Global Journal of Engineering Design & Technology

Extended Abstract

Analysis of a Traffic Accident in Turkey

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Abstract

No.2918 Turkish Highway Traffic Act has been the reference legislation for traffic accidents in Turkey since 1983. Although this act consists of several explanations and definitions, it has still deficiencies especially in defining fault rates which are vital for traffic accident analyses. Accident experts determine fault rates mostly according to their initiatives without conducting scientific analyses on accidents due to inadequate quantitative instructions on fault rates in the act. Speed analyses of accident involvements play an important role in accident investigations. A more comprehensive parameter, Energy Equivalent Speed, may be defined to explain dissipation and severity of deformation energy and crush amounts formed on vehicles which also give hint about fault rates. In this study, accessible data were collected from a sample accident scene (police reports, skid marks, deformation situations, crush depths etc.) and used as inputs for an accident reconstruction software called "vCrash" which is able to simulate the accident scene in 2D and 3D. Energy equivalent speed calculations were achieved using 784 parameters with a prediction error. Multi-layer Feed Forward Neural Network and Generalized Regression Neural Network models were utilized for estimation of energy equivalent speeds (speeds just before the collision, i.e., in case of absence of skid marks) based on using these parameters as teaching data for the models.

Keywords:

Accident reconstruction; Fault rate; Energy equivalent speed; Prediction models

Introduction

Transportation engineering firstly focuses on safety and efficiency. Public agencies put forward substantial efforts on reducing traffic accidents which also entails a huge financial burden on society. Occurrence of traffic accidents strictly depends on two major factors: driver and roadway design. Gender and age of the driver are of great importance in traffic [1]. Death rates usually tend to fall as countries develop. However, fatalities in traffic accidents grow proportionally to development of a country which means that increment in the number of motor Vehicles usually brings an increase in road traffic accidents.

According to 2002 annual reports, traffic accidents are the 11th reason for fatalities in Turkey. Traffic accidents have the 2nd priority for fatalities at the age interval of 5-29 and the 3rd for the age interval of 30-44. In 1999, while the number of registered traffic accidents was 466000, it was 501000 in year 2000. General Directorate of Highway reports indicates 2954 fatalities and 94497 injuries involving 409407 accidents in the year 2001 and 570419 accidents in the year 2005.

Materials and Methods

In the software step; simulation of a sample property damage only (PDO) accident (one of the most frequent in Turkey) was conducted on vCrash [6]. Referring to energy transfer and impulse-momentum analysis results of the software; formation of the accident, location of vehicle after the collision damages comprised on the collision regions were examined. In the following step, Energy Equivalent Speed (EES) values (or speed values) which were also directly proportional to deformations formed on the collision regions and fault rates were calculated by benefiting from 784 parameters (used for crash simulation) as teaching data for Multi-layer Feed Forward Neural Network (MFFNN) and Generalized Regression Neural Network (GRNN) models. After training the models in terms of every EES corresponding to every deformation (crush depth), predicted EES values and deformations were used as input data for the models to estimate fault rates as output data. Referring to this method, experts may refrain from using expensive reconstruction softwares for accident analysis in future.

Analysis of the sample accident scenario

In the sample accident case, two average passenger cars (APC) collide with each other at an angle of 90° on an equal-arm intersection (no traffic lights,

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"STOP", "YIELD", etc. warning signs and/or officer) .

Referring to No.2918 Turkish Highway Traffic Act (THTA), in such cases vehicle 1 (right) has the passing priority rather than vehicle 2 (left). For this kind of situations, it is assumed by the experts that the vehicle 2 is at-fault and vehicle 1 is deemed as minor faulty due to careless aggressing to the intersection. The fault rates are generally allocated to 75%-25% or 80%-20% by initiative of experts. However, several questions arise about collision speeds, absence/existence of skid marks on the road surface, intersection approaching speed of vehicle 1 (if above legal speed limits, is he/she still minor-faulty?), existence of a systematic method for fault rate determination.

Prediction methods

Multi-layer Feed-Forward Neural Network (MFFNN): Input, output and hidden layers form an MFNN model (Figure 2). Weighted inputs are received from a previous layer and their outputs are transmitted to next-layer neurons. A nonlinear activation function is used to transfer the summations of weighted input signals. In order to conduct an error analysis, a comparison with actual results is made until the error reaches an acceptable value.

Conclusion

At this term, a sample traffic accident was examined with the aid of data collection from the accident scene. Simulation and analysis relevant to these data were conducted on traffic accident reconstruction tool (software) called vCrash which showed damage levels comprised on involvements, EES values and other 14 parameters in 3D. As a result, these examinations were interpreted to comprehend the general reasons causing these accidents and precautions to minimize them. MFFNN and GRNN models were used to develop new models for EES prediction by using vCrash variables.

References

1. Miaou S, Lum H (1993) Modeling vehicle, accidents and highway geometric
2. design relationships. Accident Analysis and Prevention 25: 689-709.
3. Cangul E (2010) Development of an expert system for the quantification of fault rates in traffic accidents. Middle East Technical University, MSc Thesis, Ankara.
4. Murray C, Lopez A (1996) Alternative projections of mortality and disability by cause 1990-2020: The global burden of disease. The Lancet 349: 1498-1504.
5. http://www.tuik.gov.tr/UstMenu.do?metod=temelist
6. Virtual CRASH (vCrash) (2014) Traffic accident reconstruction tool, College of Industrial Engineers and Surveyors, Graduate Industrial Province of Naples, Italy.
7. Tomasch E (2004) Accident reconstruction guidelines. (1stedn), Graz University of Technology. Graz, Austria.
8. http://en.wikipedia.org/wiki/Generalized_extreme_value_distribution .
9. Alpaydın E (2010) Introduction to machine learning. (2ndedn), MIT press.

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