

---

## Contents

<b>Foreword</b> .....	V
<b>Preface</b> .....	VII
<b>Intelligent Machines: An Introduction</b>	
<i>Lakshmi C. Jain, Anas Quteishat, and Chee Peng Lim</i> .....	1
1 Introduction .....	1
2 Learning in Intelligent Machines .....	2
3 Application of Intelligent Machines .....	3
3.1 Unmanned Aerial Vehicle (UAV) .....	3
3.2 Underwater Robot .....	4
3.3 Space Vehicle .....	4
3.4 Humanoid Robot .....	5
3.5 Other Attempts in Intelligent Machines .....	6
4 Chapters Included in this Book .....	7
5 Summary .....	7
References .....	8
<b>Predicting Operator Capacity for Supervisory Control of Multiple UAVs</b>	
<i>M.L. Cummings, Carl E. Nehme, Jacob Crandall, and Paul Mitchell</i> ...	11
1 Introduction .....	11
2 Previous Experimental Multiple UAV studies .....	12
3 Predicting Operator Capacity through Temporal Constraints .....	14
3.1 Wait Times .....	15
3.2 Experimental Analysis of the Fan-out Equations .....	16
3.3 Linking Fan-out to Operator Performance .....	24
3.4 The Overall Cost Function .....	25
3.5 The Human Model .....	27
3.6 Optimization through Simulated Annealing .....	28
3.7 Results of Simulation .....	29

4	Meta-Analysis of the Experimental and Modeling Prediction methods .....	33
5	Conclusions .....	36
	References .....	36

**Team, Game, and Negotiation based Intelligent Autonomous  
UAV Task Allocation for Wide Area Applications**

	<i>P.B. Sujit, A. Sinha, and D. Ghose</i> .....	39
1	Introduction .....	39
2	Existing Literature .....	41
3	Task Allocation Using Team Theory .....	42
	3.1 Basics of Team Theory .....	42
	3.2 Problem Formulation .....	43
	3.3 Team Theoretic Solution .....	45
	3.4 Simulation Results .....	47
4	Task Allocation using Negotiation .....	50
	4.1 Problem Formulation .....	50
	4.2 Decision-making .....	53
	4.3 Simulation Results .....	58
5	Search using Game Theoretic Strategies .....	61
	5.1 N-person Game Model .....	62
	5.2 Solution Concepts .....	63
	5.3 Simulation Results .....	69
6	Conclusions .....	72
	References .....	72

**UAV Path Planning Using Evolutionary Algorithms**

	<i>Ioannis K. Nikolos, Eleftherios S. Zografos, and Athina N. Brintaki</i> ....	77
1	Introduction .....	77
	1.1 Basic Definitions .....	77
	1.2 Cooperative Robotics .....	79
	1.3 Path Planning for Single and Multiple UAVs .....	80
	1.4 Outline of the Current Work .....	85
2	B-Spline and Evolutionary Algorithms Fundamentals .....	86
	2.1 B-Spline Curves .....	86
	2.2 Fundamentals of Evolutionary Algorithms (EAs) .....	88
	2.3 The Solid Boundary Representation .....	89
3	Off-line Path Planner for a Single UAV .....	90
4	Coordinated UAV Path Planning .....	92
	4.1 Constraints and Objectives .....	92
	4.2 Path Modeling Using B-Spline Curves .....	93
	4.3 Objective Function Formulation .....	94
5	The Optimization Procedure .....	97
	5.1 Differential Evolution Algorithm .....	97
	5.2 Radial Basis Function Network for DE Assistance .....	99

5.3 Using RBFN for Accelerating DE Algorithm ..... 102  
 6 Simulation Results ..... 102  
 7 Conclusions ..... 107  
 7.1 Trends and challenges ..... 108  
 References ..... 109

**Evolution-based Dynamic Path Planning  
 for Autonomous Vehicles**

*Anawat Pongpunwattana and Rolf Rysdyk* ..... 113  
 1 Introduction ..... 113  
 2 Dynamic Path Planning ..... 116  
 3 Probability of Intersection ..... 122  
 4 Planning Algorithm ..... 125  
 4.1 Algorithm for Static Planning ..... 125  
 4.2 Algorithm for Dynamic Planning ..... 134  
 5 Planning with Timing Constraints ..... 135  
 6 Planning in Changing Environment ..... 138  
 7 Conclusion ..... 142  
 8 Acknowledgments ..... 143  
 References ..... 144

**Algorithms for Routing Problems Involving UAVs**

*Sivakumar Rathinam and Raja Sengupta* ..... 147  
 1 Introduction ..... 147  
 2 Single Vehicle Resource Allocation Problem  
 in the Absence of Kinematic Constraints ..... 148  
 2.1 Problem Formulation ..... 148  
 2.2 Relevant Literature ..... 149  
 2.3 Algorithms ..... 150  
 3 Multiple Vehicle Resource Allocation Problems  
 in the Absence of Kinematic Constraints ..... 155  
 3.1 Literature Review ..... 155  
 3.2 Single Depot, Multiple TSP(SDTSP) ..... 156  
 3.3 Multiple Depot, Multiple TSP (MDMTSP) ..... 158  
 3.4 Generalized Multiple Depot Multiple TSP (GMTSP) ..... 159  
 4 Resource Allocation Problems in the Presence  
 of Kinematic Constraints ..... 162  
 4.1 Problem Formulation ..... 162  
 4.2 Literature Review ..... 163  
 4.3 Alternating Algorithm for the Single UAV Case ..... 164  
 4.4 Approximation Algorithm for the Multiple UAV Case ..... 165  
 5 Summary and Open Problems ..... 169  
 References ..... 170

**State Estimation for Micro Air Vehicles**

<i>Randal W. Beard</i> .....	173
1 UAV State Variables .....	174
2 Sensor Models .....	176
2.1 Rate Gyros .....	176
2.2 Accelerometers .....	177
2.3 Pressure Sensors .....	177
2.4 GPS .....	179
3 Simulation Environment .....	180
4 State Estimation via Model Inversion .....	182
4.1 Low Pass Filters .....	182
4.2 State Estimation by Inverting the Sensor Model .....	183
5 The Continuous-Discrete Kalman Filter .....	188
5.1 Dynamic Observer Theory .....	189
5.2 Essentials from Probability Theory .....	189
5.3 Continuous-Discrete Kalman Filter .....	191
6 Application of the EKF to UAV State Estimation .....	195
6.1 Roll and Pitch Estimation .....	195
6.2 Position and Course Estimation .....	197
7 Summary .....	198
References .....	198

**Evolutionary Design of a Control Architecture for Soccer-Playing Robots**

<i>Steffen Prüter, Hagen Burchardt, and Ralf Salomon</i> .....	201
1 Introduction .....	201
2 The Slip Problem .....	204
2.1 Slip and Friction .....	204
2.2 Experimental Analysis .....	205
2.3 Self-Organizing Kohonen Feature Maps and Methods .....	206
2.4 Results .....	207
3 Improved Position Prediction .....	209
3.1 Latency Time .....	209
3.2 Experimental Analysis .....	210
3.3 Back-Propagation Networks and Methods .....	211
4 Local Position Correction .....	213
4.1 Increased Position Accuracy by Local Sensors .....	213
4.2 Embedded Back-Propagation Networks .....	213
4.3 Methods .....	214
4.4 Results .....	215
5 Path Planning using Genetic Algorithms .....	217
5.1 Gene Encoding .....	218
5.2 Fitness Function .....	218
5.3 Evolutionary operations .....	219
5.4 Continous calculation .....	219
5.5 Calculation Time .....	220

5.6 Finding a Path in Dynamic Environments ..... 220  
 6 Discussion ..... 221  
 References ..... 222

**Toward Robot Perception through Omnidirectional Vision**

*José Gaspar, Niall Winters, Etienne Grossmann,  
 and José Santos-Victor* ..... 223

1 Introduction ..... 223  
 1.1 State of the Art ..... 225

2 Omnidirectional Vision Sensors: Modelling and Design ..... 226  
 2.1 A Unifying Theory for Single Centre of Projection Systems ... 228  
 2.2 Model for Non-Single Projection Centre Systems ..... 229  
 2.3 Design of Standard Mirror Profiles ..... 230  
 2.4 Design of Constant Resolution Cameras ..... 233  
 2.5 The Single Centre of Projection Revisited ..... 237

3 Environmental Perception for Navigation ..... 238  
 3.1 Geometric Representations for Precise Self-Localisation ..... 239  
 3.2 Topological Representations ..... 246

4 Complementing Human and Robot Perceptions  
 for HR Interaction ..... 255  
 4.1 Interactive Scene Reconstruction ..... 257  
 4.2 Human Robot Interface based on 3D World Models ..... 262

5 Conclusion ..... 263  
 References ..... 265



<http://www.springer.com/978-3-540-72695-1>

Innovations in Intelligent Machines - 1

Chahl, J.S.; Mizutani, A.; Sato-Ilic, M. (Eds.)

2007, XIII, 270 p., Hardcover

ISBN: 978-3-540-72695-1