Platoon Coordination in Large-Scale Networks: A Game Theoretic Approach

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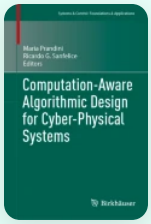

Computation-Aware Algorithmic Design for Cyber-Physical Systems

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Abstract

The emerging commercial rollout of heavy-duty vehicle platooning necessitates the development of efficient platoon coordination solutions. The commercial vehicle fleet consists of vehicles owned by different transportation companies with different objectives. To capture their strategic behavior, we study platoon coordination that aims to maximize

profits for individual vehicles. The interaction among vehicles is modeled as a non-cooperative game. In our cyber-physical system, we consider a large number of vehicles with fixed routes in a transportation network that can wait at hubs along their routes to form platoons. Each vehicle aims to maximize its utility function, which includes a reward for platooning and a cost for waiting. We propose open-loop coordination solutions when the vehicles decide on their waiting times at the beginning of their trips and do not update their decisions during their trips. It is shown that the corresponding game admits at least one Nash equilibrium. We also propose feedback solutions in which the vehicles are allowed to update their decisions along their routes. In a simulation study over the Swedish road network, we compare the proposed platoon coordination solutions and evaluate the benefits of non-cooperative platooning at a societal scale.

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