Face Expression Synthesis
Based on a Facial Motion Distribution Chart

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1 Introduction

In recent years, 3D computer graphic techniques are used for virtual human and cartoon characters in the entertainment industry. Their facial expressions and mouth movements are natural and smooth. However, these successful results require a tremendous amount of time and effort on the part of accomplished CG creators. In fact, the technique of producing facial expressions for a face mesh object typically calls for preparing all of the transformed objects after changing expressions. Then, using blend shape (another way of saying “morphing”) deformers, we can change the neutral face object into the transformed objects.

To solve these problems, we propose a technique to create deformed models of the expressions from any user-created face object in a short period of time (Figure 1). First, we create "Facial Motion Distribution Chart" (FMD Chart) which describes the 3D displacement difference of mesh nodes of the face object between an neutral object and a deformed objects. In order to deform a object from the user object using the FMD Chart, we modified the chart smoothly using Radial Basis Function Translation (RBFT). The user who created the face object can thereby create deformed objects with expressions automatically. In other words, the user face object can attain the necessary deformed expressions by preparing various charts of expressions that include realistic, cartoon like and personalized facial expressions. This technique is similar to expression cloning [Noh and Neumann 2001] using RBFT. However we improve accuracy and usability of cloning the face object. For example, we employ FMD-chart of the image-space field (similar to u-v texture-space), which can exactly match the target mesh to separate the upper and lower lips.

This paper describes the definition of FMD Chart, the method for creating the chart, and fitting the user face object and the deformed object. We also demonstrate the results of a re-synthesized user object with facial expression.

2 Facial Motion Distribution Chart

This chart consists of grid structures (pixels), and each pixel stores a 3D displacement. The method for generating a chart from previously defined user face objects with expressions is as follows: First, we fit the frontal face mesh object and an FMD chart that doesn’t have any displacements. Next, we determine which pixels of the chart are inside the meshes of the face. When there is a pixel inside a mesh, the 3D displacement is calculated by interpolating each node of mesh that has a corresponding displacement and store it in the pixel. The figure 2 shows an image that is colored in response to the displacements.

3 Fitting FMD Chart and User Face Object

The number of meshes and the structure of the shape are different between the source models used fore the FMD-chart and the user face model. Therefore we have to translate the chart to fit the user face object using RBFT. The anchor points are put on the previously defined frontal user-created face objects and the frontal user face object around the eyes, eyebrows, nose, mouth and outline of the face manually. The total number of the points is about 100, but it takes less than 10 minutes using an easy rule-based operation tool. The pair of anchor points is used to determine the warping of the FMD Chart using RBFT. Figure 2 shows the dedicated FMD chart for the user face object.

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4 Results

The user-created face object with expressions is created to apply the dedicated FMD Chart, as shown in video demonstraion. These objects have a different number of polygons and shape topologies. But the user face object with expression copies the FMD Chart’s displacement correctly.

Acknowledgements

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References

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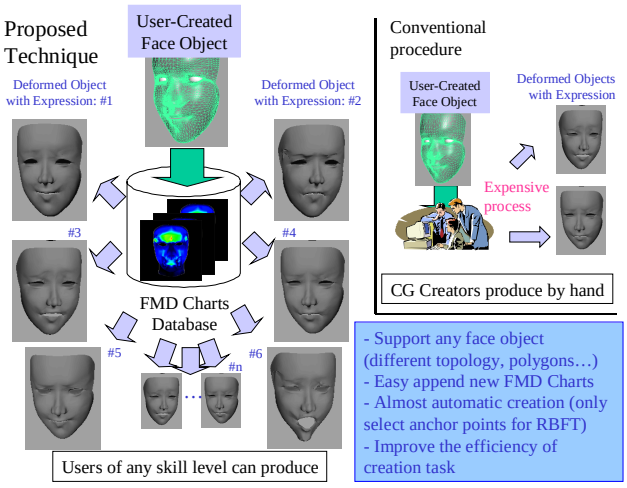
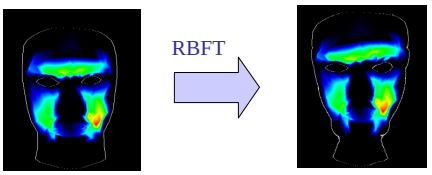


Figure 1: Overview of Proposed Technique



Original FMD Chart image

Dedicated FMD Chart image for user object

Figure 2: Convert FMD-Chart using RBFT