Contents

1 INTRODUCTION 6

2 RESEARCH OVERVIEW 8

2.1 MULTIPROCESSOR SYSTEMS 8
2.2 FAULT TOLERANCE 12
2.3 FT RECONFIGURATION AND RELATED RESEARCH AREAS 14
2.3.1 Reconfiguration from hardware viewpoint 14
2.3.2 Reconfiguration from software viewpoint 16
2.3.3 Scheduling and mobility of software elements 19
2.4 OVERVIEW CONCLUSION 22
2.5 RESEARCH STARTING-POINTS 23

3 THESIS OBJECTIVE 24

4 THESIS METHODOLOGY 25

5 DATA DRIVEN GRAPH 27

5.1 WHAT IS DDG? 28
5.2 DDG TASKS AND VARIABLES 29
5.3 GRAPHICAL REPRESENTATION 32
5.4 DDG ARCHITECTURE 33
5.5 DDG APPLICATION PROGRAMMING INTERFACE 35
5.6 COMPARISON WITH ANOTHER MODELS AND EXISTING APPROACHES 37
5.7 CONCLUSION ON DATA DRIVEN GRAPH 38

6 FAULT TOLERANCE IN DDG ENVIRONMENT 39

6.1 FAULT-TOLERANT ENVIRONMENT OVERVIEW 40
6.2 DATA AND CHECKPOINT MANAGEMENT 41
6.2.1 Complete data checkpointing 41
6.2.2 Removing obsolete data 45
6.2.3 Recovery loosing checkpoints 47
6.2.4 Partial data checkpointing 47
6.2.5 Combined data checkpointing 49
6.3 FAULT DIAGNOSTICS 51
6.4 TASK RECONFIGURATION 52
6.4.1 Control of reconfiguration 52
6.4.2 Reconfiguration module 54
6.4.3 Task reallocation 55
6.5 CONCLUSION ON FAULT-TOLERANT DDG ENVIRONMENT 57

7 IMPLEMENTATION OF FAULT-TOLERANT ENVIRONMENT 58

7.1 DATA STRUCTURES AND TASK OBJECTS 59
7.1.1 Data structures 59
7.1.2 Task objects 60
7.1.3 Data and checkpoint management 61
7.2 TASK RECONFIGURATION 64
7.2.1 Initialization 65
7.2.2 Mapping states 66
7.2.3 Computing a new configuration 67
7.2.4 Applying the new configuration 67
7.2.5 Recovery losing communications of the last task on the faulty node 68
7.3 FAULT DIAGNOSTICS 69
7.4 SUMMARY 70

8 CASE STUDY 71

8.1 HARDWARE PLATFORM 71
8.2 GAUSSIAN ELIMINATION ALGORITHM (GEM) 72
8.3 SCHEDULING AND RECONFIGURATION ALGORITHMS 75
8.4 APPLICATION PERFORMANCE IN FT DDG ENVIRONMENT WITHOUT FAULT OCCURRENCE 76
8.4.1 Application speedups in FT DDG environment 76
8.4.2 Fault-tolerant additional overheads 77
8.5 PARTIAL VERSUS COMBINED CHECKPOINTING 79
8.6 USER-DEFINED VERSUS DEFAULT DDG RECONFIGURATION ALGORITHM 81
8.7 SUMMARY 83

9 THESIS EVALUATION 84

10 CONCLUSION 86

APPENDIX 88

LIST OF ACRONYMS 88
LIST OF DEFINITIONS 90
LIST OF RULES 90
LIST OF THEOREMS 90
LIST OF ILLUSTRATIONS 91
LIST OF TABLES 93

BIBLIOGRAPHY 94