Rapid Photorealistic Blendshapes from Commodity RGB-D Sensors

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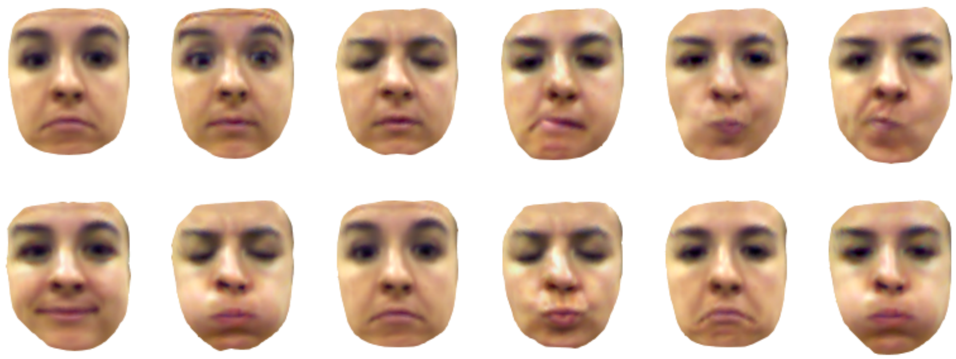

Figure 1: *We describe an end-to-end method for scanning and processing a set of facial scans from a commodity depth scanner.*

Abstract

Creating and animating a realistic 3D human face has been an important task in computer graphics. The capability of capturing the 3D face of a human subject and reanimate it quickly will find many applications in games, training simulations, and interactive 3D graphics. In this paper, we propose a system to capture photorealistic 3D faces and generate the blendshape models automatically using only a single commodity RGB-D sensor. Our method can rapidly generate a set of expressive facial poses from a single Microsoft Kinect and requires no artistic expertise on the part of the capture subject. The system takes only a matter of seconds to capture and produce a 3D facial pose and only requires 4 minutes of processing time to transform it into a blendshape model. Our main contributions include an end-to-end pipeline for capturing and generating face blendshape models automatically, and a registration method that solves dense correspondences between two face scans by utilizing facial landmark detection and optical flow. We demonstrate the effectiveness of the proposed method by capturing 3D facial models of different human subjects and puppeteering their models in an animation system with real-time facial performance retargeting.

CR Categories: I.3.7 [Computer Graphics]: Three-Dimensional Graphics and Realism—Animation;

Keywords: animation, blendshapes, faces, 3D scanning, Kinect

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1 System Overview

The goal of our work is to build an end-to-end system that can quickly capture a user's face geometry using low-cost commodity sensor and convert the raw scans into blendshape model automatically, without the need for artist intervention. Since the raw face scans have different positions and orientations, we run rigid alignment between expressions using iterative closest points (ICP) to obtain a set of aligned scans. These scans are then unwrapped into a 2D representation of points cloud and texture UV map and stored in EXR float images to be used for surface tracking. The surface tracking then utilizes the 2D representation of face scans and find correspondences from a source face pose to the target neutral face pose. To guide the surface tracking, we first apply face feature detection to find a set of facial landmark points on each scan. These feature points are used to build a Delaunay triangulation on the UV map as the intial constraints. This triangulation is used to pre-warp the 2D map of each face scan to the target neutral face pose. Then a dense image warping is done using optical flow to tranform the source image to the target image. Once the dense correspondences are established, the blendshape models can be produced by extracting a consistent mesh from each face points cloud image using an artist mesh.

Results generated by the proposed method can be used in many animation and simulation environments that utilize blendshapes. Figure 1 present results of facial animations created using the extracted blendshapes. The character rig was in less than an hour using the proposed pipeline, including capturing and processing.

The accompanying videos demonstrates the use of the data using an animation system and through puppeteering using an online facial retargeting system. We believe that the quality generated is sufficient for many uses, such as on a 3D character in a video game, or for live video conferencing.

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