African Applied Mathematics (Pure Science)

# Stochastic Models for Traffic Flow Optimization in Egyptian Networks: Stability Analysis and Convergence Proofs

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## Abstract

Stochastic models are increasingly used in traffic flow optimization to predict and manage congestion in urban networks. A comprehensive overview of existing stochastic models is provided, highlighting their application in Egypt's transportation systems. The review will also discuss methodologies used for stability and convergence analyses. Recent studies have shown that the stochastic models can predict traffic flow with a precision of up to 95% accuracy under varying conditions. The reviewed models demonstrate robust performance, showing stable behaviour across different scenarios. However, further research is needed to validate these models in real-world Egyptian networks. Future work should focus on validating the models with field data and exploring their scalability for larger urban areas. Stochastic Models, Traffic Flow Optimization, Stability Analysis, Convergence Proofs, Egyptian Networks Model selection is formalised as $\hat{\{}\theta\}=argmin_{\theta in\theta}¿L(\theta)+\lambda¿\omega(\theta)¿$ with consistency under mild identifiability assumptions.

**Keywords:** *Egypt, Stochastic Processes, Markov Chains, Queuing Theory, Simulation Modelling, Stability Analysis, Convergence Proofs*

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