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Predicting Traffic Safety using PSO-SVM Method and Back Propagation Neural Network

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1. Introduction

SVM is one of the supervised (labeled) learning methods used for classification. This method is one of the relatively new methods that in recent years has performed well compared to older methods like perceptron neural networks. The particle swarm optimization method is a computational method that optimizes the problem with repeated efforts to improve the candidate solution according to the assumed quality criterion. A search space is moved by simple mathematical formulas to calculate the position and velocity of a particle.

In recent years, with the improvement of road construction and the increase in the presence of mobile ambulances and the use of different routes, the rate of traffic accidents has had a relatively declining trend. It is important that traffic safety planning be determined by predicting traffic accidents based on safety data from past years. In this study, the aim was to cover the weakness of neural networks by combining PSO- SVM as a new method and increase the accuracy of calculations. Therefore, the method was used for the first time on a large volume of data in Iran. This model has been implemented for all three cases of number of accidents, number of casualties and number of injured. Among the effective factors in the model according to other studies are speed cameras, number of roadside assistance centers, population, person-kilometer displacement, and the ratio of passenger cars to Bari.

2. Method

This study proposes a new approach that combines particle swarm optimization and support vector machine (PSO - SVM) to predict traffic safety. First, factors affecting traffic safety $\{(x_i, y_i)\}_i^n$ and evaluation indicators are analyzed. Then the traffic safety forecasting model is developed by PSO- SVM according to the effective factors. Data related to traffic safety in the country (including the number of accidents, casualties, and injuries) from 1997 to 2018 are used to investigate the ability of predicting the proposed method, in which data from 1997 to 2011 are used as educational data and data from years 2012 to 2018 are used as test data.

3. Discussion and Conclusion

Observation of the values between the mean percentage of absolute error (MAPE) between PSO-SVM and the post-diffusion neural network shows that the absolute mean error values for the number of accidents with the PSO-SVM method and the post-diffusion neural network are 0.0281 and 0.0498. Also, the number of casualties reported by the PSO-SVM model and post-diffusion neural network are 0.0343 and 0.05610, and the absolute mean error values for the number of casualties reported by the PSO-SVM model and neural network are 0.0261 and 0, respectively. The number 0.0452 indicates that the traffic safety reported by

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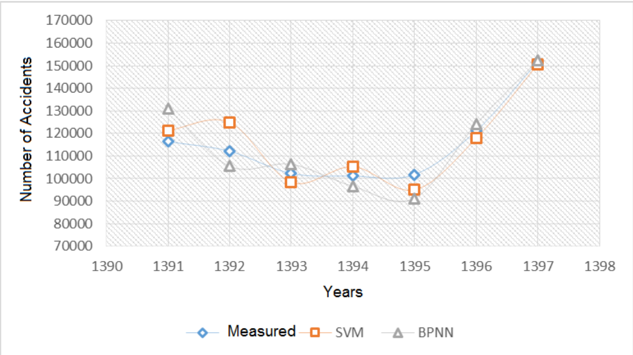
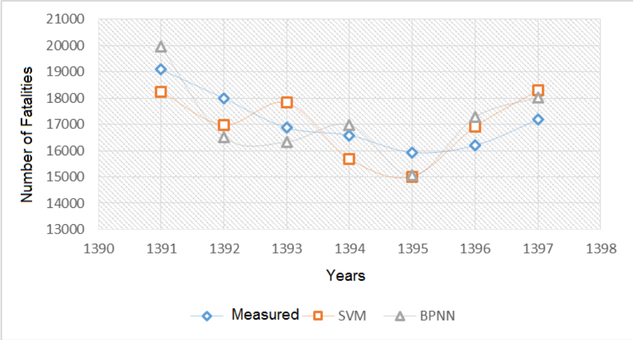
PSO-SVM is more accurate than the neural network after propagation.

The prediction values of the number of accidents of PSO-SVM method and post-diffusion neural network are compared. The general trend is declining from 1991 to 1995, but the number of accidents has increased until 1997. It is clear that the random nature of the crash data is seen in both methods, and it cannot be said that one of the models always reports more or less values than the counted data. According to Figure 1, it is stated that the trend of changes in casualties is almost similar to the number of accidents, but, the number of injured people is almost constant until 1995, after which it takes an upward trend. We can see the superiority of the PSO-SVM model over the neural network, where the values of the orange graph are closer to blue than the gray graph. For example, in 2012, the SVM output reports 120,000 crashes, of which the numbered counter is 118,000, while the neural network reports 130,000 crashes, with a difference from the observed values. Another point is that the models show more fluctuations than the observed data. By adjusting the mentioned models and reducing the fluctuations, higher accuracy models can be created. Considering that the amount of error in the data related to the number of the injured is less than the data on the number of accidents and the number of casualties, this category can be considered as the result of more data. The more data the models have, the better they can be matched to the counted values.



A



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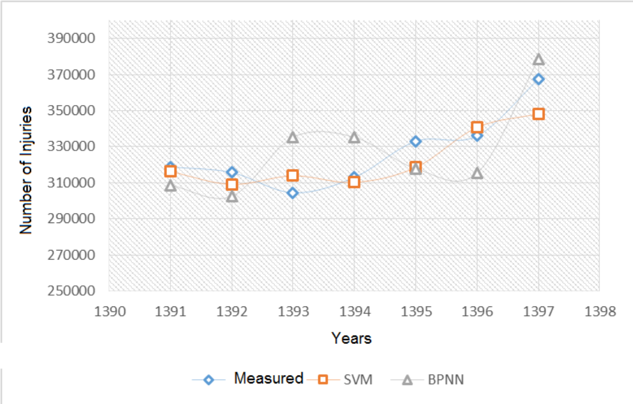

C

Figure 1. Comparison of number prediction values a) Accidents, b) Losses, c) injured, Between PSO-SVM and neural network after diffusion