SYNTHETIC DATA GENERATION FOR AN ALL-IN-ONE DMS

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NEED FOR SYNTHETIC DATA

Where does real world data fall short?

High resolution devices are needed for measuring parameters – headpose, gaze

Some measuring devices interfere with scene – glasses for eye tracking

No devices available for recording parameters – face landmarks at extreme angles

Need for manually labelling real world data – Hand label parameters

Limited by manpower and time – need subjects for recording in different environments

Less flexible in terms of environment parameters – lighting, camera distance, background

AGENDA

Data generation pipeline

Parameter settings

Deployment

DATA GENERATION PIPELINE

DATA GENERATION PIPELINE

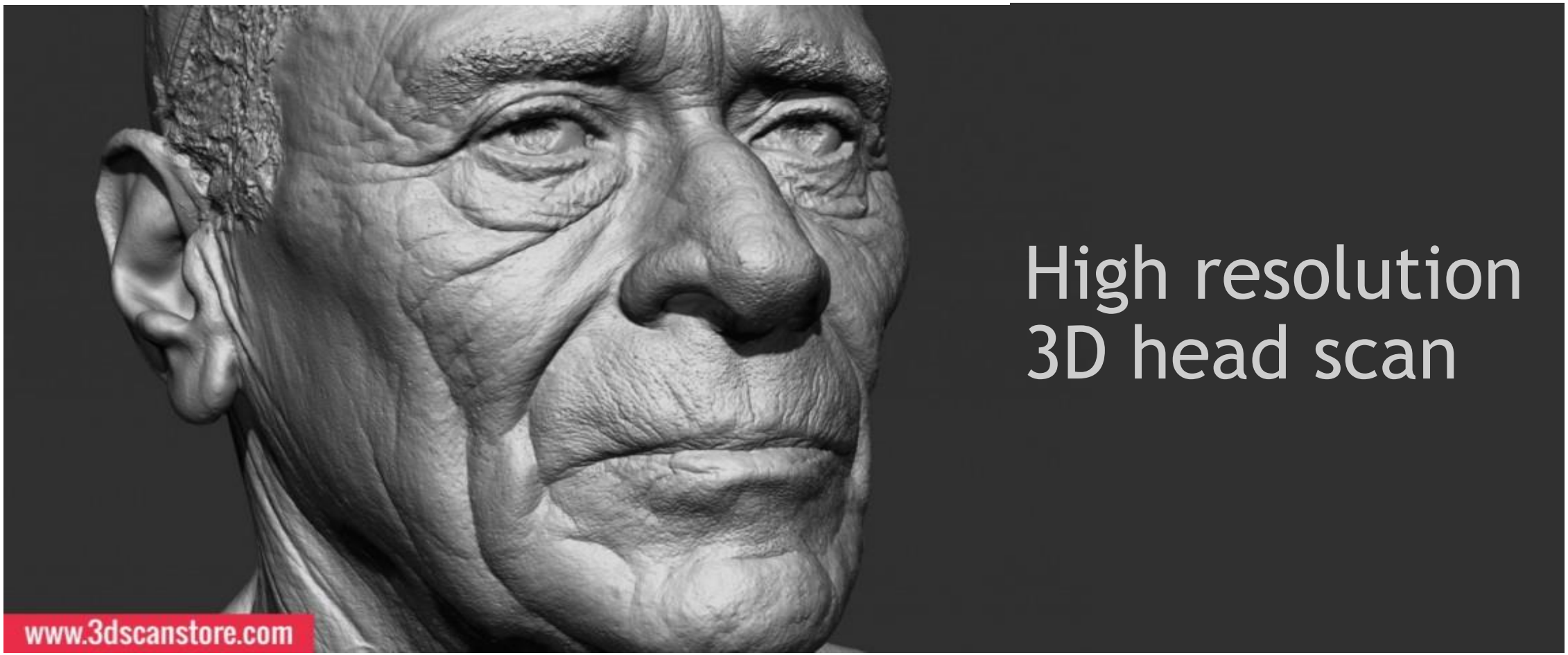
3D head scan High resolution

Retopology

Defining mesh deformation

Annotation

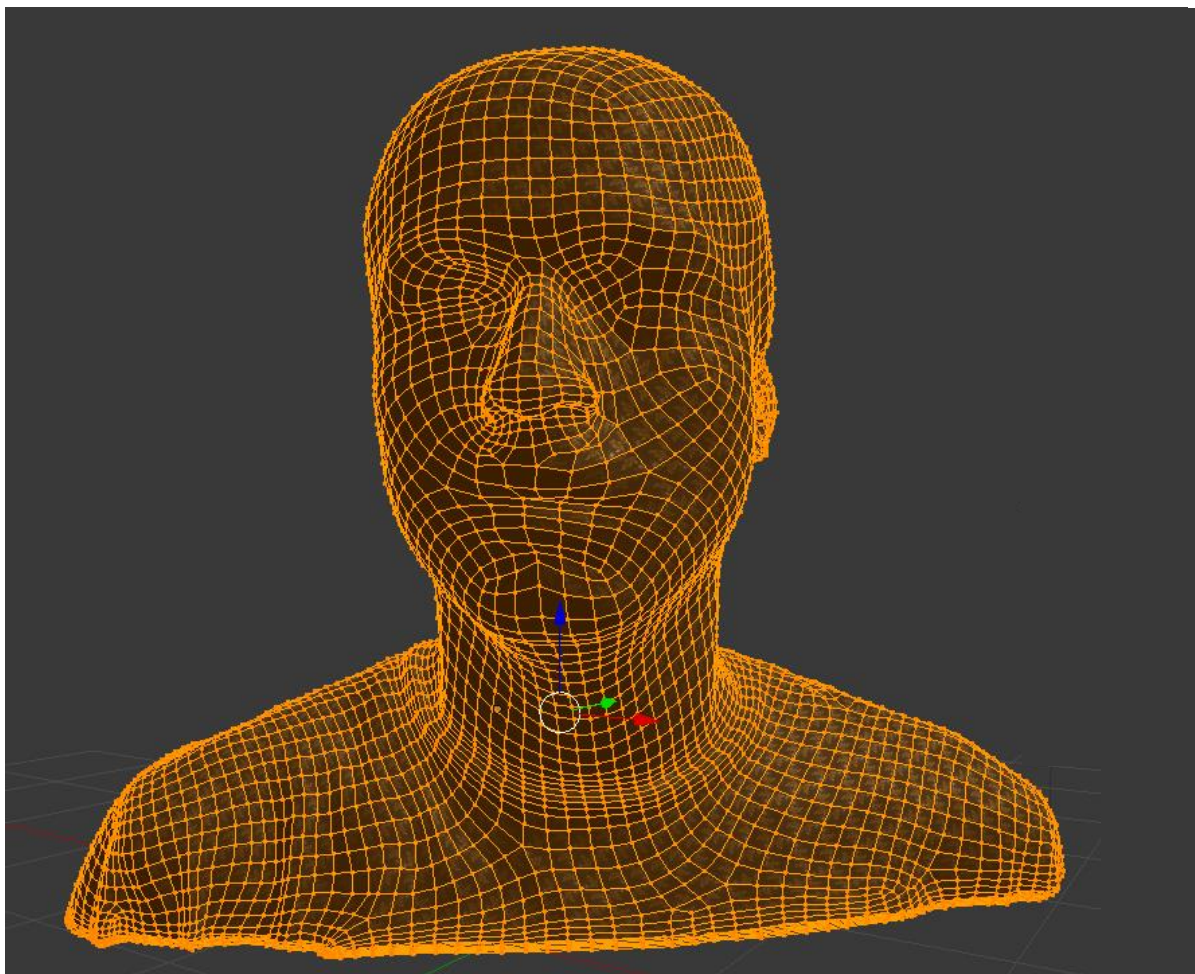
DATA GENERATION PIPELINE



High resolution
3D head scan

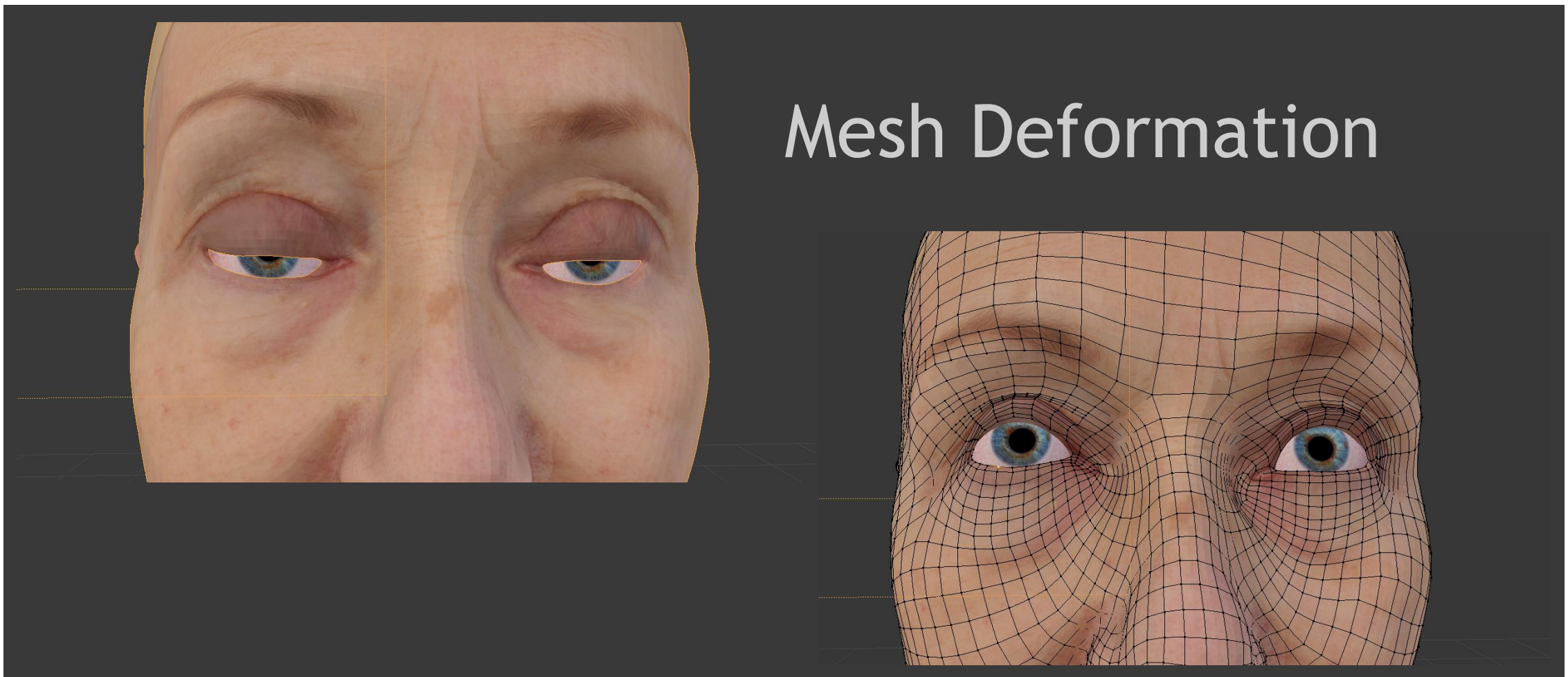
http://ten24.info/10-x-high-resolution-head-scans-avaliable-to-download/

DATA GENERATION PIPELINE

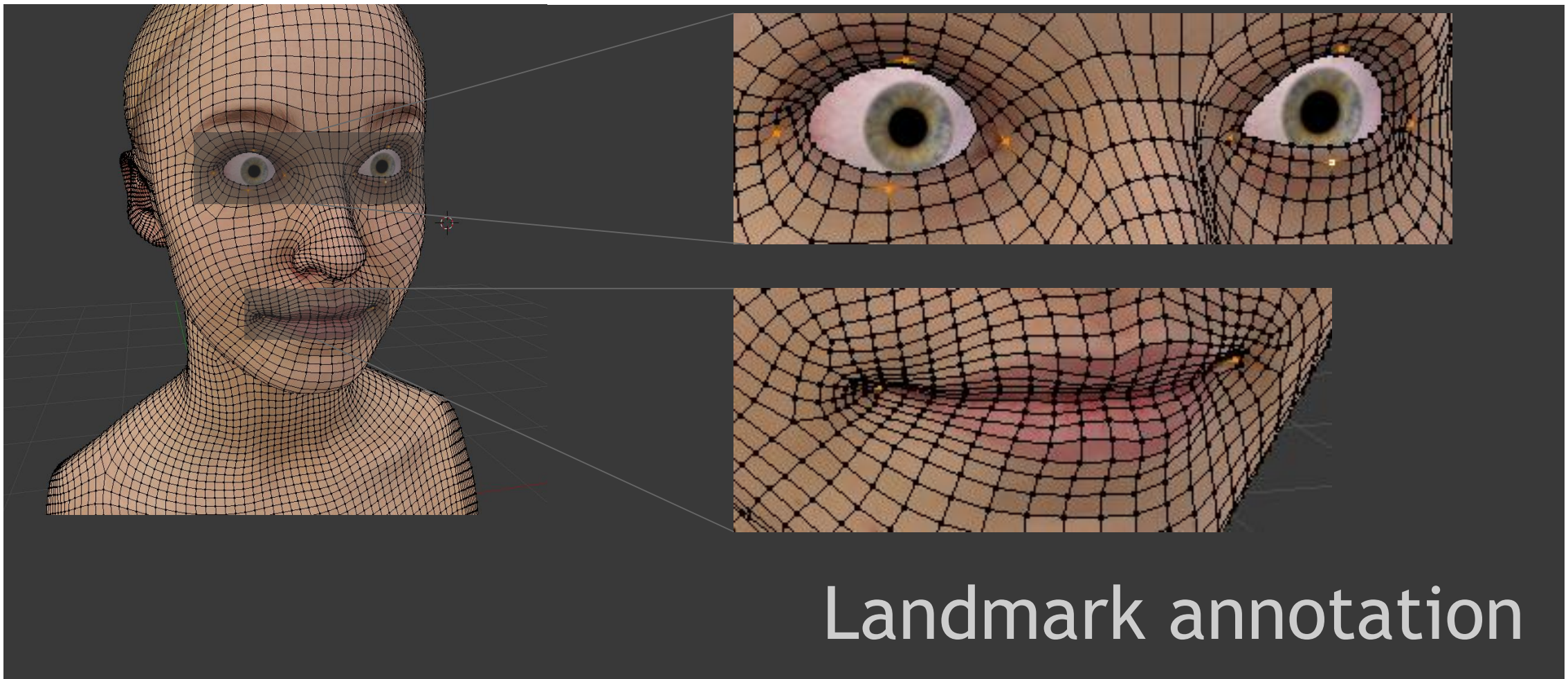


Retopology

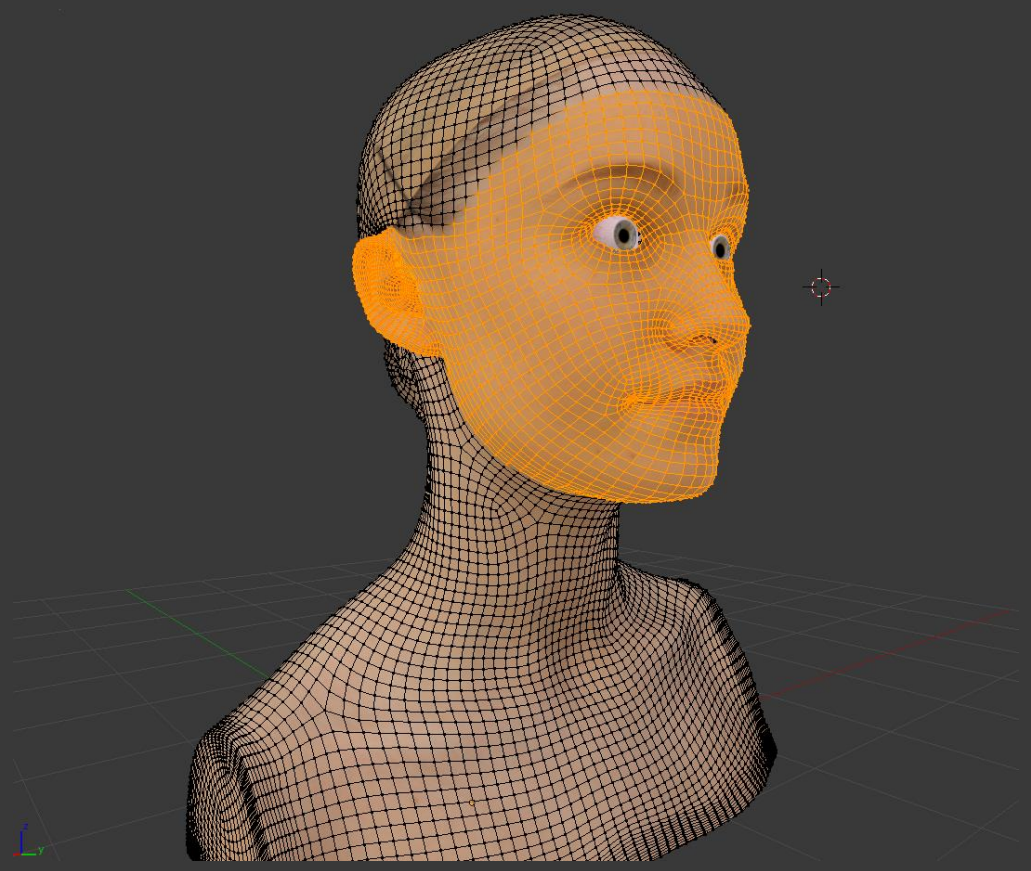
DATA GENERATION PIPELINE



DATA GENERATION PIPELINE



DATA GENERATION PIPELINE



Facemask annotation

PARAMETER SETTING

PARAMETER SETTING

Programmatically control following parameters

Face Detection

Head Pose

Gaze coordinates

Lighting

Iris color

Pupil Dilation

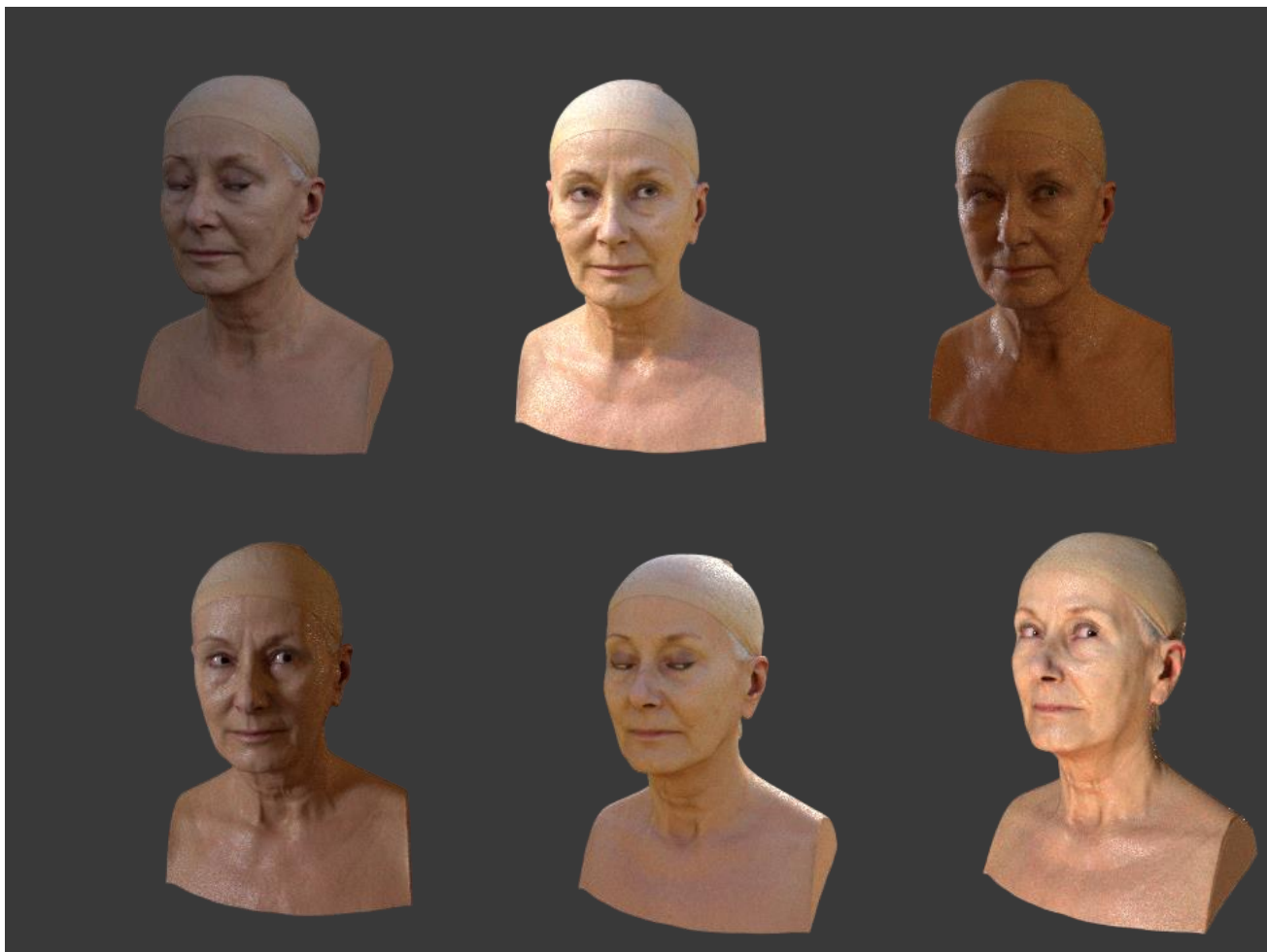
Mouth openness

Eye openness

PARAMETER SETTING

Head Pose control

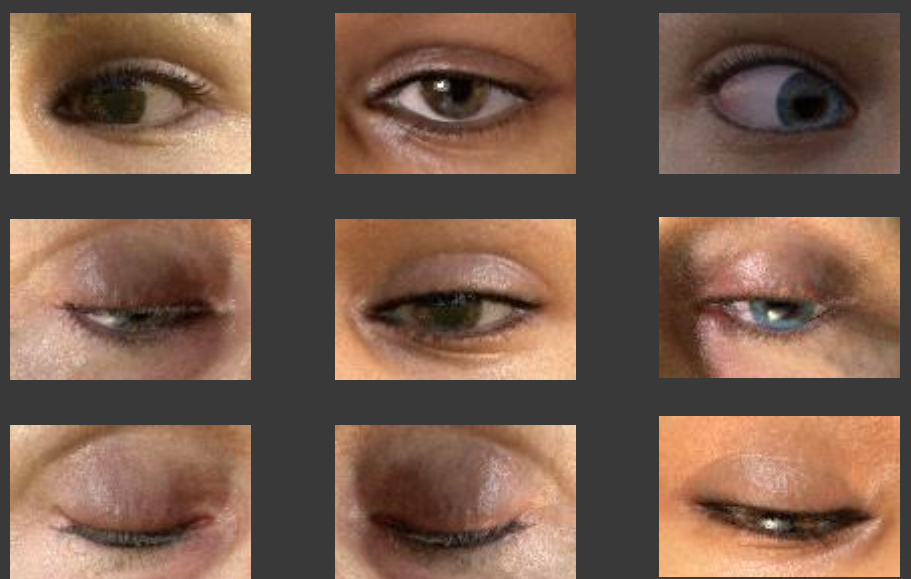
PARAMETER SETTING



Gaze control

PARAMETER SETTING

PARAMETER SETTING



Eye Openness

DEPLOYMENT

DEPLOYMENT

Execution	SEC/FRAME	150K FRAMES *	COMMENTS
CPU	40	70 days	Consumes entire CPU
GPU	8	14 days	30-60% GPU
DGX (say 10 GPUs)	8/10	1.3 days	

* Training a DNN requires images in the order of ~150K and higher

POST PROCESSING

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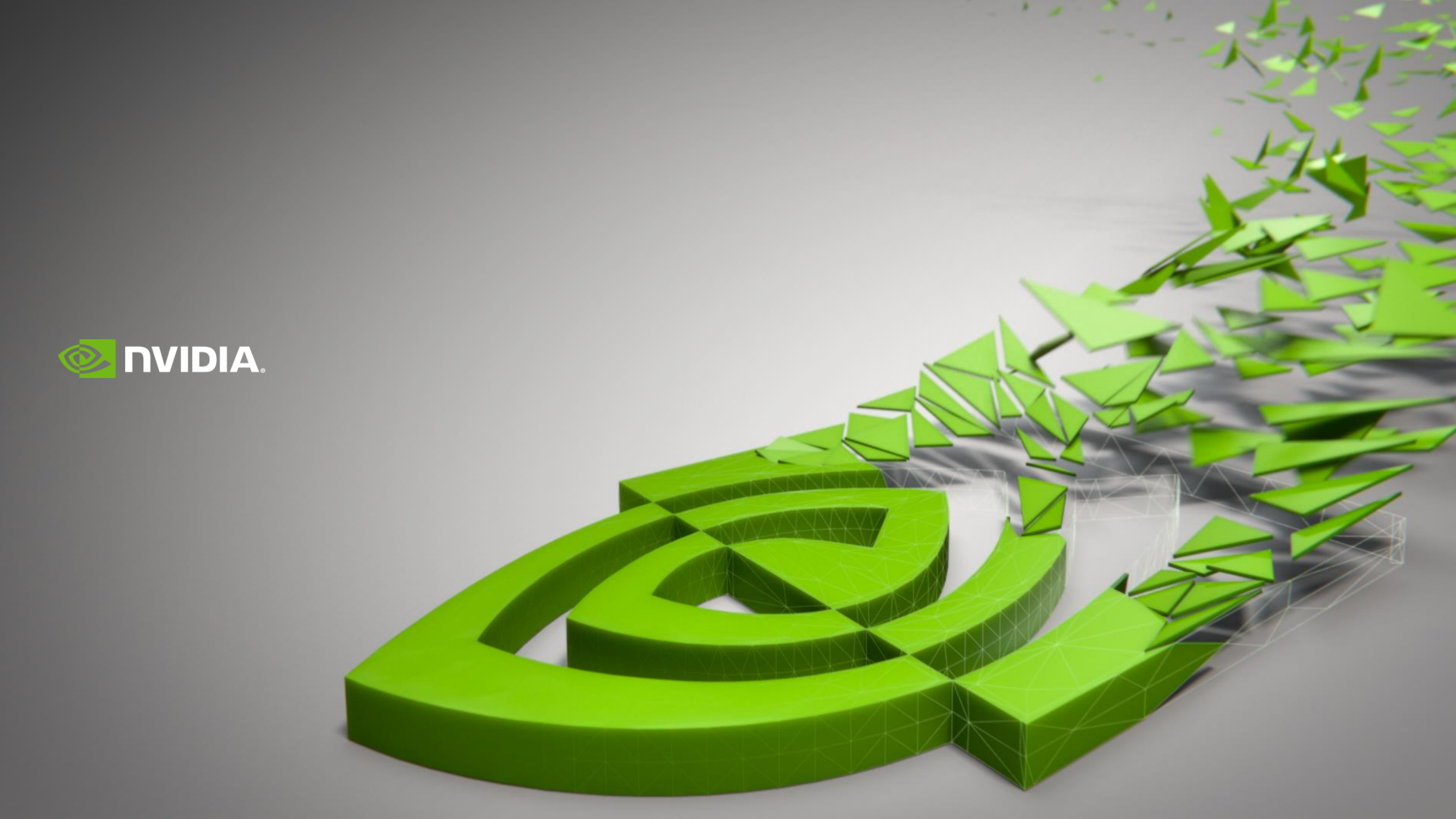
Domain adaption to resemble real data

Gaussian filtering

Blurring

Noise addition

Brightness/contrast correction


NVIDIA

REFERENCES

[1] Erroll Wood, Tadas Baltrusaitis, Xucong Zhang, Yusuke Sugano, Peter Robinson, Andreas Bulling (ICCV 2015) Rendering of Eyes for Eye-Shape Registration and Gaze Estimation
[2] http://ten24.info/10-x-high-resolution-head-scans-avaliable-to-download/

BACKUP

Pipeline to generate synthetic data for a scanned 3D face:

1. 3D scan subject face and get the model in .obj file format and texture files as .jpg files
2. Open the .obj files in Blender GUI
    1. Define the eye cornea, pupil, lids
    2. Re-mesh the face based on retopology techniques and
    3. Save it as .blend file (Blender GUI uses its own proprietary .blend format which is similar to the standard .obj or .mtl format)

3. Copy the texture files (neutral) as look_up and look_down texture .jpg files respectively.
    1. Create the displacement map files.
    2. Remove the dark crease line above and below both the eyes for look_up and look_down texture .jpg files respectively.
    3. This is done for both the color and disp images.
4. Open this .blend file in Blender GUI to manually label the vertices based on some template (6 or 68 points)
    1. The order of vertices in the 6 points template is Right eye right edge, Right eye left edge, left eye right edge, left eye left edge, lips right edge and lips left edge.

4. Next, you note down the vertex group ordering in the script. When the .blend file is saved, the order is not maintained, so note it down to handle it in script.
   (This is done because blender does not store vertices in correct order despite labeling them in the right sequence)
5. Following which you animate both the eyes (Use Blender GUI for steps 2 to 5)
    1. Eye animation is defined by eye lashes movement, eye lid movement and eye ball rotation.
    2. Eye lashes and eye lid movements are defined by two parameters “look up” and “look down”. We need to define how precisely should the eye lashes and eye lid deform for these two parameters.
    3. “look up” being high indicates the upper eye lid should be more curved and should move closer to the eyebrows and lower eye lid should also move upwards though less and with lesser changes in curvature.
        1. The corners of the eye also move a bit upwards.
        2. Upper eye lashes tend to have an angle and become somewhat vertical facing upwards; lower eye lashes become somewhat horizontal.
    4. Similar deformations for “look_down” parameter where the curvature for upper eye lid is lesser (flattened) and the lower eye lid moves a bit lower.
        1. Upper eye lashes are somewhat horizontal and lower eye lashes are inclined and somewhat vertical facing downwards.
    5. Eye balls orientation and position needs to be aligned with cornea and sclera.
6. You run the scripts over the .blend and texture .jpg files which are placed in a folder for each of the subjects to get the synthetic data (at different head pose and gaze values)
   Python scripts + .blend executed using blender binary => .png files