation between some cause and outcome indicators related and these indicators been in an evaluation system. There are mainly two aspects for roadside safety improvement countermeasures research: research and development of roadside safety facilities, identification and disposal the roadside dangerous objects (Guo, 2012). On the basis of roadside safety qualitative or quantitative classification, engineers decided improvement countermeasures mainly through the engineering experience in a roadside safety improvement project. However, according to this way to carry out the project, the right equilibrium point is difficult to be found between benefits and costs. Therefore, further research should been to develop evaluation standard for roadside safety indicators, and to summarize safety indicators corresponding improvement countermeasures at home and abroad, and to use mathematical methods to find the equilibrium point. Based on this idea, the paper proposes a decision-making information fusion model of roadside safety improvement by Game Theory. The model can provide support for roadside safety improvement program.

2. Methodology

On the basis of domestic and overseas research results and certain statistics data, the paper develops evaluation standard for roadside safety indicators, and summarizes safety indicators corresponding improvement countermeasures, and uses Game Theory to find the equilibrium point between safety benefits and costs for improvement project. In order to obtain optimal costs or safety benefits, there is a research work for the conflict analysis and cooperation analysis. Research methodology is shown in Figure 1.
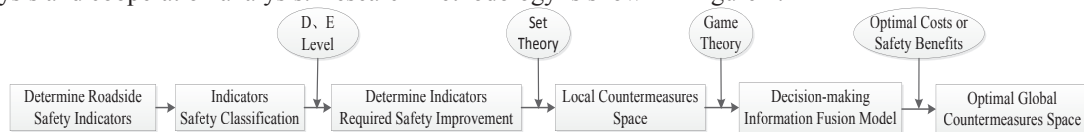

Fig.1. The study idea of roadside safety improvement program

2.1. The method of roadside hazards classification on two-lane highway

There are mainly two aspects for objective indicators of roadside safety from the roadside hazards analysis:
- Roadside objective characteristics indicators affect the severity of roadside accidents.
- Geometric alignment and traffic flow make different possibility of run-off-road.

These constitute necessary conditions for the different severity roadside accident occurred. Therefore, the paper divided roadside hazards into five levels (A、B、C、D、E) according to these two conditions with mathematical statistics research, as shown in Table 1.

Table 1 Safety classification standard for roadside hazards indicators

Conditions	Safety Indicators	Safety Level				
		A(Safest)	B (Safer)	C (Safe)	D(Dangerous)	E(More Dangerous)