Facial asymmetry in 3D face recognition

PROPOSED METHOD

The pre-processing procedure of the system consists of the following steps: selection of face area, scaling image, rotation. The main area of the face selected and rejected areas that contain little useful information on the outskirts of face. The selection of face area made based on key points, and the coordinates of these points are obtained from database. Based on inner corners of the eyes, the face image is scaled so that the distance between them was equal to 120 pixels. Next, the angle of rotation is calculated from the mentioned coordinates, and face image is rotated by an angle alpha. This operation is aimed at establishing the identical position for all faces.

Measurement of the asymmetry

There are many methods to found vertical line of face asymmetry. Ostwald et al. [15] propose a definition of the line asymmetry so that the differences between the face and its mirror reflection are as low as possible. Other method is proposed by Kurach et al.[16]. They propose to appoint line asymmetry in such a way that the differences between the left and right part of the face are as small as possible.
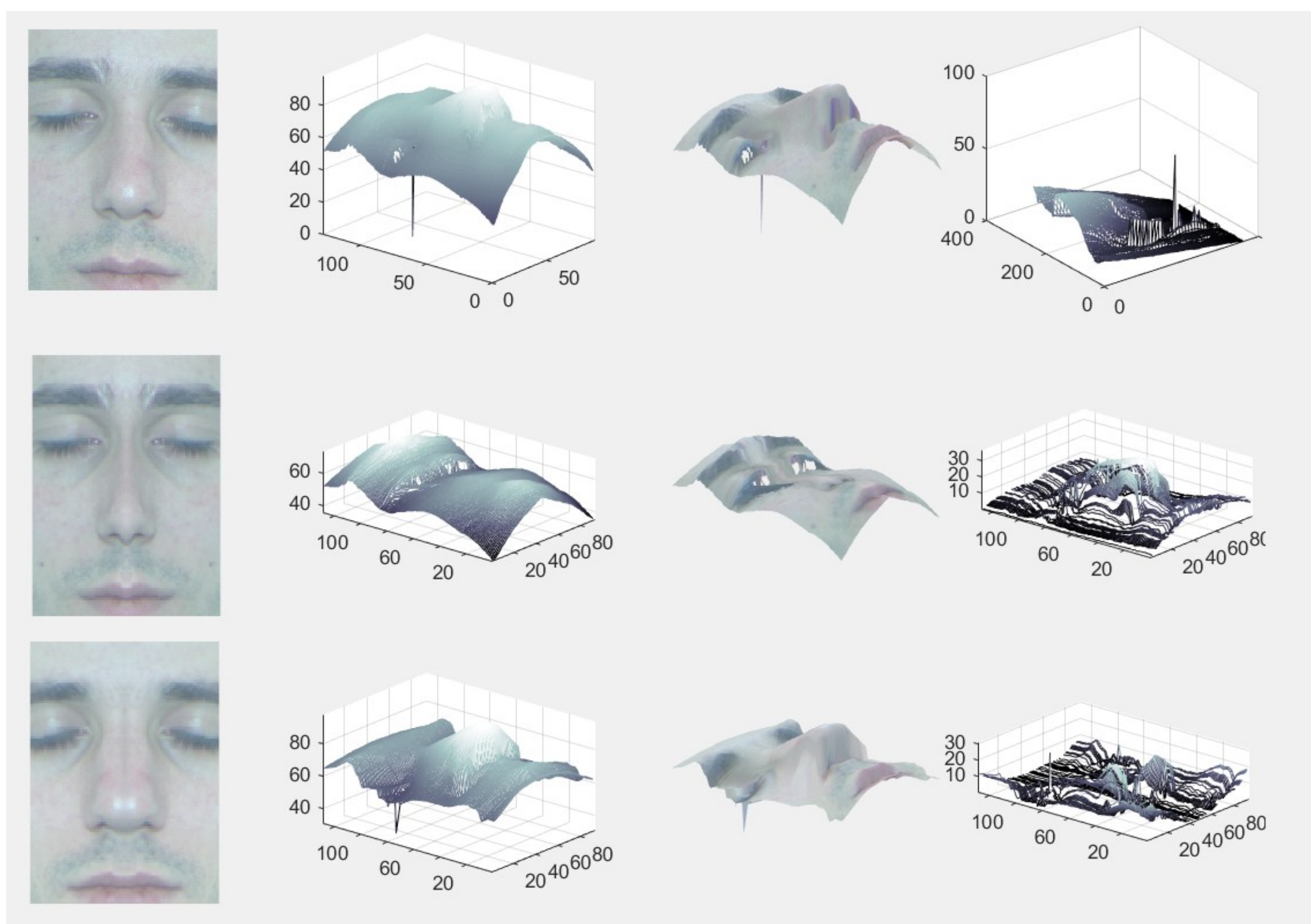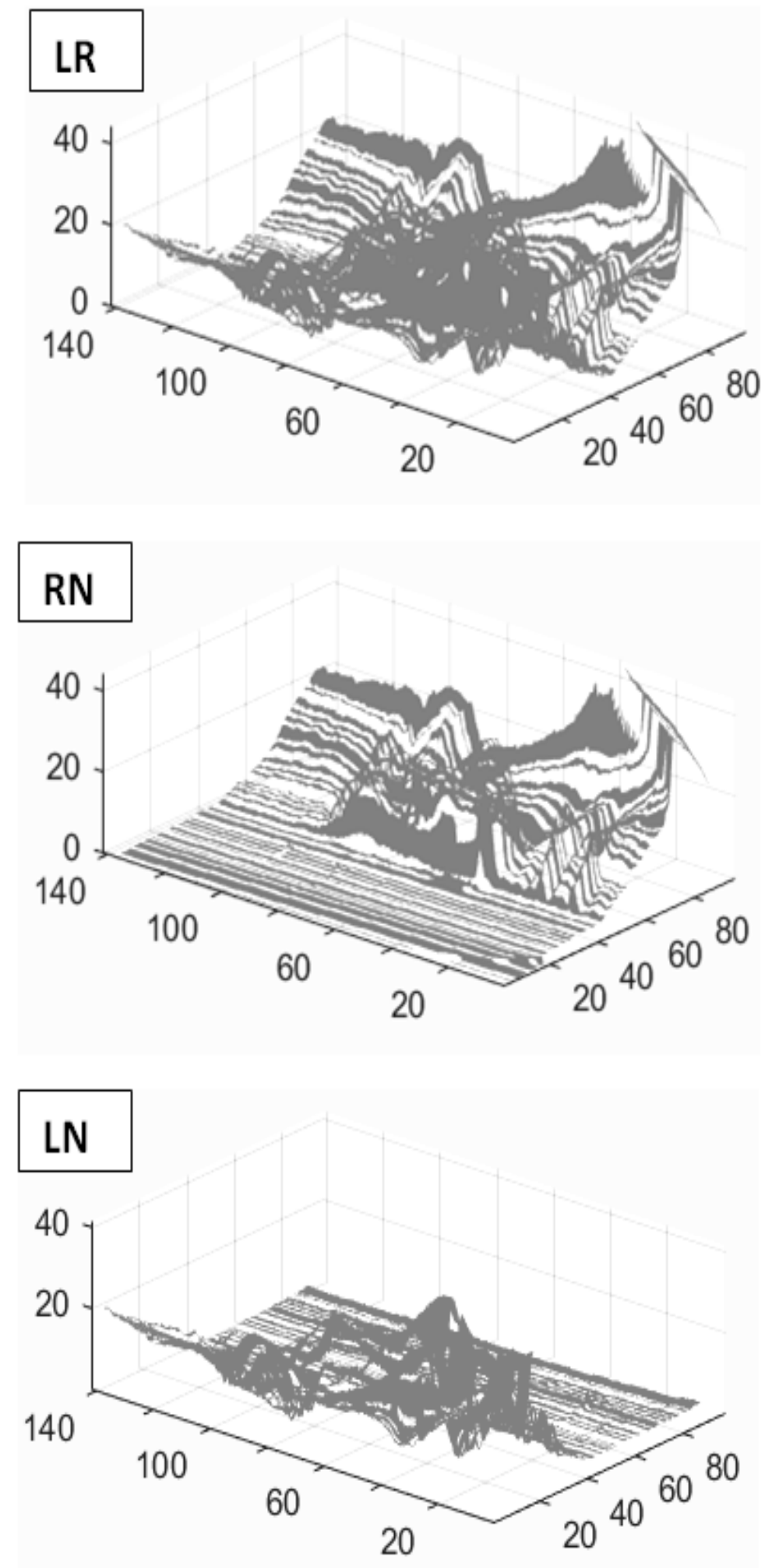
We propose simple and fast method of designate the line of asymmetry. The coordinates of key points obtained from database exploit to find the centre of line connecting the inner corners of the eyes. Thus obtained value is used to determine the x-coordinate defining the lines of facial asymmetry.

In this way we are dividing the face into the right and left part. Through the mirror vertically they are rising from these parts right face (RF) and left face (LF). From z-coordinate of these two elements and the normal face (NF) the measurement of the asymmetry is being made. In this way, the three metrics are formed that are differences between the RF, LF and NF (eq.1-3).

$$LN = |LF - NF| \qquad (1)$$
$$RN = |RF - NF| \qquad (2)$$
$$LR = |LF - RF| \qquad (3)$$

Experiments

In experiments we used the image database UMB-DB. The University of Milano Bicocca 3D face database is a collection of multimodal (3D + 2D colour images) facial acquisitions. The database is available to universities and research centres interested in face detection or face recognition. They recorded 1473 images of 143 subjects (98 male, 45 female). The images show the faces in variable condition, lighting, rotation and size .

We chose three datasets, each consist of 50 persons in order to verify the method, and for each individual chose two images for learning and two for testing. The HMM implemented with parameters N = 10, O = 20.

Conclusion

This paper presented conception of fast and rough method for determines 3D face asymmetry. Presented method allows for faster 3D face processing and recognition because they do not use complex calculation for features extraction. The obtained results are satisfactory in comparison to other method and proposed method may be the alternative solution to the others. Experiments confirmed the validity of the concept of 3D face asymmetry, and it is a faster method in comparison to another. The research results indicate that face recognition with 3D face asymmetry may be used in biometrics systems.

Type of asymetry	No. of test set	Recognition rate [%]
LN	1	58
LN	2	62
LN	3	60
Average		60
RN	1	58
RN	2	60
RN	3	62
Average		60
LR	1	68
LR	2	70
LR	3	72
Average		**70**

Method	Recognition rate [%]
LBP	82
CCA	68
Our	70