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Traffic Stream Space-Mean Speed Estimation from Common Double Loop Detector Aggregated Data

ABSTRACT

Wardrop [1] in one of the very first papers on traffic flow theory presented the difference between the space mean speed (SMS) and the time mean speed (TMS) of a group of traveling vehicles, and derived a relationship suitable for estimating TMS, given SMS and the speed variance over SMS. As time goes by, traffic practitioners have tended towards computing TMS instead of SMS, mainly when using double loop detectors, and nowadays this is the usual practice in traffic management centers. Therefore, the useful relationship between TMS and SMS should go the other way around in relation to Wardrop's. Recently, Rakha and Zhang [2] proved the complementary relationship, suitable for estimating SMS from TMS and the speed variance over TMS. However this is not enough, as speed variance is usually not available. The present paper develops a probabilistic method to estimate SMS from TMS without the previous knowledge of speed variance and only using the usual time aggregations of loop detector data. The main assumption of the method – the normality of vehicle speed distribution – is discussed and a formulation to obtain the expected error of the estimation is derived. The results obtained with test data from the AP-7 highway, near Barcelona in Spain, show that the developed methodology is able to estimate SMS with an average relative error as low as 0.5%.