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THE APPLICATION OF ADHDP(λ) METHOD TO COORDINATED MULTIPLE RAMPS METERING

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Abstract. *Ramp metering has been developed as a local traffic management strategy to alleviate congestion on freeways sections, however, the coordination of multiple ramps metering still need more attention of effective control strategies on a larger freeway section. The object of this paper is to use action-dependent heuristic dynamic programming based on eligibility traces (ADHDP(λ)) method to implement coordinated ramp metering. The traffic flow plant is a second order macroscopic traffic flow model. The whole coordinated ramp metering problem is considered as an approximate optimal control problem. A valid coordination performance index is proposed. ADHDP(λ) method is an effective and fast learning control method to solve such problems. With the help of eligibility traces, the learning rate is highly improved. Simulation studies on a hypothetical freeway are reported to show that the proposed control scheme is efficient.*

Keywords: Heuristic dynamic programming, Eligibility traces, Multiple ramps metering

1. **Introduction.** Ramp metering is implemented as a traffic signal that is placed at the on-ramp of a freeway as is represented in Figure 1. Ramp metering means metering the traffic allowed entering the freeway through the on-ramps, and it has been regarded as the most efficient means to alleviate the freeway traffic condition. Ramp metering can maintain uninterrupted, non-congested traffic flow on the freeway, and increase traffic volume in mainline due to avoidance or reduction of congestion duration. Ramp metering has been verified efficient both in theoretical and practical aspects [1]. Ramp metering problems are divided into local ramp metering and multiple ramps metering problems.

The existing various local ramp control algorithms can be generally classified into two categories: fixed time metering and traffic-responsive metering. The latter is proved to be more effective in dealing with freeway congestion problems than the former. Typical algorithms of this kind include occupancy algorithm [3], ALINEA (a linear local feedback control algorithm) [4], and LQR (linear quadratic regulation) [5]. These metering algorithms only provide linear control laws, so they may not be able to control the ramp system which is known as a nonlinear model. For example, ALINEA responses concussively to drastic traffic flow variations, causing unsafe effect on freeway.

Local ramp metering, only considering the local freeway traffic condition, could not handle multiple ramps metering problems, because of the interacting influence of traffic condition on the upstream and the downstream. Therefore, the coordinated ramp metering which is based on the system-wide traffic information has attracted many experts' interest. The multiple ramps metering problem is illustrated in Figure 2. The question for multiple ramps metering becomes how the ramp metering should be designed taking into account the interactions among the various ramps.