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Urban Logistics Dynamics: A User-Centric Approach to Traffic Modelling and Kinetic Parameter Analysis

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Abstract : Efficient city logistics requires a comprehensive understanding of traffic dynamics, particularly as it pertains to kinetic parameters influencing energy consumption and trip duration estimations. While real-time traffic information is increasingly accessible, current high-precision forecasting services embedded in route planning often function as opaque 'black boxes' for users. These services, typically relying on AI-processed counting data, fall short in accommodating open design parameters essential for management studies, notably within Supply Chain Management. This work revisits the modeling of traffic conditions in the context of city logistics, emphasizing its significance from the user's point of view, with two focuses. Firstly, the focus is not on the vehicle flow but on the vehicles themselves and the impact of the traffic conditions on their driving behaviour. This means opening the range of studied indicators beyond vehicle speed to describe extensively the kinetic and dynamic aspects of driving behaviour. To achieve this, we leverage the Art. Kinema parameters are designed to characterize driving cycles. Secondly, this study examines how the driving context (i.e., exogenous factors to the traffic flow) determines the mentioned driving behaviour. Specifically, we explore it investigates how accurately the kinetic behaviour of a vehicle can be predicted based on a limited set of exogenous factors, such as time, day, road type, orientation, slope, and weather conditions. To answer this question, statistical analysis was conducted on real-world driving data, which includes high-frequency measurements of vehicle speed. A Generalized Linear Model has been established to link kinetic parameters with independent categorical contextual variables. The results include the analysis of the regression's accuracy, as well as the utilization of the regression's results in freight distribution scenario elaboration and analysis for Supply Chain Management purposes.

Keywords : driving context, generalized linear model, kinetic behaviour, real world driving data
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