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Three-dimensional face point cloud hole-filling algorithm based on binocular stereo matching and a B-spline

Key words: Three-dimensional (3D) point cloud; Hole filling; Stereo matching; B-spline

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Motivation

1. Computer vision technology is one of the key core technologies of artificial intelligence. It can be applied in the fields of security, finance, hardware, marketing, automobile design, and medicine. Facial recognition algorithms based on the fundamental issue of visual recognition have received extensive attention in recent years. However, the quality of face data collected always affects the accuracy of the final recognition.

2. Efficient and convenient data filling algorithms are an integral part of the recognition field.

Main idea

1. For 3D face point cloud data with no prior information and missing parts, using current technology to recover the data often leads to distortion of the final model.

2. The face point cloud data obtained by different measurement methods contain different information, which can be used in post-processing.

3. Using the face point cloud data obtained by the raster projection method, we can restore the real information of the object with the least cost, with the help of stereo matching technology for hole filling.

Method

1. A novel method called hole-filling based on stereo-matching technology combined with a B-spline is used to recover missing information in 3D face point cloud data.

2. Cross-source point clouds can complement each other very well and play an important role in information recovery.

3. When additional control points are provided, B-spline can recover complex surface information very well.

Major results

1. Simulation results of point cloud hole repairing in wing of nose

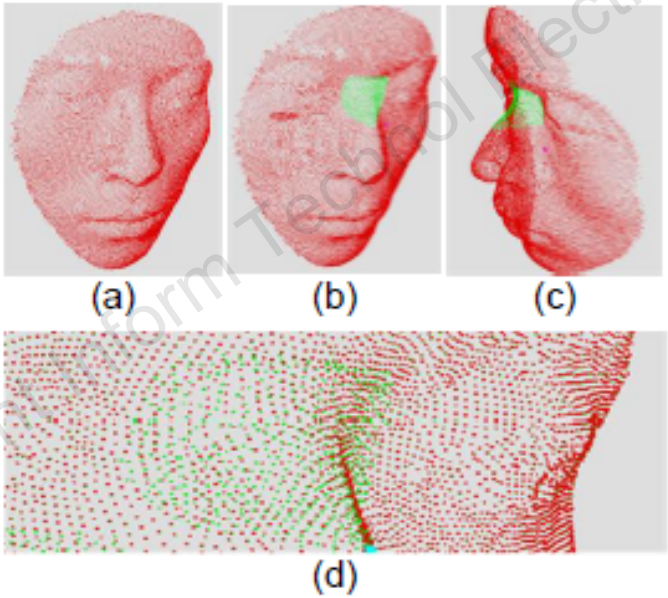

Fig. 14 Simulation results of point cloud hole repairing in wing of nose: (a) complete point cloud; (b) left-hand view of the repaired point cloud; (c) a top view of the repaired point cloud; (d) registration of the repaired point cloud

Major results (Cont'd)

2. Comparison between the implemented and initial points for different hole positions

Table 1 Comparison between the implemented and initial points shown

Hole position	Number of initial points	Number of implemented points	Number of ICP iterations	RMSE	Runtime (s)
Nose & face	1518	1612	10	0.019	123
Between eyebrows	643	651	10	0.072	74

ICP: iterative closest points

Conclusions

1. In this research, a hole-filling algorithm based on stereo matching and a B-spline is proposed, using a laboratory-developed identification system combined with a consideration of measurement principles. The proposed algorithm can effectively reproduce surface details and accurately restore complex surface shapes.

2. Since the algorithm requires a high-precision structure from motion (SFM) data set, although the accuracy and completeness of the VisualSFM-reconstructed point cloud are high for most objects, this method is not particularly effective for objects that lack texture.

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