Supplementary Materials

Anonymous CVPR submission

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1. Codes and Datasets

We provide our codes for facial shape completion in `FaceCom` folder. All code will be open-sourced after the paper is accepted. Due to limitations on file upload size, we trained a lightweight model with smaller hyperparameters for your verification and testing. Please refer to the `README` in `FaceCom` folder for configuration and experimentation.

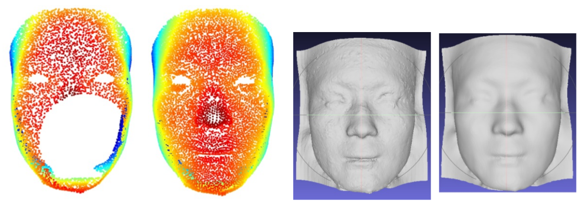
2. Ethical Issues

Due to the involvement of clinical patient body (facial) data in our research, we have obtained approval from the local Institutional Review Board in accordance with regulatory requirements. The approval reference number is `PKUSSIRB-202385001`. Due to the potential violation of the blind review principle, the approval document containing information about the researchers is not included here. We will provide it in the future.

3. Point Cloud Shape Completion on Faces

In Section 4.2 of our paper, we mentioned, ”The experiments of point cloud completion methods for facial datasets have yielded unsatisfactory results.” Here, we provide relevant experimental samples and analysis.

We conducted completion experiments using SpareNet [1] on FaceScape [2] dataset, and an example is illustrated in Fig. 1. As stated in our paper, while point cloud completion methods can effectively reconstruct facial features, the absence of strong constraints on vertex relationships may lead to vertical fluctuations in each vertex. Consequently, the generated surface often appears coarse, and smoothing processes may inadvertently remove critical features. In contrast, our proposed method addresses these challenges. Due to the less-than-ideal results obtained from point cloud completion experiments on facial data and the scarcity of recent work specifically addressing shape completion for faces, our paper lacks horizontal comparisons in this aspect.



(a) (b) (c) (d)

Figure 1. **SpareNet experiment on faces**. (a) Defective face. (b) Completion result. (c) After Poisson reconstruction. (d) After Laplacian Smoothing.

4. Facial Shape Completion results

In Section 4.2, we presented the facial completion results of our method under various types of defects. The original files can be found in the `4.2results` folder, and the file (folder) numbers correspond to the identifiers in Figure 4. Please refer to this location for more detailed completion results.

5. Post Processing Technique

Identification. Identify the originally missing parts in the fitted face using a thresholding method. Specifically, set a threshold, calculate the distance from the vertices of the fitted face to the incomplete face, and label those with distances below a certain value. This step may label some inaccurately fitted vertices. Therefore, we will select the largest connected component as the missing part to mitigate this issue.

Projection. The primary objective of this step is to restore the non-defective regions to the position of the input face. We define a vector of length n to represent the distance each vertex moves along its normal. Following the method proposed in Section 3.2, we iteratively optimize this process, ultimately applying normal displacement to all vertices in the non-defective region. At this point, the non-defective region of the fitted face is roughly aligned with the input, but there may be some discrepancies between the defective and non-defective regions.

Refinement. The identified defective region forms a connected component. Subsequently, we expand the outer boundary of this connected component by three neighbors to create an extended component. In the previous step, the extended component is projected onto the surface of the defective input. We make the assumption that there is a strong correlation between the displacement of the extended component and the completion of the defective region. Under this assumption, for each vertex in the completion, we identify the k nearest vertices in the extended component. The displacement of these vertices is then weighted and summed based on their distances. This sum is utilized as the displacement for the corresponding vertex in the completion, completing the deformation of the completion.

For some densely curved surface regions or areas with significant curvature, outliers are prone to appear after post-processing. Therefore, in the final steps, we identify and restore these outliers. Ultimately, we apply a smoothing process to both the defective and extended regions to achieve a more seamless completion result.

In the `post-processing` folder, we have provided the original mesh files corresponding to each image in Figure 3 of the paper.

References

[1] Chulin Xie, Chuxin Wang, Bo Zhang, Hao Yang, Dong Chen, and Fang Wen. Style-based point generator with adversarial rendering for point cloud completion. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pages 4619–4628, 2021. 1

[2] Haotian Yang, Hao Zhu, Yanru Wang, Mingkai Huang, Qiu Shen, Ruigang Yang, and Xun Cao. Facescape: a large-scale high quality 3d face dataset and detailed riggable 3d face prediction. In *Proceedings of the ieee/cvf conference on computer vision and pattern recognition*, pages 601–610, 2020. 1