CONTENTS

PREFACE v

ABSTRACT vii

ACKNOWLEDGMENTS ix

LIST OF FIGURES xv

LIST OF TABLES xvii

1 INTRODUCTION 1

1.1 Motivation 1

1.2 Issues 2

1.3 Contribution 5

1.4 Example of results 7

2 NATURAL OBJECT RECOGNITION 13

2.1 Visual capabilities for autonomous robots 13

2.2 Related research 14

2.2.1 Recognizing objects 15

2.2.2 Recognizing natural scenes 15

2.3 Limitations of current machine-vision technology 19

2.3.1 Shape 19

2.3.2 Universal partitioning 21

2.3.3 Contextual knowledge 23

2.3.4 Computational complexity 24

2.4 Key ideas 24

2.4.1 Context-limited vision 25

2.4.2 Global consistency 27

2.4.3 Candidate comparison to control complexity 29

2.4.4 Layered partitions 31

Bibliografische Informationen
http://d-nb.info/931101557

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

2.5 Experimental results 34
2.6 Conclusions 41

3 A VISION SYSTEM FOR OFF-ROAD NAVIGATION 43
3.1 Task scenario 43
3.2 Prior knowledge 44
3.3 The role of geometry 47
3.3.1 Sources and limitations of range data 47
3.3.2 Using three-dimensional geometric information . . . 49
3.4 A vocabulary for recognition 50
3.4.1 Target vocabulary 51
3.4.2 Recognition vocabulary 51
3.5 Contextual information 54
3.5.1 Types of context 54
3.5.2 Using context 55

4 CONTEXT-BASED VISION 57
4.1 Conceptual Architecture 57
4.1.1 Overview 57
4.1.2 Context sets 60
4.1.3 Candidate generation 62
4.1.4 Clique formation 65
4.1.5 Candidate comparison 67
4.1.6 The recognition process 70
4.2 Implementation of Condor 71
4.2.1 Processing sequence 71
4.2.2 Representation of context 74
4.2.3 Context-set construction 77
4.3 Example of natural-object recognition 79
4.3.1 Candidate generation 81
4.3.2 Candidate comparison 85
4.3.3 Clique formation 89
4.3.4 Clique selection 92
4.4 Automated knowledge acquisition 95
4.4.1 Learning a description of the environment 97
4.4.2 Applying recognition procedures more effectively . . 98
4.4.3 Refining context sets 101
4.4.4 Discovering new procedures 105

4.5 Complexity analysis 105
4.5.1 Mathematical details 107
4.5.2 The number of cliques 108
4.6 Discussion 110
4.6.1 Reliability 110
4.6.2 Recognition strategies 111
4.6.3 Knowledge-base construction 111
4.6.4 Multiple-image interpretation 112

5 EXPERIMENTAL RESULTS 115
5.1 Evaluation scenario 115
5.2 Experimentation 119
5.2.1 Experiment 1 119
5.2.2 Experiment 2 123
5.2.3 Experiment 3 132
5.3 Analysis of results 132
5.3.1 Fixing mistakes 135
5.3.2 Accounting for success 137
5.3.3 Evaluating relevance to the goal 138

6 CONCLUSION 139
6.1 Contribution 139
6.2 Evaluation 142
6.2.1 Competence 142
6.2.2 Scalability 143
6.2.3 Generality 145
6.2.4 Evaluation plan 146
6.3 Summary 148

A THE CORE KNOWLEDGE STRUCTURE 149
A.1 Introduction 149
A.2 Core Knowledge Structure 150
A.3 Logical Interpretation of the CKS Database 151
A.3.1 Semantics 152
A.3.2 Insertions 154
A.3.3 Queries 154
A.3.4 User–Defined Relations 158
A.3.5 Discussion 159

A.4 Slot Access 160
A.5 Summary 162

REFERENCES **165**