

Quantitative model checking is an important research area, aimed at analysing performance and dependability aspects of a wide variety of systems. Applications include biological systems, power management controllers, communication protocols and security algorithms. The scope of quantitative model checking is limited mostly by the expressivity of the underlying modelling formalism and the omnipresent state space explosion.

This thesis contributes to the solution of both problems, building on the notion of Markov automata. First, we introduce a novel process-algebraic language that allows the modelling of systems incorporating nondeterminism, stochastic timing and discrete probabilistic choice. Second, we define and investigate several reduction techniques to speed-up state space generation as well as model checking.

Case studies show that our techniques greatly reduce the impact of the state space explosion: a major step forward in efficient quantitative verification.