## Contents

### Abstract

### Acknowledgments

#### 1 Motivation and Introduction

1.1 Numerical Optimization in the Multicore Era

1.1.1 A Nonlinear Least-Squares Problem

1.2 Algorithmic Differentiation

1.2.1 Second Derivative Code

1.2.2 dcc - A Derivative Code Compiler

1.2.3 A Nonlinear Constrained Optimization Problem

1.3 OpenMP Standard 3.1

1.4 Related Work

1.5 Contributions

1.6 Outline of the Thesis

#### 2 Transformation of Pure Parallel Regions

2.1 Formalism and Notation

2.2 SPL - A Simple Language for Parallel Regions

2.3 AD Source Transformation of SPL Code

2.3.1 Tangent-Linear Model of SPL - Transformation \( \tau(P) \)

2.3.2 Adjoint Model of SPL - Transformation \( \sigma(P) \)

2.3.3 SPL Code Inside of C/C++ Code

2.4 Closure of the Source Transformation

2.4.1 Closure Property of \( \tau(P) \)

2.4.2 Closure Property of \( \sigma(P) \) and the Exclusive Read Property

2.5 Summary

#### 3 Exclusive Read Analysis

3.1 Control Flow in SPL code

3.2 Integer Interval Analysis

3.3 Directed Acyclic Graphs and Partial Orders