
Contents

Acknowledgements	vii
Abstract	ix
List of Figures	xxiii
List of Tables	xxvii
1 Introduction	1
1.1 Motivation	2
1.2 Objectives	3
1.3 Structure of the thesis	3
2 From single UAVs to an autonomous swarm: an overview	7
2.1 The fundamentals of Unmanned Aerial Vehicles (UAVs)	7
2.2 Why we need UAV swarms	14
2.3 Current solutions for swarm coordination	15
3 ArduSim: a multi-UAV simulator	19
3.1 Original version of ArduSim	20
3.2 Design and implementation	22
3.3 UAV swarm formation	25
3.4 UAV-to-UAV communications	27
3.5 Summary	33

CONTENTS

4	Assigning airborne positions efficiently	35
4.1	Overview	36
4.2	Experiments & results	39
4.3	Summary	47
5	Taking off	49
5.1	Analysis of possible take-off strategies	49
5.2	Experiments & results	63
5.3	Summary	71
6	Maintaining the swarm coherent	75
6.1	The original version of MUSCOP	76
6.2	Proposed resilience mechanism	77
6.3	Experiments & results	80
6.4	Summary	90
7	Advanced mid-flight maneuvers	91
7.1	Swarm reconfiguration	91
7.2	Adjusting the altitude for changing terrain levels	99
7.3	Experiments & results	105
7.4	Summary	114
8	Accurate vision-based landing	115
8.1	Implementation	116
8.2	Experiments & results	120
8.3	Summary	126
9	Conclusions, Future Work and Publications	129
9.1	Conclusions	130
9.2	Future work	131
9.3	Publications	132
	Acronyms	135
	Bibliography	139