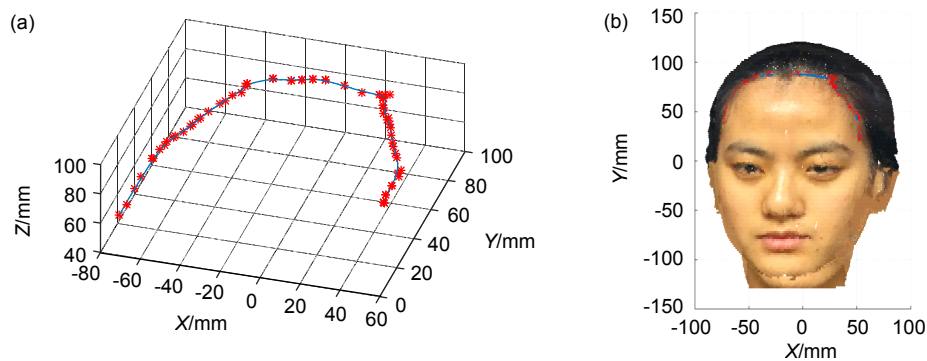


Three-dimensional hairline extracting based on the color point cloud of human head

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3D Hairline. (a) The fitting of 3D hairline. (b) The showing of 3D hairline in head cloud point.

Abstract: As the hairline is an important feature of human head, hairline extraction has great research significance and wide applications, such as face perception systems, plastic surgery, 3D film and television, facelift game, hair set customization. With the development of 3D point cloud model acquisition technology, the study on the three-dimensional (3D) hairline extraction, which can be used to analyze the characteristics of hairline qualitatively and quantitatively, turns into a research hot gradually. Based on the 3D color point cloud of human head, a direct 3D hairline extraction method is proposed. Firstly, the point cloud is transformed into the face coordinate system which is built on the basis of human facial features. Secondly, the head dark parts, including eyeballs, eyebrows and hair, were extracted based on gray threshold T_1 which can separate hair color from skin color and was calculated using the Otsu algorithm. Thirdly, the boundary points of the dark parts were picked out. The dark parts were layered based on the Y value and the points in every same layer were sorted in accordance with the X value. For each layer, the difference $d_{j,j+1}$ of X coordinate component between consecutive points p_j and p_{j+1} for arbitrary index j was calculated and the two points were selected out if the difference between them was higher than a certain threshold T_2 . In this way, all layers were visited and the boundary points were obtained. Fourthly, the 3D hairline points were acquired by filtering noise points out. According to the prior knowledge of human face that the locations of the eyeballs and eyebrows are on the front of hairline at the same height of face, the boundary points of eyeballs and eyebrows were deleted and the remaining points were 3D hairline points. Finally, the 3D hairline points were fitted to obtain 3D hairline curve. In order to speed up the fitting procedure, the hairline points were simplified using the method of bounding box which can keep the hairline character mostly, and then 3D points were fitted with the algorithm of three B-spline curve fitting. Some actual 3D color point clouds of human head were used to extract the 3D hairlines. The experimental results show that the method proposed here is proven a feasible and effective method. What's more, compared with the 2D hairline extraction algorithm, it can get more information of hairline.

Keywords: hairline; layering; sorting; color point cloud

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