Pascal's New Wager: AI Is Not Explainable, But Governable

Dear All,

I would like to update you with the following news:

- By September 12, IEEE TIV has received 2788 original manuscripts, and our SPD (submissions per day) has reached 10.92, a new record for TIV [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12].
- IEEE TIV's tracking Impact Factor is 8.1 now, making it the 6th top journal among all IEEE publications, thanks to the effort of our authors, reviewers, and members of the TIV editorial board.
- Our rapid development is calling for a renewed effort to recruit more associate editors with diversified backgrounds and a commitment for fast and high-quality review reports, but we are facing major difficulties in the process. I am sorry to assign more works to the current AEs recently, and we will continue our effort with your help and support in finding more AEs.

In light of the continuous development of our periodical, at the second Five-Year Review by Periodicals Review and Advisory Committee (PRAC) for IEEE TIV, I have proposed to make certain modification to our publication scope under the suggestion of some PRAC members.

After extensive discussions with our editorial board, we have recommended a minimal modification, that is, the removal of the phrase "in a roadway environment". The rationale behind this change is to better encapsulate the diverse range of papers we have published. As expressed by PRAC members, papers on autonomous surface ships, underwater submarines, drones, airplanes, and railway systems. and many other intelligent vehicles that do not need roadway environments have appeared in TIV since the very beginning.

Related materials concerning scope changes from our sponsoring societies have been collected and forwarded to the IEEE TAB Proposal Development Committee and these materials will be discussed by the TAB Periodicals Committee on 15-16 November 2023.

This issue comprises 1 letter and 10 regular papers. The first letter is the report of the recent Distributed/Decentralized Hybrid Workshop on Sustainability for Transportation and Logistics and aims to enhance the sustainability of intelligent vehicle systems from the lifecycle management perspective. The second one addresses the problem of using non-interpretable Machine Learning algorithms in safety critical automated driving functions.

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After Scanning the Issue, I would like to address issues on the interpretability and governability of Artificial intelligence (AI) and its implication to IV and ITS. Since this year marks the 400th anniversary of Blaise Pascal's birth, I will use Pascal's Wager to share my thought with you: Artificial Intelligence or any General Intelligence, is intrinsically not interpretable, but hopefully, practically governable.

I. Scanning the Issue

Communication and Letters

Sustainable Lifecycle Management for Automotive Development via Multi-dimensional Circular Design Framework

Y. Zhang, J. Chen, S. Teng, H. Zhang, and F.-Y. Wang

Regular Papers

Adaptive Pure Pursuit: A Real-time Path Planner Using Tracking Controllers to Plan Safe and Kinematically Feasible Paths

B. Li, et al.

This article introduces an Adaptive Pure Pursuit (APP) path planner, which is fast and near-optimal for autonomous driving in cluttered environments. The APP planner generates feasible paths via a simulated closed-loop tracking control process of a virtual vehicle. Unlike search-based planners that suffer from the "curse of dimensionality" and optimization-based methods that often run slowly, the APP planner samples primitives flexibly, runs fast, and guarantees kinematic feasibility.

Cooperative Path Following Control of a Team of Quadrotor-Slung-Load Systems Under Disturbances

Y. Wang, et al.

A distributed path coordination framework is proposed to address the path-following control problem of a group of Quadrotor-Slung-Load Systems (QSLSs) subject to time-varying disturbances. The proposed approach employs a saturated robust controller for each quadrotor to drive the respective load along the assigned path while maintaining a fixed inter-load formation pattern. Simulation and experimental results validate the effectiveness of the proposed approach.

Specification-Compliant Driving Corridors for Motion Planning of Automated Vehicles

E. Liu and M. Althoff

Automated vehicles should explicitly comply with specifications, including traffic rules, to ensure their safe and effective participation in road traffic. We propose a novel approach addressing the problem of specification-compliant motion planning for automated vehicles. Our approach couples set-based reachability analysis with automata-based model checking and outputs specification-compliant driving corridors. These driving corridors serve as motion planning constraints and expedite the generation of trajectories complying with specifications expressed in metric temporal logic.

VistaGPT: Generative Parallel Transformers for Vehicles With Intelligent Systems for Transport Automation

X. Li, et al.

This article addresses the information barriers arising from both system-level and module-level heterogeneity and facilitate knowledge automation in end-to-end intelligent vehicular systems, this article proposes a Transformer-based unified framework named VistaGPT which is mainly composed of Modular Federations of Vehicular Transformers (M-FoV) and the procedures for Automated composing of Autonomous driving systems (AutoAuto). M-FoV collects and organizes Transformerbased models in a modular fashion to facilitate system integration by providing diversity and versatility. AutoAuto utilizes large language models (LLMs) to automatically compose end-to-end autonomous driving systems with "Dividing and Recombining" strategy

NMPC-Based Integrated Thermal Management of Battery and Cabin for Electric Vehicles in Cold Weather Conditions

M. R. Hajidavalloo, et al.

Extreme cold or hot environments can significantly impact the EV's range. To overcome this issue, an optimal control strategy based on nonlinear model predictive control is proposed to simultaneously optimize the EV range and cabin comfort in real time. Simulation results demonstrate the efficiency of the proposed integrated thermal management strategy (ITM) and identify operating conditions under which the proposed ITM is critically needed.

MTP-GO: Graph-Based Probabilistic Multi-Agent Trajectory Prediction With Neural ODEs

T. Westny, et al.

This article proposes a multi-agent trajectory prediction model, titled MTP-GO. The model combines temporal graph neural networks with learnable differential constraints to compute physically feasible predictions for diverse road users. Multimodal probabilistic predictions are obtained by combining mixture density networks and Kalman filtering. The novel architecture preserves interactions throughout the complete prediction process, illustrating competitive predictive capabilities across various data sets and outperforming several state-of-the-art methods.

Learning From Interaction-Enhanced Scene Graph for Pedestrian Collision Risk Assessment

C. Gou, et al.

This article proposes a novel approach that involves constructing traffic scene graphs with enhanced vehicle-pedestrian interactions, along with introducing an innovative deep model built upon Transformer and GCN for pedestrian collision risk assessment. Specifically, to facilitate spatio-temporal modeling of traffic scene graph sequence, we propose a novel unified framework that integrates Multi-Relation Graph Convolution Network and Temporal Transformer Encoder. In addition, two variants of traffic scene graph datasets termed as Interaction-Enhanced Scene Graph and None-Interaction-Enhanced Scene Graph are created for the purpose of assessing pedestrian collision risk, utilizing the CAP-DATA and JAAD respectively.

Parallel Testing for Centralized Traffic Control Systems of Intelligent Railways

W. Xu et al.

This article proposes a scenario-driven parallel testing method for the CTC system. We use divisible and combinable scenarios to describe the functionality and processes of testing. Building upon the scenario representation, a virtual-real interactive testing method is adopted, where virtual testing is employed to generate a large number of scenarios simultaneously, thereby accelerating the testing process of the CTC system while ensuring comprehensive testing coverage. Field testing is carried out to validate the reliability of the CTC system in real operational environments, particularly in critical scenarios.

Active Suspension Robust Preview Control by Considering Actuator Delay

H. Yang, et al.

A novel integrated robust MPC-based preview control (RMPC) algorithm for ASS is proposed to better enhance the road holding and ride comfort of autonomous vehicles by considering multiple uncertainties and actuator delay. Utilizing this integrated RMPC algorithm, superior state observation, ride comfort and road holding have been obtained in the simulation and bench tests under two typical road conditions.

A Novel Method for Land Vehicle Positioning: Invariant Kalman Filters and Deep-Learning-Based Radar Speed Estimation

P. R. M. d. Araujo, M. Elhabiby, S. Givigi and A. Noureldin

This article presents a novel method for land vehicle positioning using invariant Kalman filters and deep-learning-based radar

speed estimation. The method achieves accurate vehicle position, velocity, and orientation estimation with low-cost sensors in different scenarios. By eliminating accelerometers, the proposed method enhances robustness and demonstrates a 1.45% average translational error. The integration of the proposed method and invariant Kalman filters proves effective, making it a robust alternative to IMU-based positioning methods for autonomous vehicles in urban environments.

II. Pascal's New Wager

For over 40 years, I have been working on finding ways to build explainable intelligent systems with mathematical logic or rule-based reasoning and decision making. The success of deep neural networks and deep learning has inspired me to pick up my old research works on neuro-fuzzy networks 30+ years ago that insert a special knowledge structure into neural networks for generating and refining decision rules of fuzzy logic nature, in the hope of making DNNs explainable and traceable in its learning behaviors [13], [14], [15].

This year we celebrate the 400th birthday of my favorite hero, French mathematician, physicist, philosopher, and inventor, Blaise Pascal (1623 – 1662). In preparing my talk for a workshop dedicated to this event at Beijing [16], Pascal's Wager struck me like an epiphany: Artificial Intelligence is not explainable, but governable. I call my new belief as Pascal's New Wager.

Pascal's Wager is an "extraordinary confluence of several important strands of thought: the justification of theism; probability theory and decision theory, used here for almost the first time in history; pragmatism; voluntarism (the thesis that belief is a matter of the will); and the use of the concept of infinity." [17], [18], [19] Through this he contends that "a rational person should adopt a lifestyle consistent with the existence of God and actively strive to believe in God" since "if God does not exist, the individual incurs only finite losses, potentially sacrificing certain pleasures and luxuries. However, if God does indeed exist, they stand to gain immeasurably, as represented for example by an eternity in Heaven in Abrahamic tradition, while simultaneously avoiding boundless losses associated with an eternity in Hell." [20]

We should treat the issue of explainable or unexplainable AI in a similar way as Pascal dealt with the problem of believing or unbelieving in God in Pascal's Wager. A rational person or society should adopt a philosophy consistent with the unexplainable AI and actively strive to believe in AI is governable since if AI is explainable, the individual and the whole society incurs only finite losses. However, if AI is indeed not explainable, they stand to gain immeasurably, as represented for example by avoiding the technological singularity where we might become the slave of machines in Ray Kurzweils' imagination, while simultaneously enjoying boundless personal conveniences and social prosperities associated with intelligent technology.

Of course, for a particular problem, we still need to do our best for an explainable AI or any scientific solution. Actually, intelligence in general is not scientific but philosophic, and philosophy is the studies of seeking wisdom or intelligence. AlphaGo is not explainable so far, now ChatGPT is neither. Therefore, I adopt to my Pascal's New Wager.

I have realized that this should be the major reason and motivation that for so many years I have championed for Blockchain Intelligence, Smart Contracts, DAO (Decentralized Autonomous Organizations/Operations) and TAO (TrueDAO), as well as DeSci for research and development in ITS and particularly in Intelligent Vehicles [21].

III. Call for Participation: Decentralized Hybrid Workshops

At IEEE TIV we will continue to organize decentralized and hybrid workshops or symposia (DHW or DHS) on various issues in ITS and IVs.

Welcome to participate in our investigations on-line or off-line. Our discussions will be summarized and reported as perspectives, letters, or regular papers at IEEE TIV. The following DHWs have been organized so far:

1) Verification and Validation for IVs (V&V4IV)
2) Autonomous Mining (AM)
3) Ethics, Responsibility, and Sustainability (ERS)
4) Intelligent Vehicles for Education (IV4E)
5) Data Science for Intelligent Vehicles (DSiV)
6) Vehicle 5.0 (V5)
7) Scenarios Engineering for Smart Mobility (SE4SM)
8) CrowdSensing Intelligence (CSI)
9) Sustainability for Transportation and Logistics (STL)

Any suggestions or proposals for future topics of DHW/DHS are greatly appreciated. Looking forward to having you in IEEE TIV DHW/DHS.

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