# Contents

1 | Introduction ........................................ 1  
   1.1 Problem Statement and Approach .................... 2  
   1.2 Contributions of this Thesis ....................... 4  
   1.3 Thesis Outline .................................... 7  

2 | Background ......................................... 9  
   2.1 Automotive Control Software ......................... 9  
      2.1.1 AUTomotive Open System ARchitecture (AUTOSAR) 10  
      2.1.2 Migration to AUTOSAR .......................... 14  
      2.1.3 Case Study: Diesel Engine Control ............... 16  
   2.2 Software Parallelization ........................... 17  
      2.2.1 Subtask Decomposition Fundamentals .......... 18  
      2.2.2 Dependence Analysis Fundamentals .............. 19  
   2.3 Parallelization Constraints in Automotive Software 22  
      2.3.1 Extraction of Precedence Constraints .......... 22  
      2.3.2 End-to-end Paths and Latency Semantics ....... 25  
   2.4 Considered Processor Architecture and Analysis Tools 30  
      2.4.1 Static Code Analysis with Understand .......... 30  
      2.4.2 parMERASA Multi-core Processor Architecture 31  
      2.4.3 Static Worst-Case Execution Time Analysis .... 33  
      2.4.4 Erdős-Rényi Model ............................ 34  
   2.5 Summary of Background ................................ 34  

3 | State of the Art and Problem Analysis ............... 37  
   3.1 Objectives ....................................... 37  
      3.1.1 Functional Objectives ......................... 38  
      3.1.2 Non-functional Objectives ..................... 38  
   3.2 Mapping and Scheduling ............................ 40  
      3.2.1 Reconfiguring Parallelization Approaches ...... 40  
      3.2.2 Preserving Parallelization Approaches ........ 52  
      3.2.3 Discussion and Summary ....................... 57  
   3.3 Predictable Interprocessor Communication and Data Consistency 59