



**UNIVERSITY OF TALCA  
ENGINEERING FACULTY  
CIVIL COMPUTER ENGINEERING SCHOOL**

# **Hardware-accelerated algorithms for approximate search engines**

**ERIK REGLA**

Advisor: RODRIGO PAREDES

Memoria para optar al título de  
Ingeniero Civil en Computación

Curicó – Chile  
month, year



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This document was graded with a score of: \_\_\_\_\_

Curicó – Chile

month, year

*Dedicated to the me of the future. To remember him that desire knows no bounds.*

## **ACKNOWLEDGEMENTS**

Agradecimientos a ...

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## TABLE INDEX

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## **SUMMARY**

Aquí va el resumen (en Castellano)...

# 1. Introduction

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Introduction to the problem

## 1.1. Context

Aquí va el texto de la primera sección del capítulo 1...

### 1.1.1. Motivation

### 1.1.2. Goals

## **2. Required knowledge**

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## **2.1. Aproximate search indexing**

## **2.2. Metric spaces**

### **2.2.1. Dimensionality crux**

### **2.2.2. Pivot-based indices**

### **2.2.3. Permutant-based indices**

## **2.3. General overview**

## **2.4. Permutant-based indices**

## **2.5. Permutant-based search**

## **2.6. Hardware acceleration**

### **2.6.1. GPGPU**

### **2.6.2. ASIC**

### **2.6.3. FPGA**

### **2.6.4. Design synthesis**

### **2.6.5. High Level Synthesis**

## **2.7. Embebbed Linux**

### **2.7.1. Linux kernel**

### **2.7.2. Modules**

### **2.7.3. Devicetree**

## **2.8. Adapteva Paralela**

### **2.8.1. Hardware**

### **2.8.2. Inner workings**

## **3. Metric Space indexing**

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**3.1. Dataset description**

**3.2. Implemented algorithm**

## **4. Software implementation analysis**

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### **4.1. Algorithm analysis**

#### **4.1.1. Index generation**

#### **4.1.2. Approximate search**

### **4.2. Code analysis and benchmarking**

#### **4.2.1. Permutation distance**

#### **4.2.2. Permutation generation**

## **5. Accelerator Implementation**

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### **5.1. High Level Synthesis**

#### **5.1.1. Overview**

#### **5.1.2. Latency**

#### **5.1.3. Throughput**

#### **5.1.4. Directives**

#### **5.1.5. Impact of coding style**

### **5.2. Permutation distance**

#### **5.2.1. Analysis**

#### **5.2.2. Implementations**

### **5.3. Permutation generation**

#### **5.3.1. Analysis**

#### **5.3.2. Implementations**



## **6. Hardware-Software interoperation**

---

### **6.1. AXI4 Protocol**

#### **6.1.1. AXI4 Protocol**

#### **6.1.2. AXI4Lite**

#### **6.1.3. AXI4Full**

#### **6.1.4. AXI4Stream**

### **6.2. Direct Memory Access**

#### **6.2.1. AMBA & Devicetree**

#### **6.2.2. Modules and device drivers**

### **6.3. Implementation**

## **7. Results**

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**7.1. Original implementation benchmarks**

**7.2. Accelerated implementation benchmarks**

**7.3. Comparison between results**

## **8. Conclusions**

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# Glossary

**El primer término:** Este es el significado del primer término, realmente no se bien lo que significa pero podría haberlo averiguado si hubiese tenido un poco mas de tiempo.

**El segundo término:** Este si se lo que significa pero me da lata escribirlo...

## **Bibliografía**

# **ANNEX**

## **A. HLS IP C++ code**

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Aquí va el texto del primer anexo...