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Integrated Optimization of Vehicle Microscopic Behavior and Signal Control for Mixed Traffic Based on a Distributed Strategy

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Abstract : In this paper, an integrated-decentralized bi-level optimization framework is developed to coordinate intersection signal operations and vehicle driving behavior at an isolated signalized intersection in a mixed traffic environment. The framework takes advantage of both signal control and conflict elimination by incorporating an integrated level and a decentralized level. Two distinct signal control methods are introduced: the classical green phase control strategy and the white phase control strategy. The latter allows certain vehicles to pass through the intersection during a red phase, thereby reducing idle time. Besides, various vehicle trajectory optimization strategies are tailored to different vehicle-following types, leveraging the capabilities of CAV technology. Enhanced microscopic behavior control strategies, such as car-following and lane-changing controls, are also developed for CAVs to improve their performance in mixed traffic. These strategies are integrated into the proposed framework. The effectiveness of the framework is validated through numerical experiments and sensitivity analysis, demonstrating its advantages in terms of traffic effectiveness, stability, and energy economy.

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