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THE COMPARATIVE RESEARCHES OF HUMAN FACES GEOMETRY AND SKIN ROUGHNESS WITH MODAL ANALYSIS

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To increase the safety of the security systems (e.g. on airports) the new biometrics techniques are developed. One of the important and rapidly advancing areas of security identification and verification is face recognition [1, 2]. All new developed systems must be protected on any manipulations [3] and attempts of fake.
This article presents application of the PCA (Principal Component Analysis) method for comparative of geometrical similarity of 3D human faces. The discussed method is using the geometrical measurement (three-dimensional coordinates of points) of twin's faces as a data input. The points clouds are obtained from the structural light 3D scanner (3D biometric measurements) and used for testing level of sensitivity and accuracy.
The authors apply 3D version of PCA method for comparative the geometry of twin's faces. This numerical analysis is giving information about similarity and differences of analyzed faces. PCA decompose set of 3D objects into mean face and individual features (empirical modes), which describing deviations from mean value. Obtained mean shape describe the similarity of faces, eigenmodes present geometrical differences between faces. Eigenvalues can be used for numerical (mathematical) comparison of study faces.
In presented paper three sets of data of different type of twins (identical - monozygotic, fraternal-dizygotic) and thirteen typical faces are used and compared. The mean face and the features (eigenfaces) are presented and discussed.
Authors propose using the set of eigenfaces and corresponding coefficient values (computed from PCA) for security verification. As an example of authorization key the set of coefficient values for the faces are presented. Each key describes individual shape of face and can be decoded and compared with the original data of user to obtain access to restricted area or data.
Furthermore the high precision 3D data (face geometry) can be used for the mathematical analysis of the skin surface structure. That kind of data is important for topometric tests and investigations of new products from cosmetic industry [4].

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