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Literature Review 1

Visual Computer (Springer)

1) Title: Interactive Facial Expression editing based on Spatio- temporal coherency. (Primary Paper)

In today's world the application of 3D face animation is very prominent and widespread. We have the real world implementation such as the Apple "Animoji" and various other platforms offering such kind of interactive facial animations. However the problem with many of these facial expression editing approach is the restricted user edit functionality and the unnatural results generated from the final editing. The above paper proposes a very interactive and intuitive approach to edit such facial expressions based in the spatio-temporal coherency model. The main idea of this approach is to combine the user generated constraints with the set of pre recorded facial expression sets and then apply the interpolation techniques discussed below to produce more realistic and expressive facial expression animation. The approach allows the user to interactively select the 2D pixels and then displace them in a unique way to produce the desired facial expression.

The approach has mainly four steps by which we get the final animated facial expression. The figure below gives us the idea of the pipeline approach implemented in this paper .The steps are user editing, modeling the deformations of control points, soft region segmentation, soft region blending.

i) User editing:- The user can choose different control points and then imposing various constraints on them to get the desired facial expression. To do so the approach allows the user to specify the point constraints in the 2D screen space .In other words the user selects the set of source pixels in the 3D vertex by picking the pixels on the 2D screen and then a set of target pixels to change the facial expression. What it actually does is it performs the ray tracing with source pixels to select on the face model and then a new expression mesh is created by a mathematical formula p= F(q) where p= set of original pixels and 'q'= set of transformed target pixels.

ii) Modeling deformations of the control points:- The deformations specified by the user generated control points are modeled separately here. The deformations are basically represented as linear combinations of the pre recorded face set. Here the creation of natural expression is ensured by the priori embedded in the face set. A new metric is introduced here

for blending weights which not only satisfies the user edited constraints but also considers the proximity between the example and the user defined expression.

iii) Influence maps and region segmentation:- Based on the control points specified by the user the face model is segmented into various soft region each having a control point. The soft region segmentation and the influence map are both dependent on the coherency between the control points and the vertices. Thus the coherency criterion described in the paper exploits the spatio-temporal motion consistency over the vertices and the input sequence. Using this a coherency value is calculated for each vertex with respect to each control point.

iv) Soft region blending:- The final single expression is generated by blending into the soft region to propagate the influence of each region over the entire mesh. This blending is guided by the local influence map and the control point in each region.

The approach was tested against various other established methods such as the Zhang's method. Zhang's method used the radial basis function which only involves the spatial distance to compute the influence map unlike the approach implemented in the paper which introduces the spatio-temporal consistency of vertices over the face sequence as well as spatial proximity to calculate the influence map. Based on various experimental data and results it is found that the this approach produced more accurate and natural facial expression in many cases compared to Zhang's method.

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2) Title: Vision based Control of 3D facial Animation (Secondary paper)

This paper was published prior to the one above and the primary paper uses the work done in this particular paper like the preprocessed set of facial database recorded which is used in the above(primary) paper to enhance the animation and facial expression.

Controlling and animating the computer generated 3D face model is difficult because the face has many degrees of freedom whereas the current input systems can only identify and record few on these. This paper proposes implementing a new system using which a rich lifelike set of facial expressions and animations can be achieved using the preprocessed database.

The system described in the paper has four main components:-

i) Video Analysis:- Simultaneously track the 3D position of the head and some important facial expressions and then automatically translate them into high level animation control parameters

ii) Motion capture and data preprocessing:- Separate head motion from facial deformations and extract the expression control parameters from the decoupled motion captured data.

iii) Expression control and animation:- Efficiently transform the noisy and low-resolution signal to high quality motion in the context of motion capture data. Degrees of freedom that were noisy and corrupt are filtered and new degrees of freedom and expression are generated using the information contained in the motion capture data.

iv) Expression retargeting:- Adapt the synthesized motion to animate the vertices of different character model at runtime.

The motion capture data is done offline where as all the other stages are completed online based on the inputs from the user. A generic cylinder model is used to calculate the head geometry of the user and then the model based tracking is applied to track the pose. The facial tracking algorithm is based in the hand initialized first frame. For the Data driven expression synthesis the paper proposes a new search method called as the K-nearest-search technique. Rather than searching the full database this technique considers only the the data points that are within the particular distance from the last query. For expression retargeting a cloning technique is used to map the expression of the source model to the target model.

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