Novel approach to View Morphing with smart blending

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Abstract

In this project, we develop a new approach to view morphing. After experimenting on state of the art approaches, we show how to use estimated 3D geometry in a new morphing pipeline to generate more visually appealing morphed images. We develop a method to reduce blurring with epipolar geometry. Stable Diffusion's inpainting pipeline is used for completing the image through outpainting.

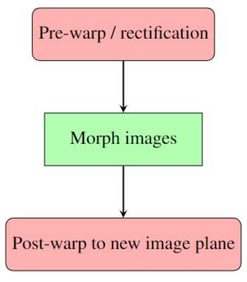
Background

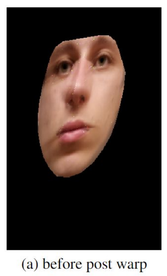
View morphing is the process of generating artificial images from virtual cameras using two images from different angles. This is done using point correspondences and epipolar geometry. The goal of view morphing is to also preserve 3D geometry when generating new images. This has previously been done using both a 2D homography based approach in [1] and using a CNN based method [2]. In recent years novel view synthesis has been dominated by machine learning approaches, while geometric methods have not been much further developed .

Baseline Method

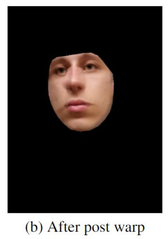
As a baseline method, we use a three-step algorithm to do "traditional" view morphing, similar to the one proposed in [1]. First, we find suitable homographies and use them to pre-warp, or rectify the images to the same plane. In the new plane, we morph the images and finally, we warp the image back to the original coordinate frame.

To find point correspondences we used both an automatic method using a pretrained neural network and manual labeling.





(a) before post warp



(b) After post warp

Our approach - with 3D reconstruction

Key features:

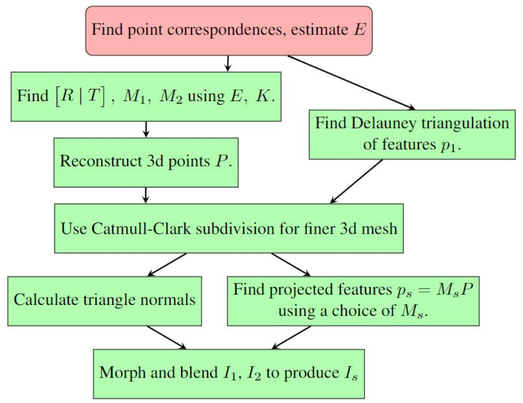


Figure 1: Block-diagram of steps

New blending/anti-fold algorithm:

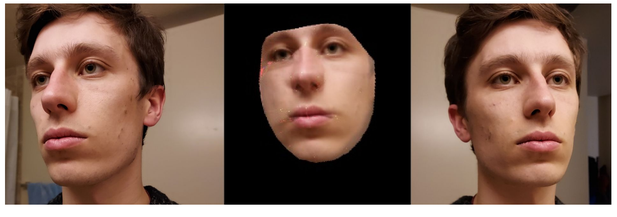
Using normals $\hat{n}$ of the 3D triangle mesh surfaces and $\hat{v}$ of the image planes to determine if a surface is viewable or not from each camera and define a blending heuristic.

$$s_1' = (0.01 - \min(\hat{n} \cdot \hat{v}_1, 0))$$
$$s_2' = (0.01 - \min(\hat{n} \cdot \hat{v}_2, 0))$$
$$s_1 = \frac{s_1'}{s_1' + s_2'} \quad s_2 = \frac{s_2'}{s_1' + s_2'}$$

Effect of anti-folding heuristic

Left with, right without. Notice the clarity in the left image. Also notice the natural shadows in the left.

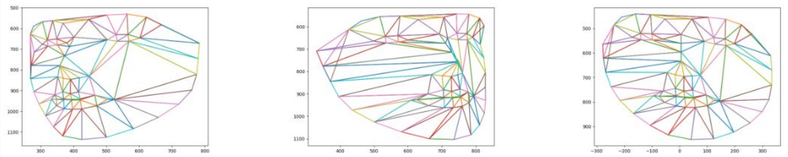
Results - Baseline



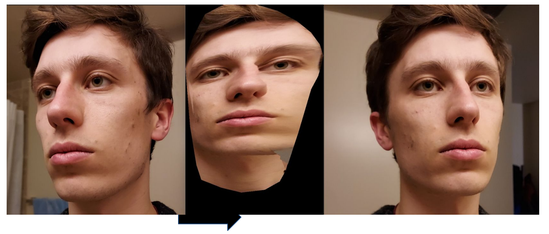
Left image Morphed image Right image

Results - Our approach

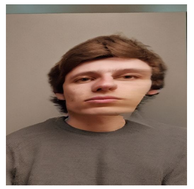
3D reconstructions:



(a) Left (b) Right (c) Morphed, s=0.5



Right image Morphed image



Stable diffusion outpainted image

Conclusions

The report presents a novel method for view morphing algorithm that further benefit from 3D knowledge obtained through calibration. By using Catmull-Clark and novel anti-folding algorithms, we mitigate blurring effects and improve the images' visual appearance. We also show how generative tools can complement our algorithm by outpainting our morphed image with Stable Diffusion. Our work focuses on face detection and we suggest further work on full body view morphing. We also would like to see further improvements on handling folds in the images as they are not entirely mitigated with our method.

References

[1] Steven M Seitz and Charles R Dyer. View morphing. In Proceedings of the 23rd annual conference on Computer graphics and interactive techniques, pages 21–30, 1996
[2] Dinghuang Ji, Junghyun Kwon, Max McFarland, and Silvio Savarese. Deep view morphing. In Proceedings of the
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