

---

# Contents

---

<b>Acknowledgements</b>	<b>vii</b>
<b>Abstract</b>	<b>ix</b>
<b>List of Figures</b>	<b>xix</b>
<b>List of Tables</b>	<b>xxiii</b>
<b>I Introduction and Context</b>	<b>1</b>
<b>1 Introduction</b>	<b>3</b>
1.1 Objectives . . . . .	4
1.2 Structure of the Thesis . . . . .	5
<b>2 Air pollution and its monitoring process: an overview</b>	<b>7</b>
2.1 Environmental Pollution Classification . . . . .	8
2.2 Air Pollution . . . . .	13
2.3 Air Pollution Monitoring worldwide . . . . .	15
2.4 Air Pollution Monitoring technologies . . . . .	18
2.5 Summary . . . . .	21
<b>3 Mobile Sensing technologies for Air Pollution Monitoring</b>	<b>23</b>
3.1 Crowdsensing in Smart cities . . . . .	34
3.2 UAV-base monitoring in rural areas . . . . .	40
3.3 Summary . . . . .	43

---

## CONTENTS

---

<b>II</b>	<b>Crowdsensing in Smartcities</b>	<b>45</b>
<b>4</b>	<b>EcoSensor Platform</b>	<b>47</b>
4.1	Architecture . . . . .	47
4.2	Central processing server . . . . .	49
4.3	Android-based Application . . . . .	53
4.4	Monitoring Process . . . . .	54
4.5	Summary . . . . .	61
<b>5</b>	<b>Mobile Sensor Design</b>	<b>63</b>
5.1	Mobile sensing requirements . . . . .	63
5.2	Overview of Available Hardware and Software . . . . .	64
5.3	Mobile Air Pollution Sensor Design . . . . .	75
5.4	Summary . . . . .	78
<b>6</b>	<b>Finding the optimal measurement strategy</b>	<b>79</b>
6.1	Optimal sensor positioning . . . . .	79
6.2	Impact of time sampling on geostatistical predictions . . . . .	81
6.3	Impact of spatial sampling on geostatistical predictions . . . . .	83
6.4	Validation of the proposed approach . . . . .	85
6.5	Summary . . . . .	88
<b>III</b>	<b>UAV-based sensing in rural areas</b>	<b>89</b>
<b>7</b>	<b>Using UAV-based systems to monitor air pollution in areas with poor accessibility</b>	<b>91</b>
7.1	Methodology and Proposed Architecture . . . . .	92
7.2	Overview of the proposed solution . . . . .	93
7.3	Summary . . . . .	97
<b>8</b>	<b>PDUC: Pollution-driven UAV Control</b>	<b>99</b>
8.1	UAV mobility control analysis . . . . .	99
8.2	Autonomous Driving approach . . . . .	101
8.3	Proposed Autonomic Solution . . . . .	102
8.4	Validation & Simulation . . . . .	106
8.5	Summary . . . . .	116
<b>9</b>	<b>PdUC-D: Discretized Pollution-driven UAV Control</b>	<b>117</b>
9.1	PdUC-D: Optimizing the PdUC protocol through discretization .	117
9.2	Validation . . . . .	121
9.3	Summary . . . . .	129

---

**Contents**

<b>IV Conclusions</b>	<b>131</b>
<b>V Appendices and References</b>	<b>139</b>
<b>Bibliography</b>	<b>145</b>