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INFORMATION OF THE DISSERTATION

PhD candidate: **DANG NGUYEN CHAU**

Title: **SINGLE SAMPLE PER PERSON FACE RECOGNITION METHODS BASED ON LT-MHD DISTANCE**

Major: **Telecommunications Engineering**

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Dissertation's objectives

Nowadays, the face recognition-based systems play important role in human life. In some real face recognition application scenarios, the single sample per person (SSPP) is an important problem that must be solved. Single sample per person face recognition problem could be defined as: The system could identify a person, that has only one image in stored database, later in time in any unpredictable lighting, pose or face expression conditions. A lot of face recognition methods had been proposed with the purpose solving the SSPP problem. These methods could be broadly divided into four groups: the global-based methods, the local-based method, virtual sample generation methods and generic databases-based methods. Each group has some disadvantages that must be overcome. For this reason, research that proposes a solution for overcoming the disadvantages of a group of methods, is very necessary.

In the group of local feature-based SSPP face recognition methods, there is a subgroup. This subgroup includes some face recognition methods that use edge pixels as feature of face image and use average Hausdorff distance for measuring the dissimilarity between two sets of features. The advantages of these methods are simple and easy to be deployed in real face recognition applications. However, these methods have some disadvantages as the recognition rate of these methods is not too high and the computational cost of these methods is too high. Our research aims to propose a solution for increase the recognition rate and decrease the computational cost of these methods.

Contributions of the dissertation

Firstly, a novel distance measurement for replacing the average distance, the Least trimmed Modified Hausdorff distance (LT-MHD), is proposed. The experimental results in this research demonstrate that the LT-MHD is very effective for measuring the dissimilarity between two sets of edge pixels or two set of edge lines. This means that the LT-MHD might

be suitable for various face recognition methods that use different types of face image's features.

Based on the LT-MHD, two SSPP face recognition methods have been proposed, the Least trimmed New Modified Hausdorff distance (LT-MMHD) and the Least trimmed Line Hausdorff distance (LT-LHD). The LT-MMHD method and the LT-LHD method are the modification of the New Modified Hausdorff distance (M^2HD) method and the Line Hausdorff distance (LHD) method, respectively. Two popular databases, that are widely used by researcher working in SSPP face recognition field, are used for evaluating the recognition rates of the LT-MMHD method and the LT-LHD method with various conditions of testing images. The experimental results of both methods, the LT-MMHD method and the LT-LHD method, show the effectiveness of using the LT-MHD for measuring the dissimilarity between two sets of features. Depending on the condition of testing image, using the LT-MHD for measuring the dissimilarity between two sets of feature makes 2-10% increasing of recognition rate in comparing with the average Hausdorff distance. This result might be a solution for other average Hausdorff distance-based face recognition methods for increasing the recognition rate.

Additionally, the recognition rates of the LT-MMHD method and the LT-MHD method are also compared with other SSPP face recognition methods. The popular face database ORL is used. The experiments of all methods with ORL database are conduct in same manner: one random picture of each person in the ORL database are used as the model set and the other image in the ORL database are used as the test set. The recognition rates of both methods, the LT-MMHD method and the LT-LHD method, are slightly higher in comparing with the recognition rates of others. Especially, the recognition rate of the LT-LHD method is 2-11% higher than that of the SSPP face recognition methods proposed in last five years.

In addition to increasing the recognition rate, our research aims to propose a solution for decreasing the computational cost of the LT-MMHD method and the LT-LHD method. A review of the methods in CAD/CAM/CAE field, that were proposed for reducing the computational cost of Hausdorff distance, is performed in this research. Based on the analyzing these methods, it shows a conclusion that the EARLYBREAK method and the LSS method are the most suitable methods for reducing the computational cost of the average Hausdorff distance-based face recognition methods. In this research, the EARLYBREAK method and the LSS method are used for reducing the computational cost of the LT-LHD method and the LT-MMHD method, respectively. The experimental results show that by applying the EARLYBREAK method for the LT-LHD method, it could reduce 67% the computational cost and 66% the recognition time. The experimental results also show that by applying the LSS method for the LT-MMHD method, it could reduce 17% the computational cost and 16% the recognition time. The above experimental results are compatible with the mathematical analysis that is presented in the research. These experimental results demonstrate the effectiveness of applying the methods, such as the EARLYBREAK method or the LSS method, for reducing the computational cost of the average Hausdorff distance-based face recognition methods.

From the positive results of using the LT-MHD for measuring the dissimilarity between two set of features in traditional face recognition, this research is expanded for applying the LT-MHD in the face recognition methods based on deep learning model. This research is limited to propose a deep model for extracting the feature of face image. The proposed model uses the LT-MHD, instead of the cross entropy, as the loss function of the model. The model is trained with the ORL database. The experimental results show that using the LT-MHD as the loss function for the model could make the recognition rate increase 43% in comparing with using the cross entropy as loss function. This result is not general because the model is trained with a small database. However, it is promising results to create a premise for our future research.

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