Projected state-wide traffic forecast parameters using artificial neural networks

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Article

Design-hour volume (DHV) and directional DHV (DDHV) are important traffic forecast parameters for both planning and operational studies. They are used for roads and intersection design and operational analysis. Estimating these two parameters requires a record of hourly volumes for every hour in a year. Therefore, permanent traffic counters are usually used to keep a record of

those hourly volumes. The use of permanent counters faces several challenges because of adjacent construction activities and hardware or communication failure. These challenges result in the missing part of the collected data. Moreover, estimating DHV and DDHV based on short-term traffic counts is often needed. In this research, an artificial intelligence approach is used to estimate DHV and DDHV for roadways with different functional classifications. An artificial neural network model, which utilises historical records of annual average daily traffic along with other road characteristics, such as number of lanes and functional classification, is developed. Results show that the model was able to achieve a highly accurate and reliable DHV and DDHV estimates.

Inspec keywords: traffic engineering computing; neural nets; road traffic

Other keywords: short-term traffic counts; important traffic forecast parameters; artificial neural network model; projected state-wide traffic forecast parameters; reliable DHV; highly accurate DHV; historical records; intersection design; annual average daily traffic; operational studies; artificial neural networks; permanent traffic counters; artificial intelligence approach; adjacent construction activities; DDHV; permanent counters; operational analysis

Subjects: Neural computing techniques; Traffic engineering computing

Related content

Hybrid machine learning and optimisation method to solve a tri-level road network protection problem

- Arash Kaviani ; Russell G. Thompson ; Abbas Rajabifard ; Majid Sarvi
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- In this study, the authors employ machine learning to develop a new solution method for solving a tri-level network protection problem. In the upper-level, the planner aims to minimise the impact of the interdictor's attempt to disrupt a road network through protection activities. At the middle-level, however, the interdictor seeks to maximise the network's cost function, that is total travel time while the user equilibrium assignment models the road users behaviour at the lower-level. The proposed solution algorithm combines implicit enumeration with machine learning for faster performance. In so

doing, four machine learning methods are evaluated among which the artificial neural network model shows the best performance and thereby to be exploited. Principal component analysis is also employed as part of the data pre-processing to perform dimensionality reduction. The proposed solution algorithm exhibits a reasonable level of tractability when employed to solve large problems in which a real-world network is under investigation. Although it cannot guarantee global optimality, it is argued that this is an essential compromise for the application of the network optimisation problems on extensive real-world networks and the large solution space that they generate.

Vehicle motion analysis based on a monocular vision system

- Yanpeng Cao ; A. Renfrew ; P. Cook
- View description Hide description
- This paper presents a comprehensive methodology for on-road vehicle motion analysis using a monocular vision system. Vehicle motion analysis plays an essential role in various intelligent vehicle applications, such as cruise control, vehicle platooning, and collision avoidance. In this paper, it's proposed to improve the accuracy of vehicle motion analysis by breaking the task into two complementary steps: incoming vehicle detection and vehicle motion analysis. In the vehicle detection, a new vehicle which enters the observation field will be identified by inspecting its vehicle-related features. Once a vehicle is detected, a fine-level motion analysis mechanism is employed to monitor its position and relative speed based on the temporal consistency exploitation. Specifically, a novel 3-D Pulse-Coupled Neural Network (PCNN) model is employed for optical flow calculation and optimization. The improved optical flow is then interpreted to generate reliable vehicle motion estimation. Overall, the proposed method shows excellent performance in terms of both accuracy and efficiency owing to its effective coarse-to-fine processing scheme and multiple-cue consideration. (6 pages)

Value-based deep reinforcement learning for adaptive isolated intersection signal control

- Chia-Hao Wan and Ming-Chorng Hwang
- View description Hide description
- Under efficiency improvement of road networks by utilizing advanced traffic signal

control methods, intelligent transportation systems intend to characterize a smart city. Recently, due to significant progress in artificial intelligence, machine learning-based framework of adaptive traffic signal control has been highly concentrated. In particular, deep Q-learning neural network is a model-free technique and can be applied to optimal action selection problems. However, setting variable green time is a key mechanism to reflect traffic fluctuations such that time steps need not be fixed intervals in reinforcement learning framework. In this study, the authors proposed a dynamic discount factor embedded in the iterative Bellman equation to prevent from a biased estimation of action-value function due to the effects of inconstant time step interval. Moreover, action is added to the input layer of the neural network in the training process, and the output layer is the estimated action-value for the denoted action. Then, the trained neural network can be used to generate action that leads to an optimal estimated value within a finite set as the agents' policy. The preliminary results show that the trained agent outperforms a fixed timing plan in all testing cases with reducing system total delay by 20%..

Trajectory tracking and prediction of pedestrian's crossing intention using roadside LiDAR

- Junxuan Zhao ; Hao Xu ; Jianqing Wu ; Yichen Zheng ; Hongchao Liu
- View description Hide description
- Trajectory tracking and crossing intention prediction of pedestrians at intersections are important to intersection safety. Recently, on-board video sensors have been developed for detection of pedestrians. However, both the detection range and operating environment of video-based systems seem to be constrained by the advancement of image-processing technologies. Additionally, on-board systems cannot alarm pedestrians to take evasive actions when at risk, a feature which is critical to saving lives. This paper summarises the authors' practice on using roadside LiDAR sensors to monitor and predict pedestrians' crossing intention, as part of an ongoing effort to develop a pioneering LiDAR-based system to systematically reduce pedestrian and vehicle collisions at intersections. The LiDAR sensors were installed at intersections to collect pedestrian data such as presence, location, velocity, and

direction. A new method based on deep autoencoder – artificial neural network (DA-ANN) was used to process data and predict pedestrian crossing intention. The case study shows the proposed model is about 95% prediction accuracy and computational efficiency for real-time systems. The roadside LiDAR system has great potential to significantly reduce vehicle-to-pedestrian crashes both at intersections and non-intersection areas, either used as a stand-alone system or in conjunction with the connected V2I and I2V technologies.

Emotional temporal difference *Q*-learning signals in multi-agent system cooperation: real case studies

- Javad Abdi ; Behzad Moshiri ; Baher Abdulhai
- View description Hide description
- Chaotic non-linear dynamics approach is now the most powerful tool for scientists to deal with complexities in real cases; and artificial neural networks and neuro-fuzzy models are widely used for their capabilities in non-linear modelling of chaotic systems. Chaos, uncertain behaviours, demanding fluctuation, complexity of the traffic flow situations and the problems with those methods, however, caused the forecasting traffic flow values to lack robustness and precision. In this study, the traffic flow forecasting is analysed by emotional concepts and multi-agent systems (MASs) points of view as a new method. Its architecture is based on a temporal difference (TD) *Q*-learning with a neuro-fuzzy structure. The performance of TD *Q*-learning method is improved by emotional learning. The concept of emotional TD *Q*-learning method is discussed for the first time in this study. The forecasting algorithm which uses the *Q*-learning algorithm is capable of finding the optimal forecasting approach as the one obtained by the reinforcement learning. In addition, in order to study in a more practical situation, the neuro-fuzzy behaviours can be modelled by MAS. The real traffic flow signals used for fitting the proposed methods are obtained from interstate I-494 in Minnesota City in USA and the E17 motorway Gent–Antwerp in Belgium.

Efficient use of artificial neural networks for path finding using fuzzy logic based antcolony system algorithm

- A. Aggarwal and J.S. Bhalla

- View description Hide description
- Path finding in major cities based on specific (or particular) requirements is one of the significant problems that city travellers face as well as a challenging demand or need for the car based navigation systems. Therefore, in this paper, we introduced a multi-parameter (taking more than one parameter into consideration) based path finding modern system which utilizes fuzzy logic to an Ant Colony System in the detection of optimum multi-parameter routes in terms of cost, distance etc. We made use of traffic data which we acquired by a traffic control online datasets and additional traffic data in the form of minutes are predicted (or forecasted) by employing (or applying) artificial neural networks (ANNs) to that. This proposed system has been virtually tested (or simulated) by taking the location: Sydney, Australia into consideration and the respective results are being evaluated. Addition to this, we tried to show the comparison analysis between the Ant Colony System based path (route) finding and Fuzzy-Logic Based Ant-Colony System.