A dynamic system optimal dedicated lane design for CAVs

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Abstract

Numerous contemporary studies have posited that connected and autonomous vehicles (CAVs) hold the potential to substantially enhance traffic safety and augment efficiency. One widely-discussed approach to optimize CAV operations within urban traffic networks involves the implementation of dedicated lanes (DLs). This study aims to assist system planners in optimally deploying DLs within heterogeneous urban traffic networks, which comprise both CAVs and Human-Driven Vehicles (HDVs). In pursuit of this objective, we have introduced a multi-class dynamic traffic assignment framework that enhances network performance and offers insights into traffic dynamics. Additionally, our methodology considers dynamic routing behaviour while devising DLs, formulating and approximating the problem as a mixed-integer linear program (MILP). The resulting strategy delineates the temporal and spatial aspects of the deployment of DLs for CAVs, specifying the quantity and locations of these lanes. Subsequently, we assessed our framework using test-bed networks of varying sizes and demand profiles, evaluating the solution's quality and the model's adaptability to diverse traffic conditions. Our findings indicate that implementing DLs for CAVs can bolster vehicular throughput across the network while neglecting dynamic capacity variation in mixed traffic may yield misleading outcomes.