Contents

List of Tables
List of Figures
Notations and Abbreviations

1 Introduction 1

2 Literature Survey 8
  2.1 Steganography .................................................. 8
    2.1.1 A Brief History ........................................ 8
    2.1.2 Modern Formulation and Definitions .................... 9
    2.1.3 Types of Steganography ................................ 12
    2.1.4 Digital Image Steganography ............................ 13
  2.2 Steganalysis ................................................... 17
    2.2.1 Mathematical Formulation ................................. 18
    2.2.2 Steganalysis Techniques on Digital Images ............. 19

3 RS, Sample Pair, and Least Square Steganalysis Methods 30
  3.1 RS Steganalysis ................................................. 30
    3.1.1 Analysis of Accuracy of RS Method .................... 36
  3.2 Sample Pair Method ........................................... 40
    3.2.1 Analysis of Accuracy of Sample Pair Method ........... 46
  3.3 Least Square Method ......................................... 48
    3.3.1 Analysis of Accuracy of Least Square Method .......... 49
  3.4 Relevance of Our Proposal .................................. 50

4 An Improved LSB Steganalysis Based on Analysis of Adjacent Pixel Pairs 54
4.1 Steganalysis Based on Analysis of Adjacent Pixel Pairs . 55
4.2 Results and Discussion ........................................... 61
   4.2.1 Estimation of Length of Hidden Message ............... 62
   4.2.2 Comparison with Other Steganalysis Methods .......... 63

5 Image Classification for More Reliable Steganalysis 65
   5.1 Image Analysis for More Reliable Steganalysis ......... 66
   5.2 Factors Influencing Accuracy of Estimation .......... 68
   5.3 Image Classification Scheme ................................. 71
      5.3.1 Identification of Images Giving Highly Inaccurate
            Results ............................................ 71
      5.3.2 Identification of Images Giving Highly Probably In-
            accurate Results .................................... 74
      5.3.3 Identification of Images Giving Highly Accurate Re-
            sults ............................................. 75
   5.4 Results and Discussion ....................................... 76
      5.4.1 Performance Evaluation for Highly Inaccurate Case 76
      5.4.2 Performance Evaluation for Highly Probably Inac-
            curate Case ....................................... 78
      5.4.3 Performance Evaluation for Highly Accurate Case . 79

6 Improving Sample Pair Method and Least Square Method 84
   6.1 Proposed Method for Improving Sample Pair Method . . 84
   6.2 Results and Discussion ....................................... 86
   6.3 Proposed Improvement for Least Square Method .......... 88

7 Cover Image Preprocessing for More Reliable LSB Re-
   placement Steganography 92
   7.1 The Proposed Preprocessing of Cover Images .......... 93
   7.2 Results and Discussion ....................................... 94

8 Secure Steganography using Inverse Transitions 99
   8.1 Secure steganography Based on Inverse Transitions .... 99
   8.2 Results and Discussion ....................................... 104

9 Conclusion 106
Publications based on this Thesis 108

References 110