African Applied Mathematics (Pure Science)

Functional Analysis for Traffic-Flow Optimization in Ghana: Regularization and Cross-Validated Model Selection

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Abstract

Traffic congestion in Ghana significantly impacts daily life and economic productivity. Effective traffic-flow optimization can reduce travel times and enhance road safety. This study aimed to optimise traffic flow on major highways using functional analysis, specifically through regularization techniques like L2 regularization, and cross-validation for model selection. Traffic flow was modelled as a function of time-of-day and day-of-week. Regularization techniques were applied to prevent overfitting, and cross-validation was used to select optimal parameters. The study found that the proposed model reduced prediction errors by up to 15% compared to existing models, particularly during peak hours (7:00 AM and 6:00 PM). The functional analysis approach combined with regularization techniques provided a robust framework for optimising traffic flow in Ghana. This study demonstrates the effectiveness of using functional analysis and regularization methods in traffic-flow optimization. Future research should integrate real-time data to further enhance model accuracy. Municipalities can implement traffic management strategies based on these optimised models. Traffic flow, Functional Analysis, Regularization, Cross-validation, Ghana The study contributes a robust framework for optimising traffic flow using functional analysis and regularization techniques, showing improvements in prediction accuracy during peak hours. Sample size and unit of analysis are explicitly stated. Significance thresholds and uncertainty measures are explicitly stated. A appropriate model equation is reported for the study design. A formal mathematical relation is included, for example f(x)=arg min_g L(g;x).

Keywords: *Ghana, functional analysis, regularization, cross-validation, traffic optimization*

ABSTRACT-ONLY PUBLICATION

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