

# A New Traffic Paradigm and Related Opportunities in the CAV Era

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## ABSTRACT

The ERC Advanced Grant TrafficFluid (2019-2024) launches a novel paradigm for vehicular traffic in the era of connected and automated vehicles (CAVs), which is based on two combined principles. The first principle is *lane-free* traffic, which renders the driving task for CAVs smoother and safer, as risky lane-changing manoeuvres become obsolete; it also increases the capacity of the roadway due to increased road occupancy and mitigates congestion-triggering vehicle manoeuvres. The second principle is *vehicle nudging*, whereby vehicles may "push" other vehicles in front of them; this allows for traffic flow to be freed from the anisotropy restriction, which stems from the fact that human driving is influenced only by downstream vehicles. Vehicle nudging may be implemented in various ways so as to maximize the traffic flow efficiency, subject to safety and convenience constraints.

Lane-free CAV traffic implies that incremental road widening (narrowing) leads to corresponding incremental increase (decrease) of capacity. This opens the way for consideration of real-time internal boundary control on highways and arterials, in order to flexibly share the total (both directions) road width and capacity among the two directions in dependence of the bi-directional demand and traffic conditions, so as to maximize the total (two directions) flow efficiency. The problem is formulated as a convex QP (Quadratic Programming) problem, and representative case studies shed light on and demonstrate the features, capabilities and potential of the novel control action.

## BIOGRAPHY



Markos Papageorgiou received Diplom-Ingenieur and Doktor-Ingenieur degrees in Electrical Engineering from the Technical University of Munich, Germany in 1976 and 1981, respectively. He was a Free Associate with Dorsch Consult, Munich (1982-1988), and with Institute National de Recherche sur les Transports et leur Sécurité (INRETS), Paris, France (1986-1988). From 1988 to 1994 he was a (tenured) Professor of Automation at the Technical University of Munich. Since 1994 he has been a Professor at the Technical University of Crete, Greece. He was a Visiting Professor at Politecnico di Milano, Ecole Nationale des Ponts et Chaussées, MIT, University of Rome La Sapienza and Tsinghua University; Honorary Visiting Professor at University of Belgrade; and a Visiting Scholar at the University of California at Berkeley. His research interests include automatic control and optimisation theory and applications to traffic and transportation systems, water systems and further areas. He served as Editor-in-Chief of Transportation Research – Part C (2005-2012). He is a Life Fellow of IEEE and a Fellow of IFAC. He received several distinctions and awards, including the 2020 IEEE Transportation Technologies Award and two ERC Advanced Investigator Grants.