Gaze Driven Animation of Eyes

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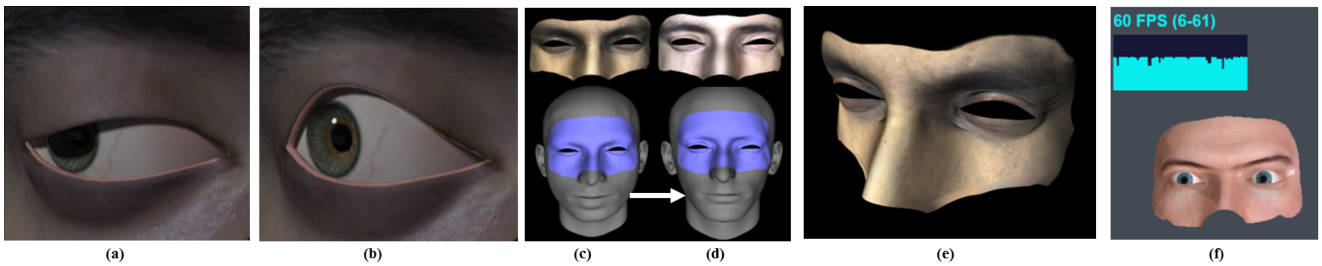

Figure 1: *Eye movement without any skin deformation looks unrealistic (a). Our model interactively computes skin deformation introducing realism in eye movements (b). After training the model on one actor (c), it can be used to transfer expressions to other characters (d). Wrinkles can be added using our model to produce realistic deformation (e). We also developed a real-time application that generates deformation at an interactive rate for user controlled gaze (f).*

1 Introduction

We present a data driven model of eye movement, that includes movement of the globes, the periorbital soft tissues and eyelids and also the formation of wrinkles in the tissues. We describe a pipeline for measurement and estimation of tissue movement around the eyes using monocular high speed video capture. We use dense optical flow techniques to simultaneously estimate skin and globe motion, as well as high resolution texture images. Our methods are robust to transient occlusions. Finally, we present a system for interactive animation of eyes using a small number of animation parameters, including gaze. These parameters can be obtained from any source, such as keyframe animation or an actor's performance.

2 Our Approach

The pipeline is decomposed into four stages: measurement, motion estimation, model construction, and interactive motion synthesis.

To measure motion around the eye region, we used a single camera at 120 fps with image resolution of 1960×1200 pixels. The scene is lit by a DC powered LED light source using polarizing filters. We perform camera calibration using Matlab's Computer Vision System Toolbox. Our skin tracking algorithm requires a subject specific 3D mesh acquired using FaceShift [Weise et al. 2011] technology with a Kinect RGB/D camera.

We track dense motion using an Eulerian representation of skin using a 2D parameterization and slide it on the 3D mesh. The skin and body move in physical space and can be imaged by a camera. The motion is obtained by tracking the mesh projected onto the camera image using [Brox and Malik 2011]. We can also estimate the color of a point in the skin atlas, the skin texture image.

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In order to model skin motion as a function of gaze parameters, we learn two models. The first model learns the shape of the eyelid margin (which we will refer to as "eyelid" for short) from gaze parameters since eyelid shape is highly dependent on gaze parameters. The second model learns skin motion depending on eyelid shape. This makes sense since the soft tissues around the eye move primarily due to the activation of *orbicularis oculi* and *levator palpebrae* muscles that control the eyelids. We use a neural network of radial basis functions to learn both the models.

Once the generative model is learned, movements of the eyes are efficiently synthesized from a specification of gaze, and a small number of additional parameters such as the aperture of the eyelid opening. Motion synthesis is extremely fast, with speed only constrained by rendering time.

3 Results

We were able to obtain $0.265mm$ reconstruction error. Using gaze data from static scene and video observation, our method produces realistic skin movement, even when performing saccades. Blink sequences can be reproduced by changing eyelid aperture.

Our work is the first to specifically address the problem of measuring and building a data-driven model the entire region of the eye. Unlike other recent work, the pipeline for measurement and estimation of tissue movement makes use of monocular video, which is more easly available. Also, a single trained model can be transfered to many different characters, separating capture from synthesis.

References

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