# Lane-Changing in Multilane Freeway Traffic

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ABRIDGMENT

•A SERIES of analyses are presented indicating that lane-changing in multilane freeway traffic may be effectively described as a random process.

Assuming first that lane-changing may be treated as an isolated, independent event within the traffic stream, it is shown that the number of lane changes, $X_{ij}^{kt}$, between lanes i and j within a length of freeway k and a time span t may be estimated as the outcome of a simple Poisson process $\left\{ X_{ij}^{kt};\ t > 0 \right\}$, where

$$\text{Prob.} \left\{ X_{ij}^{kt} = N \right\} = \frac{\exp\left(-\lambda_{ij}^{k} t\right)\left(\lambda_{ij}^{k} t\right)^{N}}{N!}$$

and $\lambda_{ij}^{k}$ = Avg. No. lane changes between lanes i and j per unit time within section k.

Empirical data are presented to show that the value of $\lambda_{ij}^{k}$ varies systematically with both traffic speed and traffic volume, and with proximity to entrance and exit ramps. Further, the assumption of randomness is shown to break down during medum-heavy flow periods (flows equivalent to 62 to 87 veh/min/3 lanes and at points immediately downstream from freeway entrance ramps.

It is similarly shown that the pattern of lane changes with the k'th section of length L may be modeled as a finite Markov process $\{X(k);\ L > 0\}$, where

Prob. $\{X(k) = j \mid X(0), \ldots, X(k = 1); L\}$ = Prob. $\{X(k) - j \mid X(k - 1); L\}$, and

Prob. $\{X(k) = j\}$ = Prob. that a given vehicle is in lane j as it leaves section k. A simple Markovian model based on this structure is calibrated from field data collected on a 6-lane freeway in Chicago, and extended to cover the situations of lane-changing in the vicinity of freeway entrance and exit ramps and within a complex weaving section. In each case the model effectively replicates the observed maneuver pattern.

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