

Contents

List of Figures	ix
List of Tables	xi
Abbreviations	xiii
Symbols	xv
Preface	xvii
1 Introduction	1
1.1 Proximal Point Algorithm	4
1.2 Splitting Methods	5
1.3 Inertial Methods	8
1.4 Fixed Point Methods	10
1.5 Outline of the Thesis	13
2 New accelareted algorithm and its Application to regression problems	15
2.1 Introduction	16
2.2 Preliminary Results	17
2.3 Accelerated normal S-iteration method and its convergence analysis	20
2.4 Numerical Example	29
2.5 Numerical Experiment with Data Sets	32
2.6 Conclusion	41
3 An Accelerated Forward-Backward Splitting Algorithm for Solving Inclusion Problems with Applications	43
3.1 Introduction	44
3.2 Preliminary Results	45
3.3 Main Results	48
3.3.1 Convergence analysis of the APFBNSM	52

3.3.2	Numerical comparison of Algorithms (3.1) and 3.3.1	60
3.4	Applications	62
3.4.1	Convex concave saddle point problem	63
3.4.2	Lasso problem	65
3.5	Numerical Experiments	67
3.5.1	Regression problems	67
3.5.2	Link prediction problems	71
3.6	Conclusion	73
4	Convergence Analysis of Two-Step Inertial Douglas-Rachford Algorithm and Application	75
4.1	Introduction	76
4.2	Preliminary Results	77
4.3	Douglas-Rachford Algorithm	80
4.4	Accelerated normal-S primal-dual algorithm	91
4.5	Applications to solve convex optimization problem	99
4.6	Conclusion	107
5	Strongly convergent Algorithms to Solve Monotone Inclusion Problems	109
5.1	Introduction	110
5.2	Preliminary Results	113
5.3	Strongly convergent common fixed point algorithm	115
5.4	Forward-Backward type Algorithms	121
5.4.1	Forward-Backward Algorithm	121
5.4.2	Forward-backward type Primal-Dual algorithm with Tikhonov regularization terms	123
5.5	Douglas-Rachford type Algorithms	130
5.5.1	Douglas-Rachford Algorithm	131
5.5.2	Douglas-Rachford type Primal-Dual algorithm with Tikhonov regularization terms	134
5.6	Numerical Experiment	142
5.7	Conclusion	145

List of Figures

2.1	log u vs number of iteration.	30
2.2	log v vs number of iteration	30
2.3	Coordinatewise graph for different iteration methods.	30
2.4	Colon.	37
2.5	Allaml	37
2.6	Carcinom.	37
2.7	Lymphoma.	37
2.8	Nci9.	37
2.9	Lung discrete.	37
2.10	The graph is plotted between number of iteration vs corresponding objective Function value for different datasets.	37
2.11	Colon.	39
2.12	Allaml.	39
2.13	Carcinom.	39
2.14	Lymphoma.	39
2.15	Nci9.	39
2.16	Lung discrete.	39
2.17	The graph is between number of iteration and corresponding root mean square error of the function.	39
3.1	Behaviour of $\ x_n\ _2$ with respect to number of iterations	61
3.2	Dolphin.	69
3.3	Football.	69
3.4	Jazz.	69
3.5	Celegansneural	69
3.6	Usair97	69
3.7	Netscience.	69
3.8	Value of $F(x_n) - F(x^*)$ for 1000 iterations with different datasets. . .	69
3.9	Dolphin.	70
3.10	Football.	70
3.11	Jazz.	70
3.12	Celegansneural	70
3.13	Usair97	70

3.14	Netscience.	70
3.15	Behavior of root mean square error (RMSE) for different datasets.	70
4.1	Initial points $x_0 = x_1 = (10, -20)$	90
4.2	Initial points $x_0 = x_1 = (20, -53)$	90
4.3	Semilog graph between number of iterations and sum of distance of iterative points to sets C and D for different initial points.	90
4.4	Circle with circle constraints.	103
4.5	Sphere with sphere constraints.	103
4.6	Generalized Heron problem for different convex set and constraints.	103
4.7	$m = 3, n = 2$	105
4.8	$m = 3, n = 2$	105
4.9	$m = 5, n = 2$	105
4.10	$m = 5, n = 2$	105
4.10	$m = 6, n = 2$	106
4.11	$m = 6, n = 2$	106
4.12	$m = 3, n = 3$	106
4.13	$m = 3, n = 3$	106
4.13	$m = 5, n = 3$	106
4.14	$m = 5, n = 3$	106
4.15	The semilog graph between number of iterations and RMSE for different choices of m and n as in Table 4.1. Figure 4.7, 4.9, 4.11, 4.13 are plotted for $\text{RMSE} < 0.001$ and Figure 4.8, 4.10, 4.12, 4.14 are plotted for $\text{RMSE} < 0.00001$	106
5.1	Original.	144
5.2	Blurred	144
5.3	Original	144
5.4	Blurred	144
5.5	The original and blurred images of Lenna and crowd.	144
5.6	Lenna.	145
5.7	Crowd	145
5.8	The variation of $F(x_n) - F(x^*)$ with respect to number of iteration for different images.	145
5.9	Algorithm (5.14).	146
5.10	[17, Algorithm 8]	146
5.11	Algorithm (5.14).	146
5.12	[17, Algorithm 8].	146
5.13	The recovered images using different algorithms for 1000 iterations.	146

List of Tables

2.1	Information about datasets	35
2.2	Detailed analysis of proximal gradient algorithms. Objective function value and RMSE corresponding to different datasets at 1000 iteration. Best results are in bold letters.	40
3.1	The evaluation of $\ x_n\ _2$ as number of iteration increases for Algorithm (3.1) and Algorithm 3.3.1	62
3.2	Topological information of real-world network datasets	67
3.3	Result	72
3.4	Result Comparison	73
4.1	Number of iterations required to have different accuracy for different algorithms. The best results are presented in bold letters.	104