

Bayesian Parameter Inference of Markov Population Model.

Master Thesis

Submitted by

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at the

Universität
Konstanz



Modeling of Complex, Self-organising Systems

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Konstanz, 2020

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Acknowledgements

To the complement of this thesis, I would like to describe my deep

Abstract

something

Chapter 1

Introduction

- Brief introduction to Markov Chain
- Brief introduction to parameterization of Markov Chains
- Applications of parameter synthesis problem.
- Description of thesis structure.

We study the parameter synthesis problem of parametric Discrete-Time Markov Chain. Markov Chain is a probabilistic model to formalize stochastic processes.

Parameter synthesis is a relatively new research area [6]

This thesis is structured as follow.

- **Chapter 1** introduces motivations and background for the research topic.
- **Chapter 2** describes the most important definitions and theoretical background. In this chapter, we defines Discrete-Time Markov Chain formally. A brief introduction to Bayesian Inference is also included.
- **Chapter 3** reviews the state-of-the-art works of other researchers on the problem of parameter synthesis.
- **Chapter 4** describes the method.
- **Chapter 5** describes the benchmark.
- **Chapter 6** conclusion and future work.

Chapter 2

Preliminaries

- transition system
- markov property
- discrete-time markov chain and parametric dtmc
- continuous-time markov chain
- bayesian inference
- metropolis-hastings algorithm

2.1 Probabilistic model checking

Temporal logic

2.2 Parametric model and parameter synthesis

2.3 Probabilistic Model Checking

2.4 Bayesian Inference

2.4.1 Bayesian formula

2.4.2 Posterior conjugation

2.4.3 Metropolis-Hastings algorithm

2.4.4 Selection of prior distribution

The selection of prior distribution has strong effect on the result [what result specifically?] of a Bayesian inference [\[Citation needed\]](#).

2.5 Bayesian

Chapter 3

Related works

The current research progress on probabilistic model checking is studied thoroughly by Katoen and Baier et al [1]. Katoen et al. [6] briefly summarized important aspect of probabilistic model checking.

Polgreen et al [7] presents a method for bayesian inference of pMC parameters in

The definition and model checking of DTMC and pMC is studied by [1], [4], and [6].

Bayesian inference of pMC parameters is studied in [7] and [5]. In [7], the authors developed methods to synthesize parameters to satisfy a given set of PCTL properties. In [5], the authors presented methods to perform model checking of biological system using Bayesian statistic. The authors in [5] uses a Bayesian hypothesis test, where H_0 is the null hypothesis that the model satisfies a PCTL P , and alternative hypothesis H_1 is that the system does not satisfies P . Similar approach to the parameter estimation in this project is described by [3].

In this project, we use bee colony model semantics from [2]. The methods and implementation in this project is designed to extend the results of [2] and its tool *DiPS*.

Chapter 4

Framework for parameter synthesis.

4.1 Model construction

4.2 Framework

Chapter 5

Case study

5.1 Biological system

5.2

Chapter 6

Conclusion

6.1 Summary

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6.2 Future works

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