Scanning the Issue and Beyond: Merton's Laws and Mertionian Systems for ITS

THIS is my last editorial and I would like to take this opportunity to express my sincere thanks to those have devoted their time and efforts in helping me making this great publication more successful during my service. First of all, thanks to Dr. Simona Bertè, my only full-time staff member, who has worked extremely hard in keeping a smooth and timely operation, in making sure that we have followed all the rules and regulations set forth by IEEE, and that we have met our own professional norms and standards. To my three part-time assistants, Dr. Yanqing Gao of the University of Arizona for the first five years, and Dr. Xiao Wang of the Chinese Academy of Sciences and Ms. Stephanie Brown from IEEE for the last two years, many thanks for your dedication and support. During my seven-year term as the Editor in Chief, the number of manuscripts submitted and pages published annually have increased 317.4% (from 322 to 1022) and 500% (from 720 to 3600), respectively. This was achieved without any addition to our editorial team; therefore, much special appreciation and recognition must be given to the four of them!

The support and contribution from our reviewers, associate editors, and members of our advisory board were also extremely critical and important to the growth of this publication—my thanks for your hard work and apologies for pushing you hard in the process. To my colleagues on the Executive Committee and the Board of Governors, thanks for your support for many of my decisions, especially my initiative of establishing the new *IEEE Transactions on Intelligent Vehicles*, an important step for our future growth.

Last but not least, thanks to all who have submitted to our TRANSACTIONS, without your support and contribution, there will be no IEEE T-ITS!

My vision was to make our TRANSACTIONS a super highway for ITS publications: fast in motion, wide in capacity, and high in quality of services. Thank you all—our numbers have clearly demonstrated that IEEE TRANSACTIONS ON INTELLIGENT TRANSPORTATION SYSTEMS has made my dream a great reality today. I believe our new EiC, Professor Petros Ioannou, will lead the journal to a new level of success with your continued support.

Fig. 1. EiC Fei-Yue Wang and EiC Elect Petros Ioannou held the IEEE T-ITS at the IEEE ITSC 2015 in Las Palmas de Gran Canaria, Spain.

A SURVEY OF TRAFFIC DATA VISUALIZATION

Wei Chen, Fangzhou Guo, and Fei-Yue Wang

Traffic visualization plays an important role in transportation research and application, especially in data-driven intelligent transportation systems. This survey introduces the basic concept and pipeline of traffic data visualization; provides an overview of related data processing techniques; and summarizes existing methods for depicting the temporal, spatial, numerical, and categorical properties of traffic data.

A SECURITY AND PRIVACY REVIEW OF VANETS

Fengzhong Qu, Zhihui Wu, Fei-Yue Wang, and Woong Cho

This paper provides background information on VANETs and classifies the security threats that challenge them. The general secure process is presented and authentication methods involved in these processes are outlined. Detailed review of privacy preserving methods and discussion of the tradeoff between security and privacy are provided afterward. Finally, an outlook on how to detect and revoke malicious nodes more efficiently and challenges that have yet been solved is provided.

A SURVEY ON PROBLEM MODELS AND SOLUTION APPROACHES TO RESCHEDULING IN RAILWAY NETWORKS

Wei Fang, Shengxiang Yang, and Xin Yao

A comprehensive survey on different problem models for rescheduling in railway networks is presented by a clear classification. Frequently used models are described by reviewing

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their variables and constraints. The solution approaches in the literature are also analyzed with their main ideas and objectives. Eventually, the problem models used in various problem types and the solution approaches used in different problem models are discussed, followed by the conclusions and suggestions.

Driver Behavior Analysis for Safe Driving: A Survey

Sinan Kaplan, Mehmet Amac Guvensan, Ali Gokhan Yavuz, and Yasin Karalurt

This paper discusses and provides comprehensive insight into the well-established techniques for driver inattention monitoring and introduces the use of most recent and futuristic solutions exploiting mobile technologies. An approach called "dissemination of driver behavior via C2C communication" is then introduced. The most remarkable studies of the last five years were examined thoroughly to reveal the recent driver monitoring techniques and demonstrate the basic pros and cons. A comprehensive compilation, including used features, classification methods, accuracy rates, system parameters, and environmental details, is also represented.

A Dynamic and Self-Adaptive Network Selection Method for Multimode Communications in Heterogeneous Vehicular Telematics

Daxin Tian, Jianshan Zhou, Yunpeng Wang, Yingrong Lu, Haiying Xia, and Zheguo Yi

An innovative network selection solution is presented for the fundamental technological requirement of multimode communications in heterogeneous vehicular telematics. A dynamic and self-adaptive method inspired by the cellular gene network is proposed for network selection, which enables terminals to dynamically select an appropriate access network according to the variety of quality of service requirements and to the dynamic conditions of various available networks. Experimental results prove the effectiveness of the bioinspired scheme and confirm its better performance.

A Large-Scale SUMO-Based Emulation Platform

Wynita M. Griggs, Rodrigo H. Ordóñez-Hurtado, Emanuele Crisostomi, Florian Häusler, Kay Massow, and Robert N. Shorten

A hardware-in-the-loop simulation platform for emulating large-scale intelligent transportation systems is presented. The platform embeds a real vehicle into SUMO, a microscopic road traffic simulation package. Emulations, consisting of the real vehicle, and potentially thousands of simulated vehicles, are run in real time. The platform provides an opportunity for real drivers to gain a feel of being in a large-scale connected vehicle scenario. Various applications of the platform are presented.

A Road Congestion Detection System Using Undedicated Mobile Phones

Mingqi Lv, Ling Chen, Xiaojie Wu, and Gencai Chen

An alternative solution to detect road congestion is proposed by exploiting the sensing ability of mobile phones. The system only depends on the accelerometer and cellular signal of undedicated mobile phones, which consists of three interactive modules: (a) an accelerometer-based vehicular movement detection module for detecting the vehicular movement periods; (b) a map-matching module for determining the traveled road segments; and (c) a road congestion estimation module for inferring the congestion degree of the traveled road segments.

Detection of Dangerous Cornering in GNSS-Data-Driven Insurance Telematics

Johan Wahlström, Isaac Skog, and Peter Händel

A framework for detecting dangerous vehicle-cornering events based on statistics considering the no-sliding and no-rollover conditions is proposed. The input variables are estimated using an unscented Kalman filter applied to global navigation satellite system measurements of position, speed, and bearing. A general framework for performance evaluation and estimator calibration is presented as depending on a generic loss function, aiming to either minimize the number of missed detections and false alarms or to estimate the risk level in each cornering event. The framework is particularly well suited for smartphone-based insurance telematics applications, for avoiding logistic and monetary costs.

Should the Desired Heading in Path Following of Autonomous Vehicles Be the Tangent Direction of the Desired Path?

Chuan Hu, Rongrong Wang, Fengjun Yan, and Nan Chen

The path-following problem for autonomous vehicles is investigated. An amendment to the definition of the desired heading, which realizes a more accurate path-following maneuver, is further provided. Backstepping is used to generate the required yaw rate in the controller design phase and an LQR controller is adopted to obtain the optimal active front steering input. The reasonability of the amendment to the desired heading is then verified in CarSim—Simulink.

Positive Train Control With Dynamic Headway Based on an Active Communication System

Yanbo Zhao and Petros Ioannou

This paper proposes a dynamic headway system for positive train control based on active communications, which is integrated with a dynamic dispatching model to improve track capacity and safety in railway operations. A simulation model of a rail network in southern California is applied to demonstrate the effectiveness of the proposed approach. Simulation results show reductions in train delays of at least 55% and reductions in travel time of at least 35%.

GPS Error Correction With Pseudorange Evaluation Using Three-Dimensional Maps

Shunsuke Miura, Li-Ta Hsu, Feiyu Chen, and Shunsuke Kamijo

An approach to estimate a pedestrian position by the aid of a 3-D map and a ray-tracing method is described. It first distributes the numbers of position candidates around a reference position. The weighting of the position candidates is

then evaluated based on the similarity between the simulated pseudorange and the observed pseudorange. Simulated pseudoranges are further calculated using a ray-tracing simulation and a 3-D map. The proposed method was verified through field experiments in an urban canyon in Tokyo that runs successfully to estimate the reflection and direct paths, whereas the result of a commercial GPS receiver is far from the ground truth.

Detection of U.S. Traffic Signs

Andreas Møgelmose, Dongran Liu, and Mohan Manubhai Trivedi

This paper presents a comprehensive research study of the detection of U.S. traffic signs. The recent advances in traffic sign detection are reviewed and the differences in signs across the world are discussed. A comprehensive extension to the publicly available LISA-TS traffic sign data set is then presented with quality high-definition footage. Finally, the authors apply the integral channel features and aggregate channel features detection methods to U.S. traffic signs and analyze how they perform on distinctive signs.

Comparison of Mixed-Integer Linear Models for Fuel-Optimal Air Conflict Resolution With Recovery

Jérémy Omer

An experimental comparison of three families of mixed integer linear models for air conflict resolution is conducted. In every model, separation is maintained through changes of heading and velocity while minimizing a combination of fuel consumption and delay. For realistic trajectories, the speed is continuous with respect to time, the acceleration and turning rate are bounded, and the planned trajectories are recovered after the maneuvers. In the results, the simplest model proves to be an excellent compromise. Afterward, a comparison of three mixed integer linear programs is made.

Machine Learning and Mass Estimation Methods for Ground-Based Aircraft Climb Prediction

Richard Alligier, David Gianazza, and Nicolas Durand

This study applies machine learning methods to improve ground-based predictions of aircraft climbs. A new approach considering the response variable of a prediction model that is learned from a set of example trajectories is introduced. Considering nine different aircraft types, the approach is proved far more accurate than two mass estimation methods based solely on a physical model.

Performance Evaluation of IEEE 802.15.4 Nonbeacon-Enabled Mode for Internet of Vehicles

Chang-Heng Wang, Chun-Ting Chou, Phone Lin, and Mohsen Guizani

Analytical models for IEEE 802.15.4 nonbeacon-enabled mode for the Internet of Vehicle (IoV) network is proposed considering two major features—non-saturated traffic pattern and large-scale network—in IoV applications. The performance of IEEE 802.15.4 nonbeacon-enabled mode for IoV is further investigated, which provides guidelines for vehicles to dynamically adjust the broadcasting rate and achieve a higher probability of success.

Automatic Detection and Classification of Road Lane Markings Using Onboard Vehicular Cameras

Maurício Braga De Paula and Cláudio Rosito Jung

A new approach for road lane classification using an onboard camera is proposed. Lane boundaries are detected using a linear-parabolic lane model by employing an automatic on-the-fly camera calibration procedure. An adaptive smoothing scheme is then applied to reduce noise and keep close edges separated. Pairs of local maxima–minima of the gradient are used as cues to identify lane markings while a Bayesian classifier is applied to classify the lane markings. Experimental results indicate an overall accuracy of over 96% with different devices and resolutions.

Learning Discriminative Pattern for Real-Time Car Brand Recognition

Chuanping Hu, Xiang Bai, Li Qi, Xinggang Wang, Gengjian Xue, and Lin Mei

A novel method called "spatially coherent discriminative pattern learning" is proposed for recognizing car brands in surveillance videos. Multiple instance learning is applied to discover the most discriminative patterns in car images, which can also be used to effectively distinguish cars of different brands with high accuracy and efficiency. A large and challenging car image dataset, consisting of 37 195 real-world car images from 30 brands, is released here.

Recognition of Car Makes and Models From a Single Traffic-Camera Image

Hongsheng He, Zhenzhou Shao, and Jindong Tan

A recognition framework of car makes and models from a single image captured by a traffic camera is proposed. The framework consists of car detection using a part-based detector, feature extraction, and rectification based on positions of license plates and headlamps, and model recognition using an ensemble of neural network classifiers. An experiment is conducted on practical images to prove the effectiveness of the proposed method in vehicle detection and model recognition.

Slip and Slide Detection and Adaptive Information Sharing Algorithms for High-Speed Train Navigation Systems

Kwanghoon Kim, Seung-Hyun Kong, and Sang-Yun Jeon

A two-stage federated Kalman filter (TS-FKF) for navigation systems in high-speed trains using multi-sensors with a feedback scheme is proposed. A detection algorithm and an adaptive information sharing algorithm are employed in the system to detect the slip and slide errors in the tachometer

measurements and to deal with large tachometer error and performance difference between sensors. Theoretical analysis and simulation results are provided to demonstrate the performance of the proposed navigation system.

Adaptive Estimation of Energy Factors in an Intelligent Convoy of Vehicles

Pardis Khayyer and Ümit Özgüner

An adaptive model-based energy factor estimation in large-scale convoys is introduced. The factors are influenced by vehicle parameters and driving condition uncertainties, while these uncertainties may shift the predicted energy consumption and result in low control performance. Mathematical formulation of the proposed estimator in the context of large-scale system is studied with detailed demonstration to their effectiveness.

A Novel Approach for Active Adhesion Control of High-Speed Trains Under Antiskid Constraints

Wen-Chuan Cai, Dan-Yong Li, and Yong-Duan Song

This paper first introduces the conditions of antiskid operation and formulates it as a constrained tracking control problem. Second, two model-based antiskid slip velocity control laws are developed. An adaptive antiskid adhesion control scheme is further established on a Barrier Lyapunov function, via applying two adaptive force observers to estimate the unknown and varying adhesion force and resistance. The effectiveness of the proposed control scheme is then authenticated theoretically with confirmation by numerical simulation.

On Achieving Seamless IP Communications in Heterogeneous Vehicular Networks

Sandra Céspedes and Xuemin Shen

The seamless provision of mobile Internet access and general IP services over heterogeneous vehicular network are investigated for loosely coupling architectures. A hybrid global mobility scheme that allows for the ongoing IP sessions to be transferred across dissimilar radio access networks that may belong to different administrative domains is proposed. The scheme combines host- and network-based mobility to achieve global mobility. Analytical evaluations and simulations of realistic urban vehicular scenarios show that the hybrid scheme achieves seamless IP communications for mobile Internet access over the heterogeneous vehicular network.

Modeling and Performance Analysis of Medium Access Control Schemes for Drive-Thru Internet Access Provisioning Systems

Ribal F. Atallah, Maurice J. Khabbaz, and Chadi M. Assi

Two complexity minimal MAC schemes are proposed for Drive-Thru Internet access provisioning systems: the random vehicle selection (RVS) scheme and the least residual residence time (LRT) scheme. A mathematical framework is established with the objective of modelling a vehicle's onboard unit's buffer and to evaluate its performance under RVS and LRT in terms of several quality-of-service metrics. Extensive simulations are conducted for the purpose of verifying the models' validity and accuracy.

Optimize the Settings of Variable Speed Limit System to Improve the Performance of Freeway Traffic

Huiyuan Liu, Lihui Zhang, Daniel Sun, and Dianhai Wang

The paper investigates variable speed limit (VSL) systems to optimize the system designs when the variable message signs are movable. A genetic algorithm is proposed to solve the optimization problem, which is formulated as a large mixed-integer nonlinear programming problem with two objectives. Numerical examples performed on a real freeway segment show that VSL can effectively achieve smooth flow and reduce the environmental impact of freeway traffic.

Automated Detection of Urban Road Manhole Covers Using Mobile Laser Scanning Data

Yongtao Yu, Haiyan Guan, and Zheng Ji

An algorithm integrated with deep learning techniques and random forests for rapidly detecting urban road manhole covers is proposed by using mobile laser scanning data. The algorithm has been successfully applied to detect urban road manhole covers from 3-D point clouds acquired by RIEGL VMX-450 system. The detection results can assist in the warning of potential road distresses and safety hazards.

A Method to Calibrate Vehicle-Mounted Cameras Under Urban Traffic Scenes

Yaonan Wang, Xiao Lu, Zhigang Ling, Yimin Yang, Zhenjun Zhang, and Kena Wang

A vehicle-mounted camera calibration method that uses line segments in urban traffic scenes is proposed considering the weaknesses of traditional calibration methods when driving on road. Both "Manhattan world" scenes and the more general "quasi-Manhattan world" scenes are considered, and calibration methods for these two types of scenes are proposed. Experiments on both one image and multiple images show the accuracy and practicability of our method.

Characterization of Wireless Channel Impact on Wireless Sensor Network Performance in Public Transportation Buses

Leire Azpilicueta, Peio López Iturri, Erik Aguirre, José Javier Astrain, Jesús Villadangos, Cristobal Zubiri, and Francisco Falcone

The impact of topology and morphology of different types of urban buses is analyzed with the aid of a 3-D ray launching code that was developed in-house and is compared with onboard measurements of a deployed wireless sensor network (WSN). The statistical analysis of simulation results considering both large- and small- scale fading are performed and a WSN has been programmed and deployed within the buses to analyze topological impact with overall system performance. The use of deterministic techniques destined to consider the inherent complexity of the buses can aid in wireless system planning

to minimize power consumption and increase overall system capacity.

A Mobile Sensing Approach to Stress Detection and Memory Activation for Public Bus Drivers

João G. P. Rodrigues, Mariana Kaiseler, Ana Aguiar, João P. Silva Cunha, and João Barros

A mobile approach to detect georeferenced stress responses and facilitate memory recall of the stressful situations for public bus drivers is proposed. Data were collected among public bus drivers in the city of Porto, Portugal, and results supported the validation of our approach and also allowed the authors to determine specific stressor categories within certain areas of the city. The system can be a promising tool to support occupational health interventions for public bus drivers and guide authorities' interventions to improve these aspects in "future" cities.

Robust Observer Design of Tire Forces in Heavy-Duty Vehicles

Hocine Imine, Omar Khemoudj, Mohamed Djemaï, and Krishna Busawon

A robust observer design methodology to estimate tyre-forces in heavy duty vehicles is presented. It uses low-cost sensors and observer-based numerical differentiators. Sliding mode differentiators are used to optimize the sensors' configuration. Validation of the proposed estimation methodology is made by comparing the results with that generated using the PROSPER software simulator. The finite-time convergence with small estimation error suggests that the proposed methodology is valid and can be applied in real time.

A Closed-Loop Speed Advisory Model With Driver's Behavior Adaptability for Eco-Driving

Xuehai Xiang, Kun Zhou, Wei-Bin Zhang, Wenhu Qin, and Qingzhou Mao

A speed advisory model that is able to adapt to the driver's behavior for eco-driving is developed. First, a closed-loop speed advisory framework is proposed. Second, the continuous acceleration with explicit high velocity boundary (CAEHV) model is established. Third, the CAEHV with coasting (CAEHV-C) model is established, in which the vehicle coasting is applied to supplement cruising to avoid oscillations. Simulation results show that the fuel economy performance of the CAEHV-C model can be improved by 4%.

An Unsupervised Approach for Inferring Driver Behavior From Naturalistic Driving Data

Asher Bender, Gabriel Agamennoni, James R. Ward, Stewart Worrall, and Eduardo M. Nebot

A two-step unsupervised method for converting naturalistic driving data into high-level behaviors is proposed. Inertial data are automatically decomposed into linear segments in the first step. Then the segments are assigned to high-level driving behaviors in the second step. The effectiveness of the proposed algorithms is demonstrated in an offline application where the objective is to summarize inertial data into driving behaviors. It is also demonstrated in an online application where the aim is to infer the current driving behavior using only inertial data.

Efficient Real-Time Train Scheduling for Urban Rail Transit Systems Using Iterative Convex Programming

Yihuiwang, Bin Ning, Tao Tang, Ton J. J. Van Den Boom, and Bart De Schutter

This paper considers both the real-time train scheduling problem for urban rail transit systems aiming to minimize the total travel time of passengers and the energy consumption of the operation of trains. A new iterative convex programming approach is proposed to solve the real-time train scheduling problem with consideration of passenger demand for urban rail transit systems. It also formulates the real-time train scheduling problem with stop-skipping and shows how to solve it using a mixed-integer nonlinear programming approach and a mixed-integer linear programming approach.

On Stochastic Analysis of Greedy Routing in Vehicular Networks

Lina Zhu, Changle Li, Yong Wang, Zhe Luo, Zhe Liu, Bingbing Li, and Xinbing Wang

An analytical model is proposed to theoretically study the greedy routing under three typical vehicle scenarios, i.e., the single-lane road, multi-lane road and multi-level road. The relationship of the routing increments and the routing length described as the h-hop coverage and hop count can be explained with this model. The correctness of the model is demonstrated by both theoretical derivation and simulations.

A Secure, Intelligent Electric Vehicle Ecosystem for Safe Integration With the Smart Grid

Aldar C.-F. Chan and Jianying Zhou

Security has been identified as an area falling short of the desired expectation in the smart grid, while a concrete demand-side management system that is compatible with state-of-the-art electric vehicles (EVs) is also lacking. This paper fills the gap by proposing a scalable defense-in-depth cybersecurity architecture for the charging infrastructure and a demand response scheme for smart EV charging. The feasibility of the system is demonstrated by implementation and testing on a real vehicle.

Precise Localization of an Autonomous Car Based on Probabilistic Noise Models of Road Surface Marker Features Using Multiple Cameras

Kichun Jo, Yongwoo Jo, Jae Kyu Suhr, Ho Gi Jung, and Myoungho Sunwoo

A Monte Carlo localization algorithm for an autonomous car based on an integration of multiple sensors data is presented. The sensor system is composed of on-board motion sensors, a low-cost GPS receiver, a precise digital map, and multiple cameras. Data from the on-board motion sensors is used to

predict the vehicle motion, and the GPS receiver is applied to establish the validation boundary of the ego-vehicle position. The digital map contains location information at the centimeter level about road surface markers (RSMs). The multiple images from the front and rear mono-cameras and the around-view monitoring system are used to detect the RSM features. The localization algorithm updates the measurements by matching the RSM features from the cameras to the digital map while the exact probabilistic modeling of sensor noise is a key factor to enhance its performance.

Time-Aware Multivariate Nearest Neighbor Regression Methods for Traffic Flow Prediction

Pietro Dell'acqua, Francesco Bellotti, Riccardo Berta, and Alessandro De Gloria

The application of nearest neighbor regression methods to traffic flow prediction are presented, which is further analyzed and optimized in two ways, i.e., by adopting a multivariate approach and by adding awareness of the time of the day. The combination of these two refinements lead to the definition of a new class of methods called time-aware multivariate nearest neighbor regression algorithms. The effectiveness of such algorithms are proven by comparing with state-of-the-art parametric and non-parametric methods.

Assistive Situation Awareness System for Mobile Multimachine Work Environments

Mika Hyvönen, Miika Rajala, Ari Virtanen, Jari Jankkari, Kalevi Huhtala, and Risto Ritala

A situation awareness system aimed as a driver/operator assistive system to enhance the safety and efficiency of multimachine work environments is proposed. The system consists of the pose estimation of the machines, the M2M communication based on the IEEE 802.11p standard, the future pose prediction of the machines, and a graphical user interface. This paper presents the implementation of the system as a proof of concept, which focuses on how the overall system works in a real harbor environment during operation, aiming for the collision avoidance of harbor machines.

A Novel On-Road Vehicle Detection Method Using πHOG

Jisu Kim, Jeonghyun Baek, and Euntai Kim

An on-road vehicle detection method is presented in four steps. First, a new feature named the position and intensity-included histogram of oriented gradients (πHOGs) is designed. Second, a new search space reduction (SSR) method is proposed to speed up the detection and reduce the computational load while decreasing the false-positive rate. A variety of classifiers including support vector machine (SVM), extreme learning machine (ELM), and k-nearest neighbor (kNN) are used to train and classify vehicles using πHOG. Finally, the validity of the proposed method is demonstrated by its application to Caltech, IR, Pittsburgh, and Kitti datasets. Experimental results demonstrate that the proposed vehicle detection method not only improves detection performance, but also reduces computation time.

Trend Modeling for Traffic Time Series Analysis: An Integrated Study

Li Li, Xiaonan Su, Yi Zhang, Yuetong Lin, and Zhiheng Li

This paper discusses the trend modeling for traffic time series. First, two types of definitions for a long-term trend that appeared in previous studies are recounted and compared. Second, the benefits of trend modeling in traffic time series is analyzed considering four major problems: abnormal data detection, data compression, missing data imputation, and traffic prediction. Third, the benefit of detrending plus multi-sensor information for traffic prediction is further explained. Findings indicate that the trend modeling is not only a technique to specify the temporal pattern but is also related to the spatial relation of traffic time series.

A Two-Way Arterial Signal Coordination Method With Queueing Process Considered

Bao-Lin Ye, Weimin Wu, and Weijie Mao

A coordination methodology for arterial traffic signal control based on a novel two-way bandwidth maximization model is proposed. The method considers the queueing process in which the queue-clearing time is calculated based on the explicitly estimated queue length of each approach of the coordinated arterial road before the green light starts at each cycle. The effectiveness and efficiency of the proposed method are validated via simulations on VISSIM. Experimental results illustrate the efficiency of the proposed method on reducing the average delay, the average queue length, and the average number of stops per vehicle on arterial roads.

Moving Object Classification Using a Combination of Static Appearance Features and Spatial and Temporal Entropy Values of Optical Flows

Chung-Wei Liang and Chia-Feng Juang

A new approach to classify four types of moving objects including pedestrians, cars, motorcycles, and bicycles based on their side views from a fixed camera is proposed. A moving object is segmented and tracked using background subtraction, silhouette projection, an area ratio, a Kalman filter, and appearance- correlation operations. For the classification of a segmented object, a combination of static and spatiotemporal features based on the co-occurrence of its appearance and the movements of its local parts is proposed. Experimental results from 12 test video sequences and comparisons with several feature descriptors show the effect and advantage of the proposed system.

Distributed Optimization for Shared State Systems: Applications to Decentralized Freeway Control via Subnetwork Splitting

Jack Reilly and Alexandre M. Bayen

A method based on the asynchronous alternating directions method of multiplier algorithm is presented. It extends distributed optimization techniques to subsystems with shared control and state variables, while maintains similar communication

structure. The method is used as basis for splitting network flow control problems into multi-subnetwork control problems with shared boundary conditions. The decentralized and parallel nature of the method permits high scalability with respect to the size of the network.

Automatic Rotor Speed Reference Generator for Electric Vehicles Under Slip Constraints

Marino Riccardo, Pasquale Laura, Scalzi Stefano, and Verrelli Cristiano Maria

A new speed reference generator for electric vehicles with fixed transmission gear ratio powered by centralized electric motors is presented. A sequence of speed reference values is then provided on the basis of a contraction mapping algorithm and without requiring any a priori knowledge of the external conditions. CarSim simulations illustrate the effectiveness of the proposed approach in the presence of uncertain parameters and complex vehicle dynamics.

An Embedded Vision System for Real-Time Autonomous Localization Using Laser Profilometry

Cosimo Patruno, Roberto Marani, Massimiliano Nitti, Tiziana D'Orazio, and Ettore Stella

An embedded vision system consisting of a high-speed camera and a laser source is designed to localize a vehicle into a known indoor environment. A low-cost and low-resource computer using the principles of laser triangulation and the comparison of consecutive frames is employed to determine the pose and the relative displacement of the vehicle. Finally, static and dynamic experiments are conducted to prove the effectiveness and the accuracy of the proposed embedded system.

Fuel-Optimal Cruising Strategy for Road Vehicles With Step-Gear Mechanical Transmission

Shaobing Xu, Shengbo Eben Li, Xiaowu Zhang, Bo Cheng, and Huei Peng

The principles and mechanism of a fuel-optimal strategy in cruising scenarios, i.e., the pulse and glide (PnG) operation, for road vehicles equipped with a step-gear transmission, are studied. In the PnG strategy, the control of the engine and the transmission determines the fuel-saving performance, which is obtained by solving an optimal control problem. The detailed control principles of engine and transmission are then optimized and the underlying mechanism is further explained graphically. Finally, a near-optimal control strategy is proposed for real-time implementation.

PROUD—Public Road Urban Driverless-Car Test

Alberto Broggi, Pietro Cerri, Stefano Debattisti, Maria Chiara Laghi, Paolo Medici, Daniele Molinari, Matteo Panciroli, and Antonio Prioletti

An autonomous driving test held in Parma, Italy, on urban roads and freeways open to regular traffic is presented. Vehicles not only performed simple maneuvers but also handled complex driving scenarios during the test. The test demonstrates the ability of the current technology to manage real situations and not only the well-structured and predictable ones. A comparison of milestones, challenges, and key results in autonomous driving is also presented.

A New Strategy for Dynamic Weighing in Motion of Railway Vehicles

Benedetto Allotta, Pierluca D'Adamio, Lorenzo Marini, Enrico Meli, Luca Pugi, and Andrea Rindi

This paper presents an innovative algorithm for the dynamical weighing in motion of railway vehicles aimed at estimating axle and wheel loads of a generic train composition by means of track measurements. It allows the axle loads estimation at high vehicle speeds and can be customized for several input track measurements. The algorithm is used to estimate the center-of-gravity position of the railway vehicle to avoid dangerous imbalances, which is able to be employed in different kinds of measurement stations.

Educational Frameworks for Vehicle Mechatronics

Tamás Bécsi, Szilárd Aradi, and Péter Gáspár

Two educational frameworks designed for students with a specialization in vehicle mechatronics are presented. Both are aimed at the emulation of real vehicle behaviors: the first is on the electric control unit level, whereas the second is on the vehicle level.

Embedded Multi-Sensor System for Safe Point-to-Point Navigation of Impaired Users

Adriano Mancini, Emanuele Frontoni, and Primo Zingaretti

A framework for a safe point-to- point navigation, owing to highly detailed road graphs including sidewalks, crosswalks, and generic obstacles, is designed. The framework is based on a low-cost modular sensor box interfaced with a mobile app acting as an intelligent navigator. It is able to sense the surrounding area while being able to perform a fast path replanning, owing to a real-time link to a remote server. The framework is tested by analyzing its performance in two different configurations and environments by using a sonar- and laser-range finder in a building scenario and radar in an urban environment, respectively.

Visual Localization based on Back Lane Markings Registry

Rafael P. D. Vivacqua, Massimo Bertozzi, Pietro Cerri, Felipe N. Martins, and Raquel F. Vassallo

The approach presented exploits a registry of the back lane markings detected corresponding to the last 240 m driven to search in the map the most similar section to estimate the vehicle position, with an additional filtering used to obtain a more robust estimation for the localization. It uses a low cost architecture of sensors that enables the algorithm be light

enough to run on a low-power embedded architecture. Using computer vision to detect the lane markings and their position relative to the vehicle, and a dead reckoning to build the driven path, the system provides high enough accuracy to satisfy autonomous drive requirements.

MERTON'S LAWS AND MERTIONIAN SYSTEMS FOR ITS

Recently a group of physicists at Cornell University have demonstrated the control of quantum tunneling in an ultracold lattice gas by the measurement backaction imposed by an imaging process, a clear manifestation of the Quantum Zeno effect [1], [2]. By smoothly varying the rate at which atoms are imaged, they observed the continuous crossover from the "weak measurement regime" (in which position measurements have little influence on tunneling dynamics of the atomic ensemble) to the "strong measurement regime" (in which measurement-induced localization causes a dramatic suppression of tunneling). This investigation leads to an experimental demonstration of the paradigmatic Heisenberg microscope in a lattice gas and sheds light on the implication of quantum measurement on the coherent evolution of a mesoscopic quantum system. Their technique reveals a powerful tool for the control of an interacting many-body quantum system via spatially resolved measurement backaction.

Does this have anything to do with transportation research and application? Yes, very much to me. Why? If measurement-induced backaction can control interacting many-body quantum systems, then message-induced influence would be an effective tool for control of interacting many-agent traffic systems. In other words, Merton's laws can be powerful for transportation management and also for social transportation, an emerging field of research and development for intelligent transportation systems, which must be investigated and utilized along this direction.

As described in [1], in quantum mechanics, a measurement can be regarded as a dynamically tunable interaction between a quantum system and a "bath" whose intrinsic, spatial, and dynamical properties can be precisely engineered. As such, measurements can be used to guide or coax a quantum system into novel collective phases and nonequilibrium states that might otherwise be inaccessible through more conventional means of cooling or state preparation. While most of measurement-induced control schemes have hitherto been demonstrated in the context of single or weakly interacting quantum entities, the extension of these concepts to the arena of strongly interacting and correlated a tantalizing prospects.

If we replace terms "measurement" by "analysis," "quantum" by "Mertonian," and "bath" by "artificial system" in above description, the whole paragraph is equally valid for the control and management of complex social systems, such as transportation systems, called Mertonian systems, or simply Merton systems by ACP-based parallel mechanism [3]. In physics, a fundamental distinction between a classical (Newtonian) and a quantum system is its response to a measurement. While the act of measurement has no or negligible effect on the evolution of a classical system, it has a significant impact on the dynamics of a quantum system; thus, the call for Heisenberg's Principle of Uncertainty. The difference between a Newton and a Merton system is similar: a Newton system can be measured or analyzed to arbitrary precision with negligible concomitant backaction, the act of measurement or analysis has profound consequences on the subsequent evolution of a Merton system. For example, weather prediction has no influence on future weather, but traffic or stock prediction might has a significant impact on future traffic or the stock market. Similarly, the parallel interaction between a quantum system and its "bath" can be applied for parallel control and management of Merton systems, particularly, complex transportation systems, and we hope the concomitant Quantum Zeno effect will lead to a dramatic suppression of traffic congestion.

Therefore, we need big data, Internet of things, cloud computing, machine learning, transportation games, total traffic control, social transportation, and many other new IT methods, i.e., Intelligent Techniques, to design various Merton's laws for intelligent transportation control and management in smart societies. Yes, privacy will be a big issue here and, frankly, I do not see any perfect solution yet. However, I still recall what I had heard in my first driving course in Troy, New York: *Driving is not a right, it is a privilege*.

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