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A Comprehensive Study to Reduce Traffic Accidents using Fuzzy Logic Approach

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ABSTRACT

In recent years, many people died or injured because of traffic accidents all over the world. When statistics are investigated India is the most dangerous country in terms of number of traffic accidents among Asian countries. However, we agree that this rate is higher in India since many traffic accidents are not recorded, for example single vehicle accidents or some accidents without injury or fatality. In this study, using fuzzy logic method; which has increasing usage area in Intelligent Transportation Systems, a model is developed which would obtain to prevent the vehicle pursuit distance automatically. Using velocity of vehicle and pursuit distance that can be measured with a sensor on vehicle a model has been established to brake.

Key words: Traffic accidents, Vehicle accidents, Fuzzy logic method, Automatic break control

INTRODUCTION

Traffic accidents are rare and random. However, many people died or injured because of traffic accidents all over the world. When statistics are investigated India is the most dangerous country in terms of number of traffic accidents among Asian countries. Many reasons can contribute these results, which are mainly driver fault, lack of infrastructure, environment, literacy, weather conditions etc. Cost of traffic accident is roughly 3% of gross national product. However, agree that this rate is higher in India since many traffic accidents are not recorded, for example single vehicle accidents or some accidents without injury or fatality. In this study, using fuzzy logic method, which has increasing usage area in Intelligent Transportation Systems, a model is developed which would obtain to prevent the vehicle pursuit distance automatically. Using velocity of vehicle and pursuit distance that can be measured with a sensor on vehicle a model has been established to brake.

Traffic Accidents and Traffic Safety

The general aim of traffic safety strategy is to eliminate the number of deaths and casualties in traffic. This objective forms the background for the present traffic safety program. The program is partly based on the assumption that high speed contributes to accidents. Many researchers support the idea of a positive correlation between speed and traffic accidents. One way to reduce the number of accidents is to reduce average speeds. Speed reduction can be accomplished by police supervision, but also through physical obstacles on the roads. Obstacles such as flower pots, road humps, small circulation points and elevated pedestrian crossings are frequently found in many residential areas around India. However, physical measures are not always appreciated by drivers. These obstacles can cause damages to cars, they can cause difficulties for emergency vehicles, and in winter these obstacles can reduce access for snow clearing vehicles. An alternative to these physical measures is different applications of

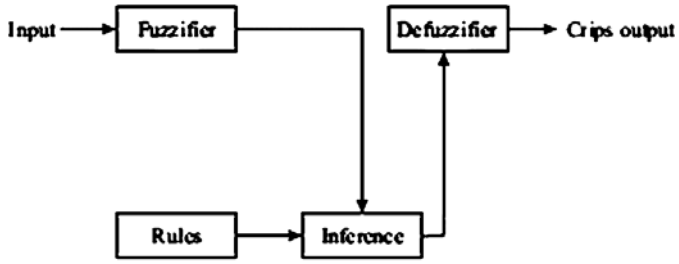

Fig. 1: Basic elements of a fuzzy logic

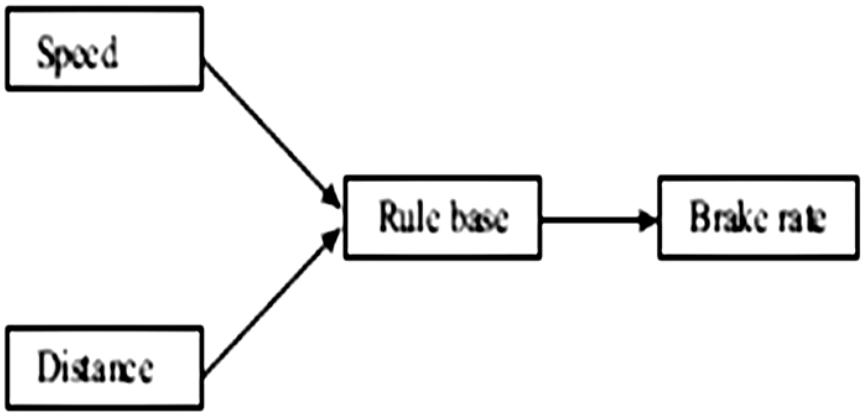

Fig. 2: General structure of fuzzy logic model

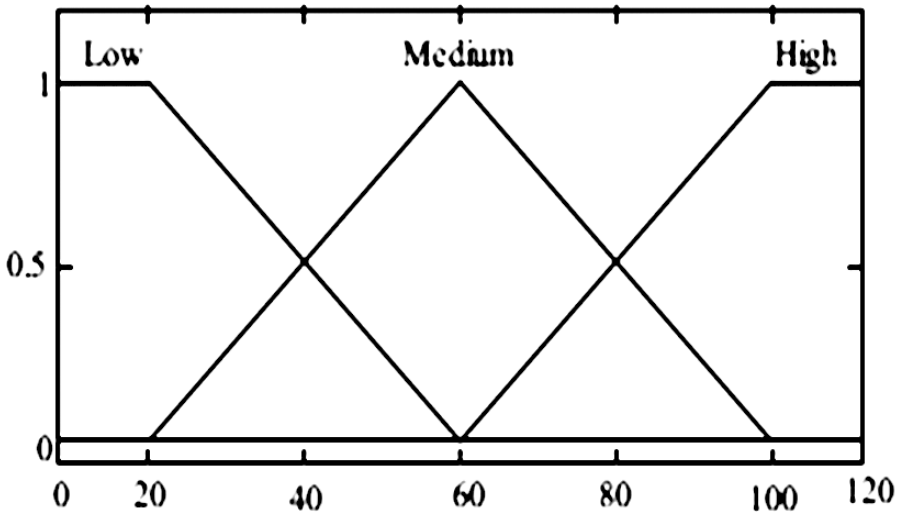

Fig. 3: Membership functions of speed

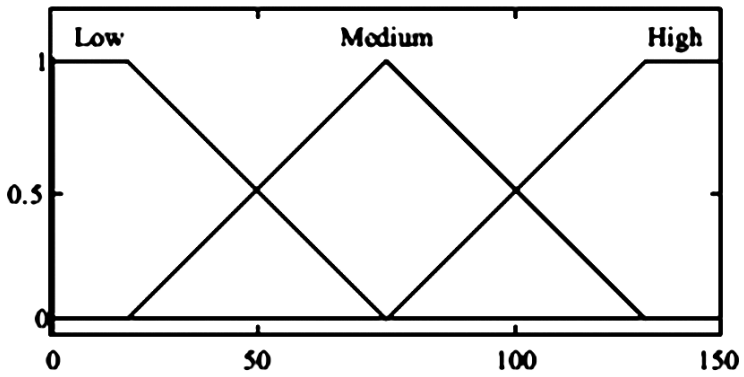

Fig. 4: Membership functions of distance

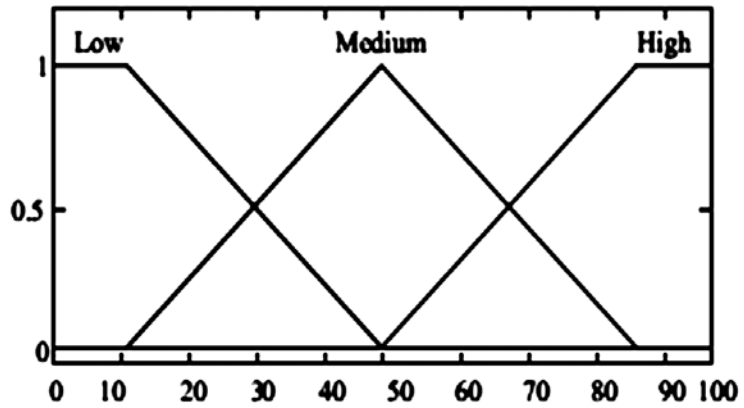

Fig. 5: Membership functions of brake rate

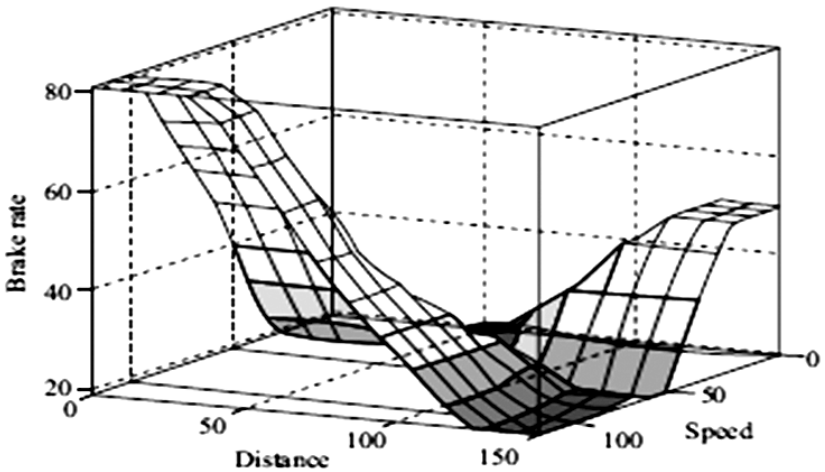

Fig. 6: Relationship between inputs and break rate

Intelligent Transportation Systems (*ITS*). The major objectives with *ITS* are to achieve traffic efficiency, by for instance redirecting traffic, and to increase safety for drivers, pedestrians, cyclists and other traffic groups. One important facet when planning and implementing traffic safety programs is therefore drivers' recognition of different safety measures aimed at speed reduction. Another facet is whether the individual's acceptance, when there is a certain degree of freedom of choice, might also be reflected in a higher acceptance of other measures, and whether acceptance of safety measures is also reflected in their perception of road traffic, and might reduce dangerous behaviour in traffic.

Fuzzy Logic Approach

The basic elements of each fuzzy logic system are, as shown in Figure 9.1, rules, fuzzifier, inference Engine, and defuzzifier. Input data are most often crisp values. The task of the fuzzifier is to map crisp numbers into fuzzy sets. Models based on fuzzy logic consist of "If-Then" rules. A typical "If-Then"rule would be:

If the ratio between the flow intensity and capacity of an arterial road is SMALL
Then vehicle speed in the flow is BIG

The fact following "If" is called a premise or hypothesis or forerunner. Based on this fact we can deduce another fact that is called a conclusion or consequent (the fact following "Then"). A set of a large number of rules of the type:

If premise
Then conclusion is called a fuzzy rule base.

In fuzzy rule-based systems, the rule base is formed with the assistance of human experts; recently, numerical data has been used as well as through a combination of numerical data-human experts. The inference engine of the fuzzy logic maps fuzzy sets onto fuzzy sets. A large number of different inferential procedures are found in the literature. In most papers and practical engineering applications, minimum inference or product inference is used. During defuzzification, one value is chosen for the output variable. The literature also contains a large number of different defuzzification procedures. The final value chosen is most often either the value corresponding to the highest grade of membership or the coordinate of the center of gravity.

Application

In the study, a model is established which estimates brake rate using fuzzy logic. The general structure of the model is shown in Fig. below:

Membership Functions

In the established model, different membership functions were formed for speed, distance and brake rate. Membership functions are given in Figures below. For maximum allowable car speed (in motorways) in India, speed scale selected as 0-120 km/h on its membership function. Because of the fact that current distance sensors perceive approximately 100-150 m distance, distance membership function is used 0-150 m scale. Brake rate membership function is used 0-100 scale for expressing percent type.

Rule Base

We need a rule base to run the fuzzy model. Fuzzy Allocation Map (rules) of the model was constituted for membership functions whose figures are given in Table below. It is important that the rules were not completely written for all probability. Figure 6 shows that the relationship between inputs, speed and distance, and brake rate.

Table: Fuzzy allocation map of the model

Speed	Distance	Brake rate
Low	Low	Low
Low	Medium	Low
Low	High	Medium
Medium	Low	Medium
Medium	Medium	Low
Medium	High	Low
High	Low	High
High	Medium	Medium
High	High	Low

Output

Fuzzy logic is also an estimation algorithm. For this model, various alternatives are able to cross examine using the developed model. Fig. given below is an example for such the case.

CONCLUSIONS

Many people die or injure because of traffic accidents in India. Many reasons can contribute these results for example mainly driver fault, lack of infrastructure, environment, weather conditions etc. In this study, a model was established for estimation of brake rate using fuzzy logic approach. Car brake rate is estimated using the developed model from speed and distance data. So, it can be said that this fuzzy logic approach can be effectively used for reduce to traffic accident rate. This model can be adapted to vehicles.

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