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Theoretical Interference Analysis of Inter-Vehicular Communication at Intersection with Power Control

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Abstract

Interference problems caused by congestion of vehicles at intersections or on highways may significantly degrade vehicle-to-vehicle (V2V) communications, especially for active-safety assistance systems due to the importance of emergency information. In this paper, we propose a theoretical interference model of V2V communications at an intersection that uses a transmission-power-control method. To evaluate and address the interference problem at an intersection, we derived an analytical expression of the outage probability of a *typical* vehicle at an intersection and provided guidelines for an optimal power-control method, which cannot be obtained through simulations. We modeled the location of vehicles in *queueing* and *running* segments separately and analyzed their interference on the basis of a stochastic geometry approach. In our model, a simple power-control method is used: the transmission power of each vehicle is determined by the status of the vehicle, i.e., stopped or running. By changing the transmission power of vehicles in queueing segments, we can mitigate the interference received at vehicles running closer to an intersection. By using the theoretical results, we obtain an optimal power-control method, which can balance the outage probabilities of vehicles in queueing and running segments. We validated our analytical results and the effect of the power-control method on V2V communications by numerical simulations.

Keywords: ITS; V2V communication; VANET; power control; stochastic geometry; Poisson point process; outage probability; intersection

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