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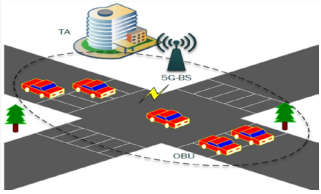
Section Transportation and Future Mobility

Featured Papers

DOI:10.3390/app12125939

Chebyshev Polynomial-Based Scheme for Resisting Side-Channel Attacks in 5G-Enabled Vehicular Networks

Authors: Mahmood A. Al-Shareeda, Selvakumar Manickam, Badiea Abdulkarem Mohammed, Zeyad Ghaleb Al-Mekhlafi, Amjad Qtaish, Abdullah J. Alzahrani, Gharbi Alshammari, Amer A. Sallam and Khalil Almekhlafi



Abstract: The privacy and security vulnerabilities in fifth-generation (5G)-enabled vehicular networks are often required to cope with schemes based on either bilinear pair cryptography (BPC) or elliptic curve cryptography (ECC). Nevertheless, these schemes suffer from massively inefficient performance related to signing and verifying messages in areas of the high-density traffic stream. Meanwhile, adversaries could launch side-channel attacks to obtain sensitive data protected in a tamper-proof device (TPD) to destroy the system. This paper proposes a Chebyshev polynomial-based scheme for resisting side-channel attacks in 5G-enabled vehicular networks. Our work could achieve both important properties of the Chebyshev polynomial in terms of chaotic and semi-group. Our work consists of five phases: system initialization, enrollment, signing, verification, and pseudonym renew. Moreover, to resist side-channel attacks, our work renews periodically and frequently the vehicle's information in the TPD. Security analysis shows that our work archives the privacy (pseudonym identity and unlikability) and security (authentication, integrity, and traceability) in 5G-enabled vehicular networks. Finally, our work does not employ the BPC or the ECC; its efficiency performance outperforms other existing recent works, making it suitable for use in vehicular networks.

DOI:10.3390/app11010032

Risk Analysis of Road Tunnels: A Computational Fluid Dynamic Model for Assessing the Effects of Natural Ventilation

Authors: Ciro Caliendo, Gianluca Genovese and Isidoro Russo

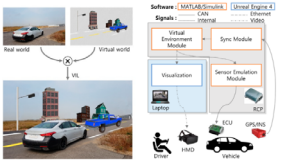
Abstract: We have developed an appropriate Computational Fluid Dynamics (CFD) model for assessing the exposure to risk of tunnel users during their evacuation process in the event of fire. The effects on escaping users, which can be caused by fire from different types of vehicles located in various longitudinal positions within a one-way tunnel with natural ventilation only and length less than 1 km are shown. Simulated fires, in terms of maximum Heat Release Rate (HRR) are: 8, 30, 50, and 100 MW for two cars, a bus, and two types of Heavy Goods Vehicles (HGVs), respectively. With reference to environmental conditions (i.e., temperatures, radiant heat fluxes, visibility distances, and CO and CO_2 concentrations) along the evacuation path, the results prove that these are always within the limits acceptable for user safety. The exposure to toxic gases and heat also confirms that the tunnel users can safely evacuate. The evacuation time was found to be higher when fire was related to the bus, which is due to a major pre-movement time required for leaving the vehicle. The findings show that mechanical ventilation is not necessary in the case of the tunnel investigated. It is to be emphasized that our modeling might represent a reference in investigating the effects of natural ventilation in tunnels.

DOI:10.3390/app10082645

Vehicle-in-the-Loop in Global Coordinates for Advanced Driver Assistance System

Authors: Changwoo Park, Seunghwan Chung and Hyeongcheol Lee

Abstract: Most vehicle controllers are developed and verified with V-model. There are several traditional methods in the automotive industry called "X-in-the-Loop (XIL)". However, the validation of advanced driver assistance system (ADAS) controllers is more complicated and needs more environmental resources because the controller interacts with the external environment of the vehicle. Vehicle-in-the-Loop (VIL) is a recently being developed approach for simulating ADAS vehicles that ensures the safety of critical test scenarios in real-world testing using virtual environments. This new test method needs both properties of traditional computer simulations and real-world vehicle tests. This paper presents a Vehicle-in-the-Loop topology for execution in global Coordinates system. Also, it has a modular structure with four parts: synchronization module, virtual environment, sensor emulator and visualizer, so each part can be developed and modified separately in combination with other parts. This structure of VIL is expected to save maintenance time and cost. This paper shows its acceptability by testing ADAS on both a real and the VIL system.



DOI:10.3390/app11188387

Development of a Hybrid Artificial Neural Network-Particle Swarm Optimization Model for the Modelling of Traffic Flow of Vehicles at Signalized Road Intersections

Authors: Isaac Oyeyemi Olayode, Lagouge Kwanda Tartibu, Modestus O. Okwu and Uchechi Faithful Ukaegbu

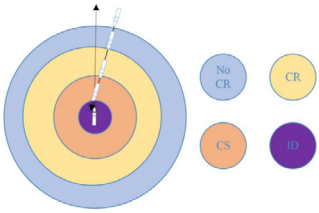
Abstract: The tremendous increase in vehicular navigation often witnessed daily has elicited constant and continuous traffic congestion at signalized road intersections. This study focuses on applying an artificial neural network trained by particle swarm optimization (ANN-PSO) to unravel the problem of traffic congestion. Traffic flow variables, such as the speed of vehicles on the road, number of different categories of vehicles, traffic density, time, and traffic volumes, were considered input and output variables for modelling traffic flow of non-autonomous vehicles at a signalized road intersection. Four hundred and thirty-four (434) traffic datasets, divided into thirteen (13) inputs and one (1) output, were obtained from seven roadsites connecting to the N1 Allandale interchange identified as the busiest road in Southern Africa. The results obtained from this research have shown a training and testing performance of 0.98356 and 0.98220. These results are indications of a significant positive correlation between the inputs and output variables. Optimal performance of the ANN-PSO model was achieved by tuning the number of neurons, accelerating factors, and swarm population sizes concurrently. The evidence from this research study suggests that the ANN-PSO model is an appropriate predictive model for the swift optimization of vehicular traffic flow at signalized road intersections. This research extends our knowledge of traffic flow modelling at a signalized road intersection using metaheuristics algorithms. The ANN-PSO model developed in this research will assist traffic engineers in designing traffic lights and creation of traffic rules at signalized road intersections.

DOI:10.3390/app12188926

Intelligent Collision Avoidance Method for Ships Based on COLRGEs and Improved Velocity Obstacle Algorithm

Authors: Xingya Zhao, Yixiong He, Liwen Huang, Junmin Mou, Ke Zhang and Xiao Liu

Abstract: Collision prevention is critical for navigational safety at sea, which has developed rapidly in the past decade and attracted a lot of attention. In this article, an improved velocity obstacle (IVO) algorithm for intelligent collision avoidance of ocean-going ships is proposed in various operating conditions, taking into count both a ship's manoeuvrability and Convention on the International Regulations for Preventing Collisions at Sea (COLREGs). An integrated model combines a three-degree-of-freedom manoeuvring model with ship propeller characteristics to provide a precise prediction of ships in various manoeuvring circumstances. In the given case, what is different to present studies, this improved algorithm allows for decision-making in two ways: altering course and changing speed. The proposed technique is demonstrated in a variety of scenarios through simulation. The findings reveal that collision-avoidance decision-making can intelligently avoid collisions with the target ships (TSs) in multi-ship situations.



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