UNIVERSITI TEKNOLOGI MARA

MODIFIED LEAST TRIMMED SQUARES METHOD FOR FACE RECOGNITION

NUR AZIMAH BINTI ABDUL RAHIM

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science (Statistics)

Faculty of Computer and Mathematical Sciences

November 2018

ABSTRACT

Face recognition involves the comparison of a given face with other faces in a database. A fully automated face recognition system would consist of several subsystems including face detection, normalization and authentication. Features of the face to be normalized include the size, orientation and the illumination. Facial feature detection must first be performed before any of the face recognition methods can be applied. A good face detection system would take care of most of these processes. There exist various frameworks and algorithms for a face recognition system. However, most of these frameworks are only reliable when the face is captured under controlled environment. The face recognition method is very much affected by noise or occlusion, which can be seen as grain in film and pixel variations if in digital images and their presence caused varying intensity in the image pixels instead of true pixel values. For most face recognition algorithms, partial occlusions affect the performance of the algorithm. This research addressed severe contamination or occlusion presence in a face recognition based on image data. A modified version of the existing least trimmed square, LTS method with genetic algorithm (LTS with GAs) was proposed to cater the problem of noise or occlusion and improve the performance of face recognition. In the proposed algorithm, the contaminated observations are distinguished in C-steps as every observation will be assigned a weight based on a cutoff value which will give a zero weight for any observations with residual error greater than the cutoff value and a weight "one" (1) otherwise. A robust standard error was used in this research for a more precise cutoff value in determining outliers. Benchmark datasets, namely the AT&T and Yale which contain occluded query images were used to examine the performance of the proposed method. The query images were contaminated with salt and pepper noise and the recognition rates was measured when the contaminated images were used as a query image in the context of linear regression. The best method was the one being least affected by the occluded images and produces highest recognition rates. The proposed approach performs almost as good as the FAST-LTS method with highest recognition rate as compared to other methods for Yale dataset. A simulation study was also done to further assess the performance of the modified approach alongside with several LTS based methods for large data sets which were contaminated with different levels of noise. The genetic algorithm configuration for n (number of observations) and p (parameter) was changed to assess the performance of modified method. The proposed method does not lose its robustness property, and its estimates are still unbiased and have a minimum variance in this configuration. It can be concluded that the modified algorithm decreases the biases, the variances and the mean squared errors of the LTS estimators. This research contributes to method in face recognition, which can be used in broad fields such as video and image processing, human-computer interaction, criminal identification, homeland security and numerous consumer applications.

ACKNOWLEDGEMENT

My utmost gratitude to Allah SWT, the almighty God who is the source of life and strength of knowledge and wisdom.

It is and it will always be a pleasure to thank the many people who have made this possible.

I gratefully acknowledge the support and guidance of Faculty of Computer and Mathematical Sciences members, most particularly my advisors Associate Professor Dr. Nor Azura Md. Ghani and Dr. Norazan Mohamed Ramli. Without their thoughtful encouragement and careful supervision, this thesis would never have taken shape. I am also grateful to them for their contributions to the direction and richness of this thesis. I am blessed to have spent time in their tutelage.

My parents Abdul Rahim Anis and deserved special recognition. I
greatly appreciate their love and unwavering support throughout my life. They have provided the character and self-discipline that has allowed me to preserve. May Allah bless them both always. This thesis is dedicated to my parents for the vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulilah.To my siblings, Jasimah and Hairazi, deepest appreciation for constantly giving me advises and support.

I am fortunate to have a very supportive and patient husband. A heartfelt thank you for Khairul Adzlan Abidin for believing in me. I truly value his toleration and patience for me throughout this study.

On a different note, many people have been a part of my study and I am highly grateful to all of them.

TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

1.1 An Overview of Image Recognition

Automatic (machine) recognition, description, classification, and grouping of patterns are important problems in a variety of engineering and scientific disciplines such as biology, psychology, medicine, marketing, computer vision, artificial intelligence and remote sensing. Watanabe and Pakvasa (1973) defines a pattern as opposite of a chaos in other words pattern is an entity, vaguely defined that could be given a name. For examples, a pattern could be a fingerprint image or a speech signal. According to (Harman & Kulkarni, 2012), an inductive method is a principle for finding a pattern in the data that can then be used to classify new cases or to estimate the value of a function for new arguments. In other words, the problem of finding a good inductive method also can be called as a pattern recognition problem.

According to Pavlidis (2000) from engineering perspective, pattern recognition is engineering. This is because people try to design machines that read documents, count blood cells, inspect parts, etc. We must understand the ‘‘physics’’ of the problem and select from amongst available tools the ones appropriate for the problem. It is futile to look for general mathematical/computational techniques that can solve all problems. Another definition of pattern recognition from science perspective is a study on human beings and its biological systems to discover, distinguish and characterize patterns in their environment and accordingly identify new observations (Duin & Pekalska, 2007).

The growth of interest in the area of pattern recognition in recent years is due to emerging applications which are not only challenging but also computationally more demanding. These applications include data mining, document classification (efficiently searching text documents), financial forecasting, organization and retrieval