

École polytechnique de Louvain

Observing the detailed behaviour of large distributed applications in real time using Δ QSD

Author: **Francesco NIERI**

Supervisor: **Peter VAN ROY**

Readers: **Tom BARBETTE, Peer STRITZINGER, Neil DAVIES**

Academic year 2024–2025

Master [120] in Computer Science

Contents

1	Introduction	1
2	Design	2
2.1	Objective	2
2.1.1	Choices	2
2.1.2	Limitations	2
2.2	Design diagram	2
2.2.1	System under test	2
2.2.2	Stub	2
2.2.3	Oscilloscope	2
3	An overview of ΔQ	3
3.1	Timeliness	3
3.2	Outcome	3
3.3	Quality attenuation	3
3.4	Convolution	3
3.5	Operators	3
3.5.1	First to finish	3
3.5.2	All to finish	3
3.5.3	Probabilistic choice	3
3.6	Outcome diagram	3
4	Wrapper/Stub	4
4.1	Design	4
4.2	API	4
4.2.1	Samples	4
4.2.2	Start span	4
4.2.3	End span	4
4.2.4	Fail span	4
4.2.5	Timeout	4
4.3	Communication	4
4.4	Internal workings	4
5	Oscilloscope	5
5.1	Representation of ΔQ	6
5.1.1	Internals	6
5.1.2	dMax	6

5.1.3	Operations on ΔQ	6
5.1.4	Algebraic operations	6
5.1.5	Convolution	6
5.1.6	Confidence intervals	6
5.2	Server	6
5.3	Outcome diagram grammar	6
5.3.1	Primitives	6
5.3.2	Observables	6
5.3.3	Operators	6
5.3.4	System	6
5.4	Parser	6
5.4.1	Syntax	6
5.4.2	ANTLR	6
5.5	System	6
5.5.1	Observables	6
5.5.2	Operators	6
5.6	Dashboard	6
5.6.1	Design	6
5.6.2	Sidebar	6
5.6.3	Plot display window	6
6	Application on synthetic programs	7
6.1	M/M/1/K queue	7
6.2	Cache	7
7	Performance study	8
7.1	Convolution comparison	8
7.2	Server performance	8
7.3	Stub performance	8

Chapter 1

Introduction

Chapter 2

Design

2.1 Objective

2.1.1 Choices

2.1.2 Limitations

2.2 Design diagram

2.2.1 System under test

2.2.2 Stub

2.2.3 Oscilloscope

Chapter 3

An overview of ΔQ

3.1 Timeliness

3.2 Outcome

3.3 Quality attenuation

3.4 Convolution

3.5 Operators

3.5.1 First to finish

3.5.2 All to finish

3.5.3 Probabilistic choice

3.6 Outcome diagram

Chapter 4

Wrapper/Stub

4.1 Design

4.2 API

4.2.1 Samples

4.2.2 Start span

4.2.3 End span

4.2.4 Fail span

4.2.5 Timeout

4.3 Communication

4.4 Internal workings

Chapter 5

Oscilloscope

5.1 Representation of ΔQ

5.1.1 Internals

PDF

CDF

5.1.2 dMax

5.1.3 Operations on ΔQ

5.1.4 Algebraic operations

5.1.5 Convolution

Naïve convolution

Fast Fourier Transform convolution

5.1.6 Confidence intervals

5.2 Server

5.3 Outcome diagram grammar

5.3.1 Primitives

5.3.2 Observables

Outcome

Probes

6

5.3.3 Operators

5.3.4 System

5.4 Parser

5.4.1 Syntax

5.4.2 ANTLR

Chapter 6

Application on synthetic programs

6.1 M/M/1/K queue

6.2 Cache

Chapter 7

Performance study

7.1 Convolution comparison

7.2 Server performance

7.3 Stub performance

UNIVERSITÉ CATHOLIQUE DE LOUVAIN
École polytechnique de Louvain

Rue Archimède, 1 bte L6.11.01, 1348 Louvain-la-Neuve, Belgique | www.uclouvain.be/epl