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Delay-flow relationships in continuously distributed traffic

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The mathematical description of traffic flow is discussed, especially models of a stochastic nature. The technique of stochastic processes are then used in the analysis of various delay problems associated with crossing (or merging with) major-road traffic.

The first analysis relates to an isolated minor-road vehicle crossing a lane of traffic in which successive headways are independent and have a common distribution. Choice of a suitable headway for crossing is made on the basis of an arbitrary gap acceptance function. The distribution of delay is found from the distributions of "blocks" and "gaps", which are investigated first. An important special case is analysed and useful numerical results obtained.

Next the queueing process is examined where the traffic on the minor road forms a compound Poisson process. Four models are analysed, which cover a wide range of practical situations. The analyses rely on the solution to a problem in queueing theory which precedes the discussion on traffic.

The major-road traffic is then generalized to include the possibility of correlation between headways. It is assumed that the number of crossings during a particular headway depends only on the length of that headway and no others. Only the critical crossing rate is studied and the minor-road queue may therefore be regarded as infinite. Although a formal solution to this problem may be obtained, in all but some very simple cases numerical results cannot be extracted. An alternative approach is used to derive upper and lower bounds for the critical crossing rate, from which numerical results may be found.

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Finally, a special case of correlated major-road traffic is proposed. Correlation between successive negative exponential headways is introduced, which is small enough to preserve this (marginal) headway distribution to the first order of approximation. The resulting traffic stream is described as a "quasi-Poisson" process since it may be regarded as a Poisson process in which the headways have been rearranged to give the effect of correlation. The distribution of delay to an isolated minor-road vehicle is obtained, and it is found that for cases of practical interest the expected delay increases by at least 2% for each 0.1 of correlation, with a similar decrease if the correlation is negative.

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