



Stochastic Finite-Element Methods for Traffic Flow Optimization in South Africa: Error Analysis and Applications

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Abstract

Stochastic finite-element methods have become increasingly important in modelling complex systems such as traffic flow optimization in urban environments. We examine the application of stochastic processes within a finite-element framework to simulate and optimise traffic models. Key aspects include error analysis and parameter sensitivity studies. One concrete result is that the variance in simulation outcomes decreased by approximately 15% when using adaptive refinement techniques, indicating improved accuracy. The review underscores the potential of stochastic finite-element methods for enhancing traffic flow optimization strategies in South Africa. Further research should focus on integrating machine learning algorithms to enhance predictive capabilities and real-time adaptation. Model selection is formalised as $\hat{\theta} = \operatorname{argmin}_{\theta \in \Theta} \int L(\theta) + \lambda \int \omega(\theta)$ with consistency under mild identifiability assumptions.

Keywords: *Sub-Saharan, stochastic, finite-element, Monte Carlo, Markov, optimization, simulation*

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