



Monte Carlo Estimation Variance Reduction in Dynamical Systems for Traffic Flow Optimization in Senegal

Madiba Diop¹, Alioune Sall^{2,3}, Tayeb Gueye¹, Ibrahima Ndiaye⁴

¹ Université Alioune Diop de Bambey (UADB)

² Council for the Development of Social Science Research in Africa (CODESRIA), Dakar

³ Université Gaston Berger (UGB), Saint-Louis

⁴ Department of Interdisciplinary Studies, Université Gaston Berger (UGB), Saint-Louis

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Correspondence: mdiop@gmail.com

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Author notes

Madiba Diop is affiliated with Université Alioune Diop de Bambey (UADB) and focuses on Mathematics research in Africa.

Alioune Sall is affiliated with Council for the Development of Social Science Research in Africa (CODESRIA), Dakar and focuses on Mathematics research in Africa.

Tayeb Gueye is affiliated with Université Alioune Diop de Bambey (UADB) and focuses on Mathematics research in Africa.

Ibrahima Ndiaye is affiliated with Department of Interdisciplinary Studies, Université Gaston Berger (UGB), Saint-Louis and focuses on Mathematics research in Africa.

Abstract

Recent advancements in dynamical systems theory have been applied to improve traffic flow optimization in urban settings, with Senegal as a case study. This review synthesizes existing literature on Monte Carlo methods applied to dynamical systems, focusing specifically on variance reduction strategies tailored for urban traffic management. A key finding is that incorporating importance sampling into traditional Monte Carlo simulations significantly reduced estimation variance by 20% in simulated Senegalese road networks. The reviewed techniques have the potential to enhance real-world traffic flow optimization models, particularly when applied with adaptive importance sampling methods. Further research should explore the integration of machine learning algorithms into Monte Carlo simulations for even more effective variance reduction in urban traffic systems. Monte Carlo Estimation, Variance Reduction, Dynamical Systems, Traffic Flow Optimization, Senegal Model selection is formalised as $\hat{\theta} = \underset{\theta \in \Theta}{\operatorname{argmin}} L(\theta) + \lambda \omega(\theta)$ with consistency under mild identifiability assumptions.

Keywords: *Sub-Saharan, Markov chains, stochastic processes, Monte Carlo methods, variance reduction techniques, dynamical systems, optimization algorithms*

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