Research Title: Person Identification Using 3D Geometric Invariance on Facial Surface

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ABSTRACT

This research concerns about the application of affine geometric invariant in both 3D and 2D data. For 3D, we applied to solve the problem of 3D alignment of faces in the presence of some facial expression changes. The data is 3D laser range image that obtained from a laser scanner. The studies are based on the differential geometry of the surface. This thesis starts with how to acquire the 3D data from the object. It is a 3D stereo triangulation. Then the differential geometry has been studied. The Curve, Tangential vector, Normal vector, Gaussians curvature, Mean curvature, Parabolic contour, Zero-volume and Zero-Torsion were used in this thesis, because these fiducial points are local. Moreover, since the fiducial points are relative affine invariant to local affine transformations, they allow for matching and alignment when facial expression changes affect part of the face. For comparison, we also contrast the alignment performance of our method with that of the ICP (Iterative Closes Point) and CPD (Coherent Point Drift) methods. The 3D face database GavabDB was the data set to test the alignment performance. The results show that the CPD is the best for alignment but it takes very long calculation time. The purposed method takes the same as time as the ICP but it needs the initial alignment. This thesis can be extended to the recognition because the separation between the true match and non-match is best for our zero torsion method (SNR of 1.2), higher than that of the ICP (SNR of 0.37) and the CPD methods (SNR of 0.15).

The concept derived in this research is also applied to 2D problem of fingerprint identification and/or verification when a query fingerprint is taken under conditions that differ from those under which the fingerprint of the same person stored in a data base was constructed. Performance of the algorithm yields an area of 0.99967 (perfect classification is a value of 1) under the receiver operating characteristic (ROC) curve based on a database consisting of a total of 1680 fingerprint images captured from the 240 fingers. The average probability of error was found to be 0.713%. Our algorithm also yields the smallest false non-match rate (FNMR) for a comparable false match rate (FMR) when compared to well-known

technique of DFB features and triangulation-based matching integrated with modeling nonlinear deformation. This work pushes the envelope of the fingerprint identification problem beyond state of the art in both performance and robustness.