

# Contents

<b>Contents</b>	<b>vii</b>
<b>List of Figures</b>	<b>ix</b>
<b>1 Introduction</b>	<b>1</b>
<b>2 Related Work</b>	<b>3</b>
2.1 Gauss's Circle Problem . . . . .	3
2.2 Covering oriented points in the plane with orthogonal polygons is NP-complete [6] . . . . .	4
2.3 Metric clustering to minimize the sum of radii problem [9] . . . . .	4
2.4 Planar sensor cover problem [9] . . . . .	4
2.5 Covering Points by Unit Disks of Fixed Location [4] . . . . .	4
2.6 Optimal Packing and Covering in the Plane are NP-Complete [7] . . . . .	5
<b>3 Our Work</b>	<b>6</b>
3.1 Basic Definition . . . . .	6
3.2 Characteristics of Circles . . . . .	7
3.3 Drawing Circle on the Grid $G$ . . . . .	7
3.4 Covering All Black Points . . . . .	9
3.5 Observation . . . . .	9
3.6 Circle Reduction . . . . .	12
3.7 Choosing Minimum Cardinality Subset of Circles . . . . .	13
3.7.1 A Greedy Algorithm . . . . .	13
3.7.2 Boundary Point Approach . . . . .	15
<b>4 Conclusion And Future Work</b>	<b>17</b>



# List of Figures

1.1	Representation of Image . . . . .	2
3.1	Circles of different radius . . . . .	7
3.2	Drawing circle at red point . . . . .	7
3.3	Covering Points . . . . .	9
3.4	All are Boundary Points . . . . .	10
3.5	$t=1, t=2$ . . . . .	10
3.6	$t=k$ . . . . .	10
3.7	Case I . . . . .	11
3.8	Case II . . . . .	11
3.9	Case III . . . . .	11
3.10	Case IV . . . . .	11
3.11	Case V . . . . .	12
3.12	. . . . .	12
3.13	Choosing only maximal circles from figure 3.3 . . . . .	13
3.14	Selecting Greedily . . . . .	14
3.15	Greedy Cover . . . . .	14
3.16	Optimal Cover . . . . .	14
3.17	Greedily choosing circles that covers maximum boundary points . . . . .	16
3.18	Choosing by boundary points . . . . .	16

# List of Algorithms

1	Drawing Circle at a given point $p(i, j)$ . . . . .	8
2	Covering all the Black Points by all possible Circles . . . . .	9
3	Greedy Algorithm for Choosing Minimum Cardinality set of Circles . . .	13
4	Modified Greedy Algorithm . . . . .	15
5	Greedy Algorithm on Boundary Points . . . . .	15