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# On Trajectory Splitting for Accelerating Dynamic Simulations in Mobile Wireless Networks

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**Abstract.** This paper presents a method to enhance dynamic simulation performance in mobile networks. The aim is to accelerate the estimation of blocking and dropping probabilities by reducing the variances of the estimators. We adopt a Trajectory Splitting method that splits the path of the simulated stochastic process into multiple copies when the station loads cross predetermined thresholds, thus focusing on configurations for which communication problems are likely to occur. We show that this method significantly reduces the variance of the estimators of both blocking and dropping probabilities. In a real network dynamic simulation, we propose an algorithm to first check the convergence of the network towards its steady state distribution and discard the initial stabilization samples, and second apply Trajectory Splitting to accelerate simulations.
**Keywords:** Dynamic simulation, mobile networks, variance reduction, convergence diagnostic.

## 1 Introduction

In classical Monte-Carlo *static* simulations, a set of samples with minimum interdependencies are generated and evaluated. In the case of UMTS (Universal Mobile Telecommunications System) simulation for example, each snapshot must describe the positions of all active mobiles, their shadowing variables with all base stations, etc., before calculating the powers and QoS indicators. However, these static simulations do not incorporate some important information about the past and the future of the active users and are not sufficient to model some Radio Resource Management (RRM) algorithms (e.g. handover and congestion control algorithms), nor some QoS indicators that are mobility dependent (e.g. dropping rates). *Dynamic* simulations are then needed to investigate the dynamic system behavior. These simulations start from a static snapshot of the system and then one single sample function of the stochastic process representing the system evolution is extracted for a reasonably long time.

These classical simulation techniques present two drawbacks. The first is that the number of drawings necessary to ensure a given precision, i.e. a given variance, generally increases with the number of input random variables. Second the lower the probability for an event to occur, the bigger the number of drawings necessary to reach a given precision.