An Art-Directed Workflow for Transferring Facial Action Coding Between Models with Different Mesh Topologies

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ABSTRACT

In this paper, we present a simple and intuitive approach to transfer existing FACS (Facial Action Coding System) based facial rig and its data set on to a different facial model that has a different mesh topology to support rigging and animation pipeline for visual effects films, 3D animations, and video games. Facial rigs are custom built for each character and are time consuming and complex to create, and even minor tweaks on the model typology may cause the rigging process to start from scratch. In order to maximize the data reuse, this system can apply one set of data onto a variety of human or creature facial rigs.

KEYWORDS

FACS, Rig Transfer

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1 INTRODUCTION AND MOTIVATION

One of the most challenging problems for high profile feature films and video games is to construct realistic facial rigging for turning digital models to obtain nearly any anatomically possible facial expression shapes. The most common facial rigging systems in movie and game industry to obtain lifelike realistic facial are based on Facial Action Coding System (FACS) [Ekman 1997]. FACS is a landmark technique that enables remarkable improvements in making realistic facial animations, it helps animators to represent and build realistic facial expressions by configuring all possible facial animation units of the human face [Tolba et al. 2018]. A FACS based facial rig consists of 700 to 1,100 shapes and creating a complete production ready facial rig is extremely time consuming and and labor intensive. There is, therefore, a need for techniques to transfer existing FACS based facial rigs. Our inspiration for this work came from techniques to transfer biped characters rigs. These techniques have already being used widely in the visual effects and video games industries. There are already many implemented approaches and workflows such as transferring rigs using full-body inverse kinematics. On the other hand, as far as we know there is no technique to transfer facial rigs. This is mainly because using a facial rig onto a different character's head is elusive and extremely challenging. Unique personality and look of each character manifest itself in faces more than any other part of human body. In addition, the complexities in facial rigs limit the transfer rig and expressions on dissimilar characters. Therefore, there is a need for an approach that can allow intuitive transfer of facial rigs.An important property of this approach is that the two meshes do not have to have the same topology. The number of their vertices can also be different. We have also tried to transfer FACS to shapes other than faces such as a model of an helicopter (See Figure 2).

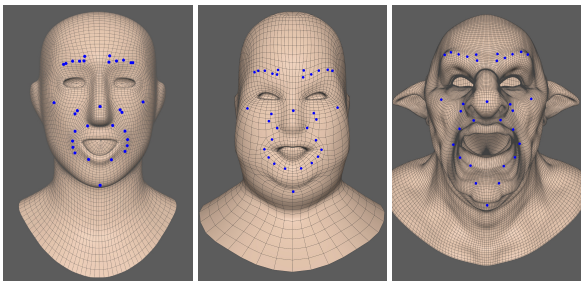

Figure 1: One example of transferring a facial expression to other models using our workflow.

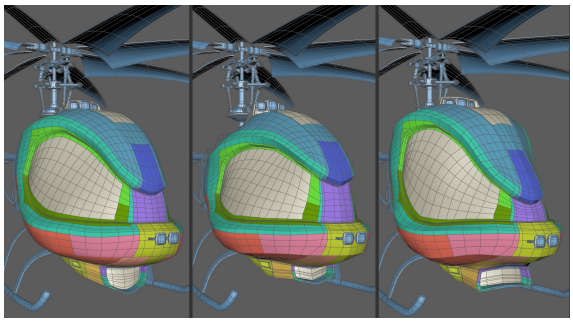

Figure 2: Transferring facial expressions of source model to a model of an helicopter.

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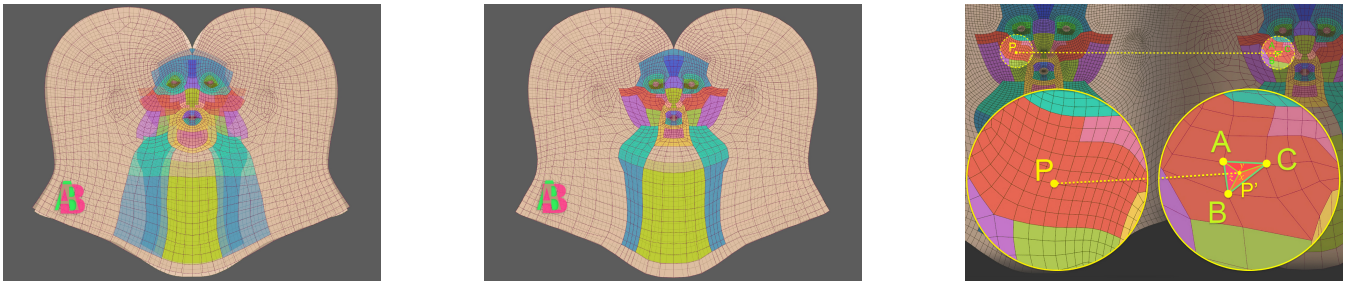
(a) Source facial models with associated Facial Action Coding System. **(b) Target facial model with different topology and vertex counts.** **(c) Facial muscle anatomy of Source under X-Ray visualization.** **(d) Facial muscles are organized into different groups.** **(e) Artist's retargeting reference for source model.** **(f) Artist's retargeting reference for target model.**



(g) Overlay view of before matching flattened region maps. **(h) Overlay view of after matching flattened region maps.** **(i) Weight calculation using Barycentric algebra.**

Figure 3: The overview of our art-directed workflow for transferring Facial Action Coding System from one facial model to another facial model with different topology and vertex counts. In this process artists have a simple control on results by painting retargeting reference maps as shown in 3e and 3f.

2 WORKFLOW

In this work, we introduce a workflow to modify and match the user defined key regions on the face. This workflow helps to transfer an appropriate amount of performance from any given key region. As a result, artists can have the freedom to elevate and decrease values in certain areas and through this workflow. This workflow allows to extract each of the FACS shapes in the facial rig, and then replace them with the existing FACS shapes. Our workflow consists of four stages. In implementation, We used Autodesk Maya for content browser.

(1) Turning a Facial Model into a Source Model: We start with a facial model that already have a powerful FACS (see Figure 3a). The models shown here are retrieved from Pluralsight. Using facial muscle anatomy of source model under X-Ray visualization (see Figures 3c and 3d), artists paint a retargeting map on the surface of source polygonal mesh, where colors refers different muscle groups (see Figure 3e).
(2) Preparing Target Models: Artists also paint a similar retargeting map on the surface of target polygonal mesh. In this retargeting map, the same colors refers the same muscle groups, however, these maps do not have to be topologically the same as the original reference (see Figure 3f).
(3) Matching Flattening Regions: In this stage, we flatten both source and target meshes. The initial flattened shapes can be significantly different as shown in Figure 3g. Then, artists approximately match the boundaries of the flattened shapes and two retargeting maps as shown Figure 3h.
(4) Barycentric Correspondence: Using approximately corresponded flattened shapes and retargeting map, we identify one-to-one correspondence between any vertex in target model to a 3D position in source model. Using this correspondence, we go through all the source FACS to generate new FACS based off of the target model by applying the calculated weights (see Figure 3i).
(5) Assembling Target FACS Based Facial Rig: Once, the target FACS are generated, we simply replace the source FACS with the target FACS in the existing rig motion system that has the same controls and animation data, and we are able to obtain similar expressions as shown in Figure 1. The quality of final facial expressions is, of course, depends on the quality of initial FACS model.

REFERENCES

Rosenberg Ekman. 1997. *What the face reveals: Basic and applied studies of spontaneous expression using the Facial Action Coding System (FACS).* Oxford University Press, London, UK.

Rahma M Tolba, Taha Al-Arif, and El-Sayed M El Horbaty. 2018. Realistic Facial Animation Review: Based on Facial Action Coding System. *Egyptian Computer Science Journal* 42, 1 (2018), 1–9.