Head Model Reconstruction and Animation Method Using RGBD Image

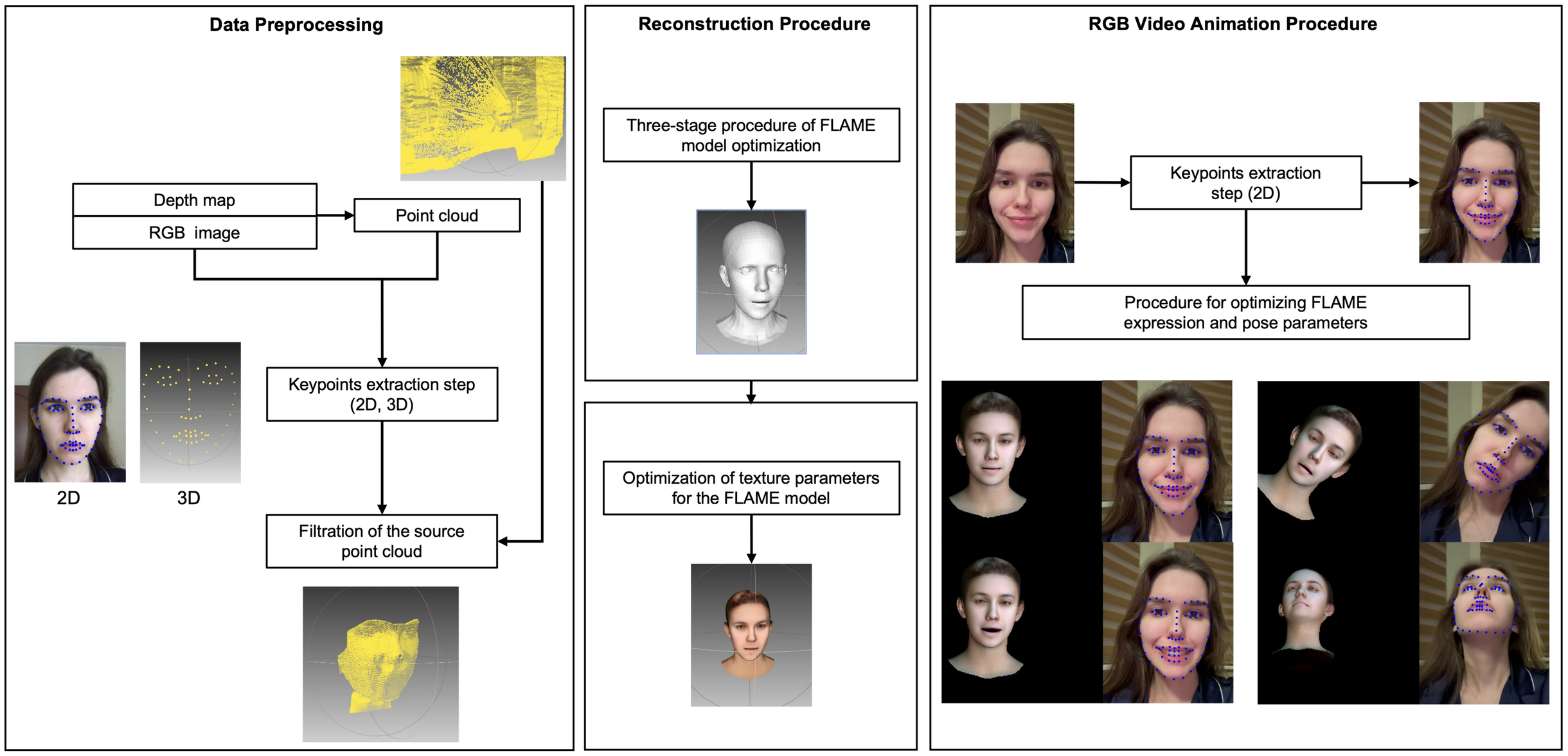
Yu. Kh. Kozlova[1]
jganeeva99@gmail.com

V. V. Myasnikov[1]
vmyas@geosamara.ru

Abstract

The article presents a method for reconstructing and animating a digital model of a human head from a single RGBD image. An approach is proposed for optimizing the parametric FLAME model using a point cloud of a face corresponding to a single RGBD image. The results of experimental studies have shown that the proposed optimization approach makes it possible to obtain a head model with more prominent features of the original face compared to optimization approaches using RGB images or the same approaches generalized to RGBD images.

Diagram of the method of reconstruction and animation of the head model using single RGBD image



A dataset was collected from several people to conduct experimental studies using the ZED2 stereo camera. Each person has an RGB image, a depth map, and a point cloud.

As the data is specific to reconstructing the head model, we can only rely on visual evaluation. The methods tested were the proposed method, the original method [5], and the DECA method. The DECA method uses information on 3D key points of the face from [12], resulting only in approximations for key face points. To make a meaningful comparison, target 3D key points were given to DECA. Results of the comparison are in Figure 1.

From the obtained results, we can conclude that the classical approach to optimizing the FLAME model based on the two-dimensional coordinates of key points allows only the plane to obtain some similarity between the model and a person. As in DECA, the introduction of an additional encoder-based refinement step has allowed facial features to be refined. However, the result is still only an approximation. The approach to optimization proposed by us made it possible to obtain the result of the reconstruction closest to reality. The average error values for data from the entire data set at each optimization stage of the head model reconstruction procedure are presented in Table 1. It is important to note that the increase in the error value at the final optimization stage is due to a different nature of the data entering the optimization criterion.

After the reconstruction stage, we performed texturing of the resulting models. We present the texturing result for one of the models in Figure 2. The average value of the loss function over the entire dataset at the current stage was 0.038.

The final stage of the method is the animation of the reconstructed head model based on the RGB video sequence. It is important to note that the input video sequence can contain articulation for any person. That is, the reconstructed model has no rigid dependence on the person corresponding to it. First, the extraction of key points for each frame is performed, after which the parameters of the reconstructed head model are optimized, as described in the corresponding subsection devoted to the description of the proposed method. Diagram of the method shows an example of the current stage for arbitrary video sequence frames. During optimization at the current stage, the maximum error value for a frame was 0.04. This value was chosen experimentally and is considered the most appropriate for the correct display of articulation. Choosing this value allows us to find a compromise between speed and quality of work. We set it as a threshold value in the optimization cycle. That is, the optimization of the facial expression for the final mesh per frame is performed until the value of the error function becomes less than 0.04.

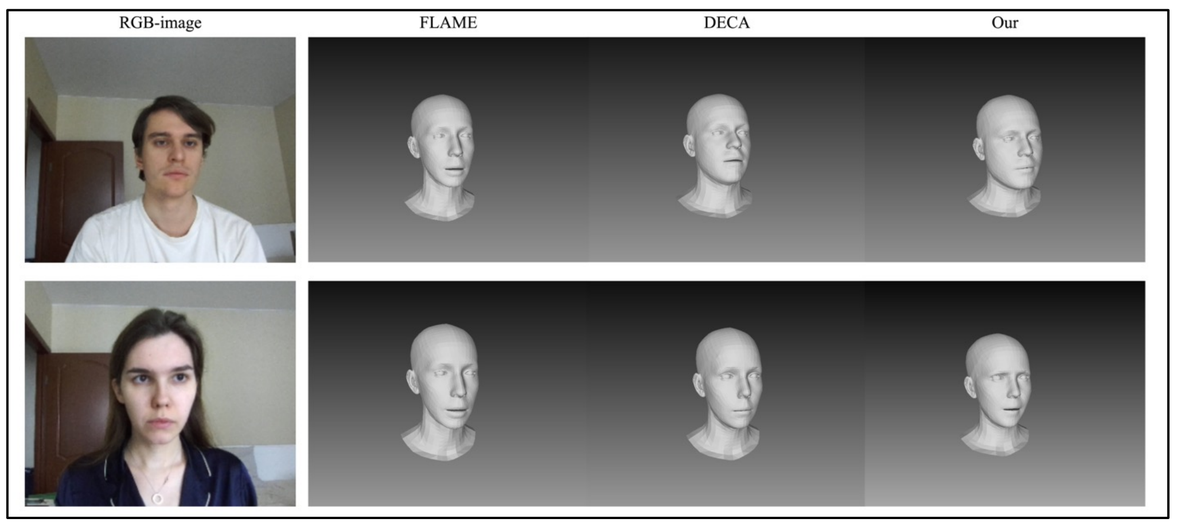


Fig. 1. Comparison of methods for reconstructing the human head model

Fig. 2. Texturing result of the reconstructed human head model.

Table 1. Average values of the loss function at the stage of reconstruction of the human head over the entire dataset

Optimization stage	Value of the loss function
First optimization block	0.049
Second optimization block	0.019
Third optimization block	0.0017

[1]**SAMARA NATIONAL RESEARCH UNIVERSITY**
34, Moskovskoye shosse, Samara, 443086, Russia
www.ssau.ru

SAMARA UNIVERSITY