



香港中文大學(深圳)  
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HUAWEI



# ***RaBit*: Parametric Modeling of 3D Biped Cartoon Characters with a Topological-consistent Dataset**

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# Overview

- *3DBiCar*, the first large-scale dataset of 3D biped cartoon characters

*3DBiCar* includes 1,500 textured models among 15 species.

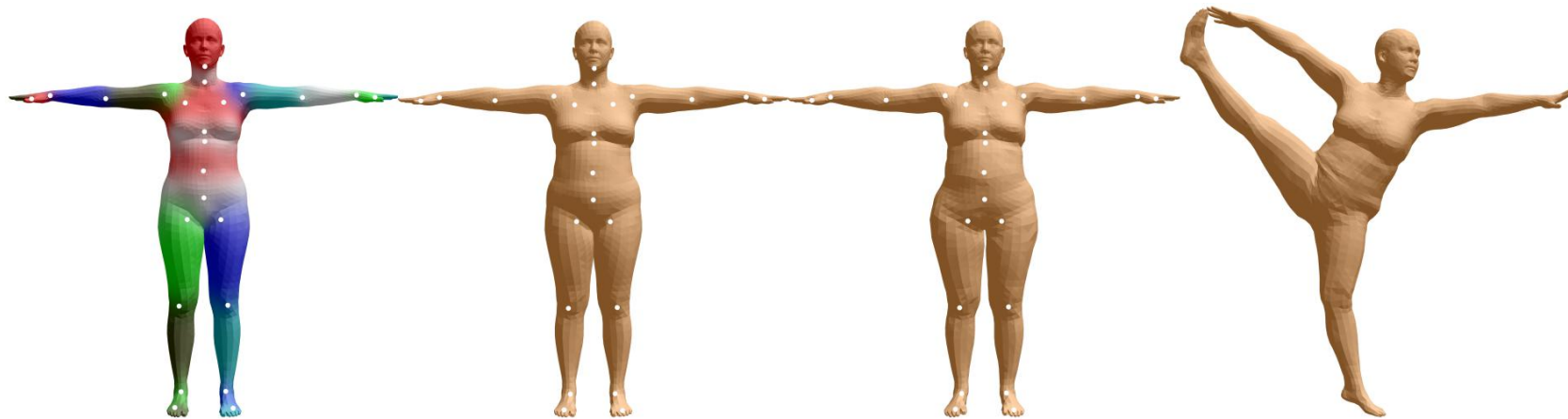
All models are in topological-consistency.

Animation is for visualization.

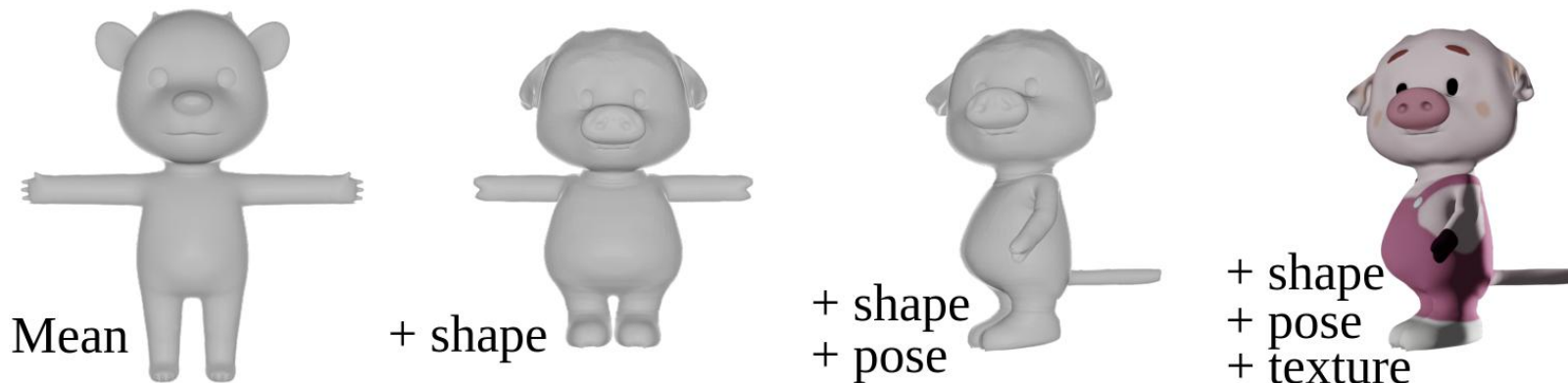


# Overview

- *RaBit*, the first 3D full-body parametric model for biped character modeling



SMPL (SIGGRAPH Asia 2015)

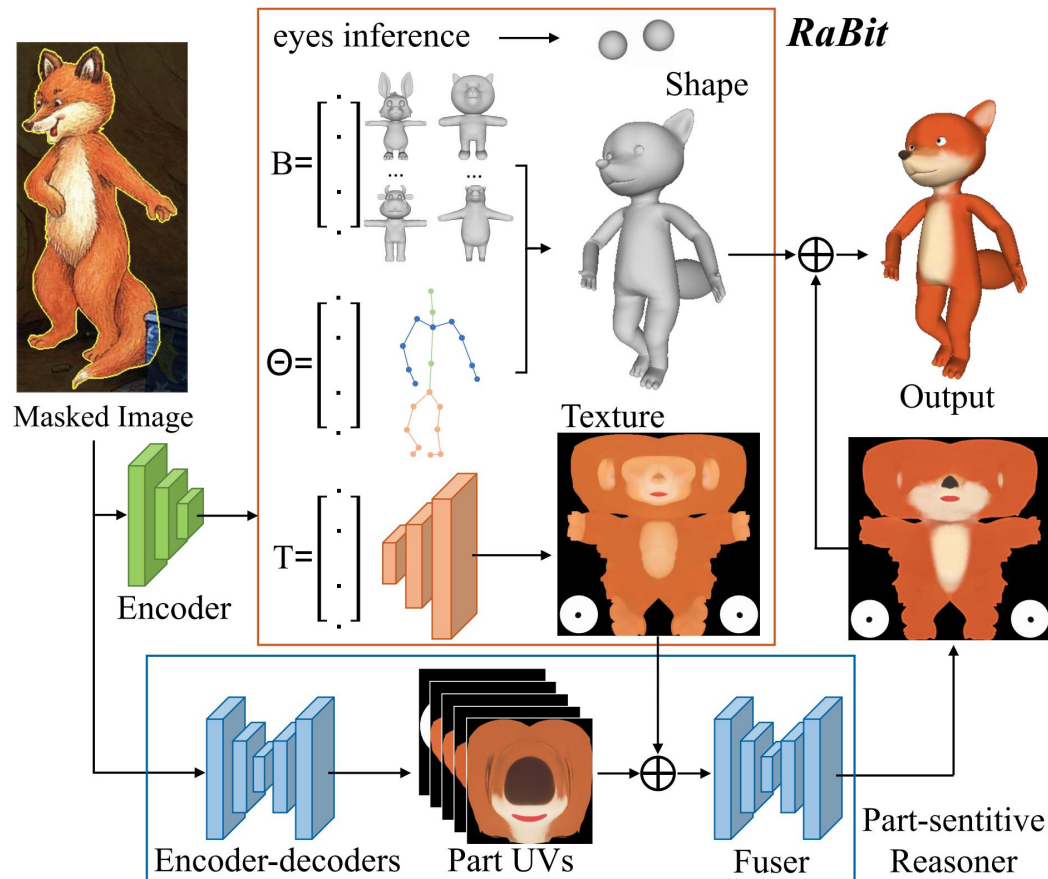


*RaBit*, SMPL-Like Parametric Model for Biped Characters



# Overview

- *BiCarNet*, the SVR baseline for reconstructing 3D biped cartoon characters



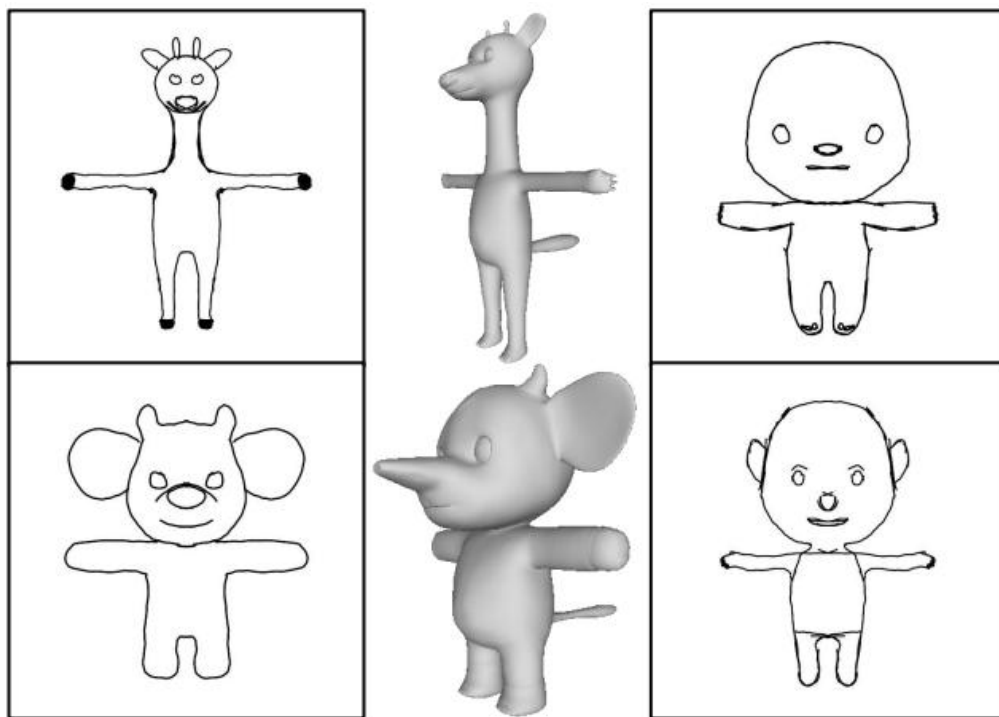
The pipeline of *BiCarNet*



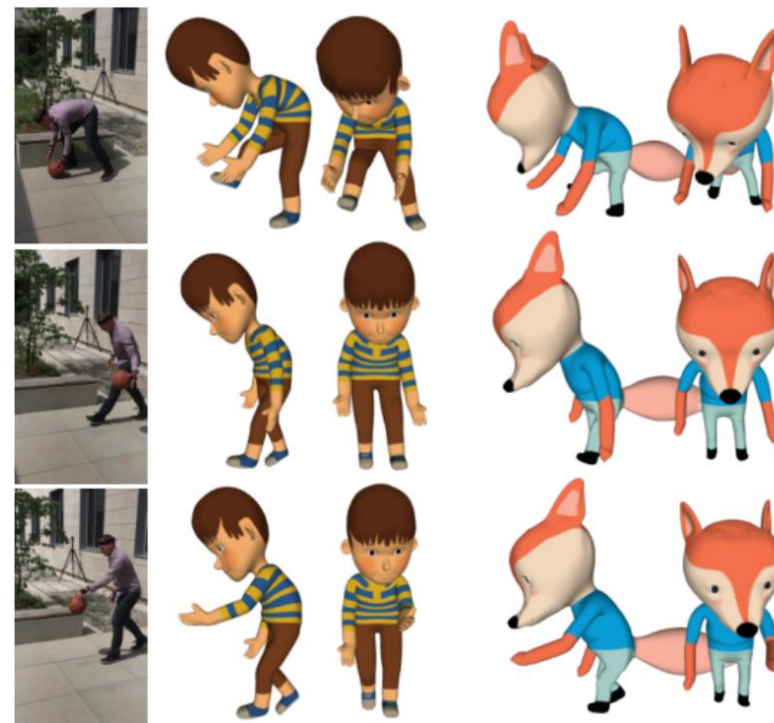
Results of *BiCarNet*

# Overview

- Two other applications, i.e., **sketch-based modeling** and **3D character animation**, also demonstrate the promising potential of *3DBiCar* and *RaBit*



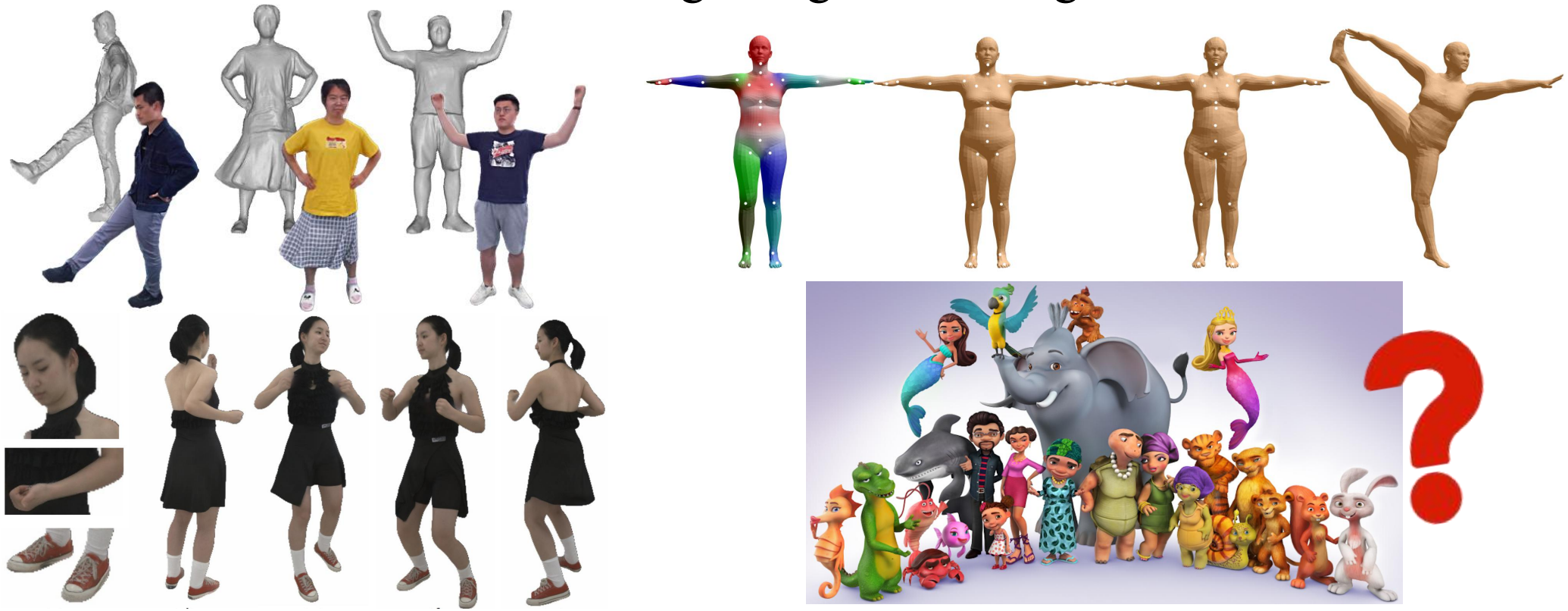
Results of sketch-based modeling



Results of 3D character animation

# Background

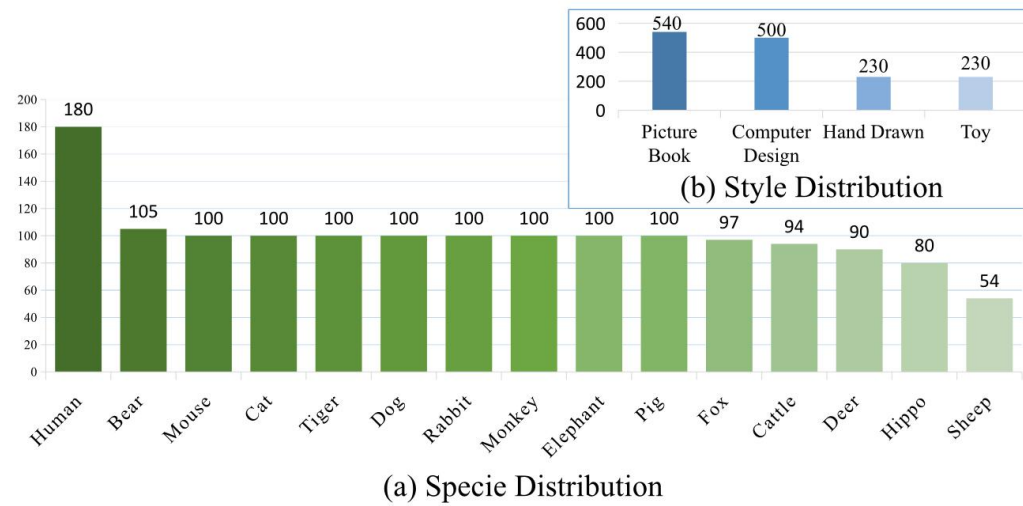
- Recent learning-based approaches have achieved unprecedented accuracy and efficiency in the area of 3D real human digitization
- None of the prior works focus on modeling **3D biped cartoon characters**, which are also in great demand in gaming and filming





# *3DBiCar* (The First Large-Scale 3D biped Cartoon Character Dataset)

- Diversity: 1,500 high-quality 3D textured models, 15 species
- Richness: mesh, pose, texture and so on
- Topological-consistency: all 3D characters are unified in mesh topology



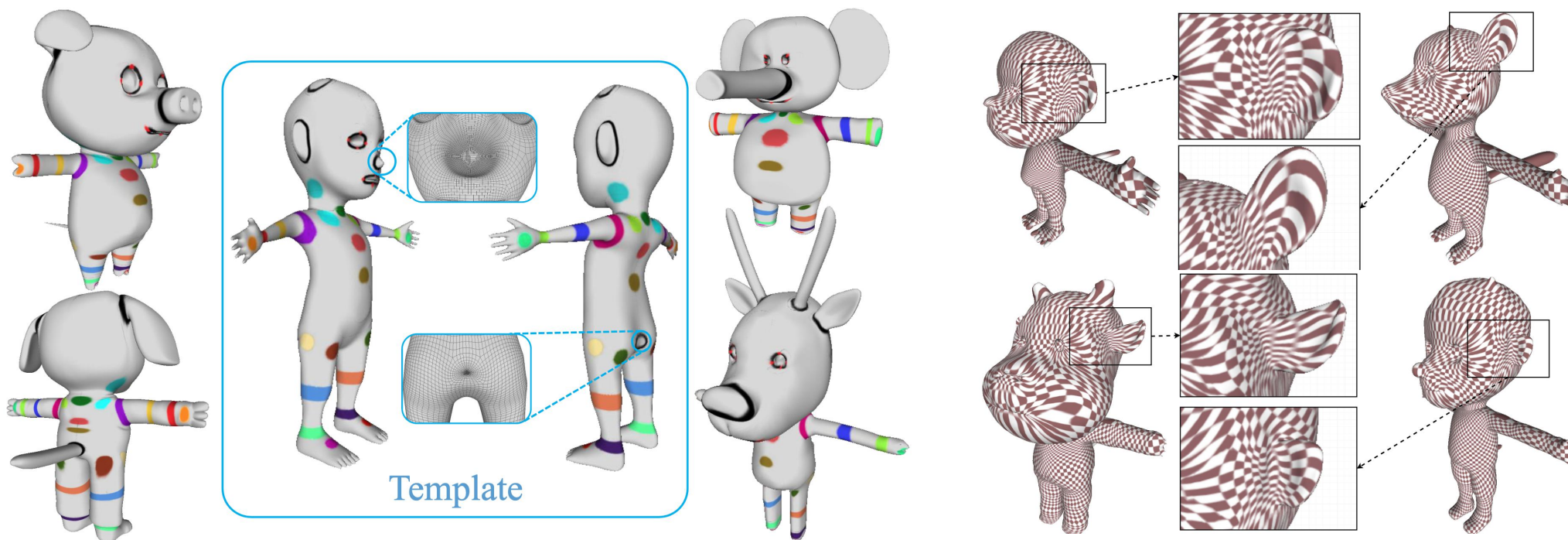
Data statistics of *3DBiCar*



Representative examples sampled from *3DBiCar*

# *3DBiCar* (The First Large-Scale 3D Biped Cartoon Character Dataset)

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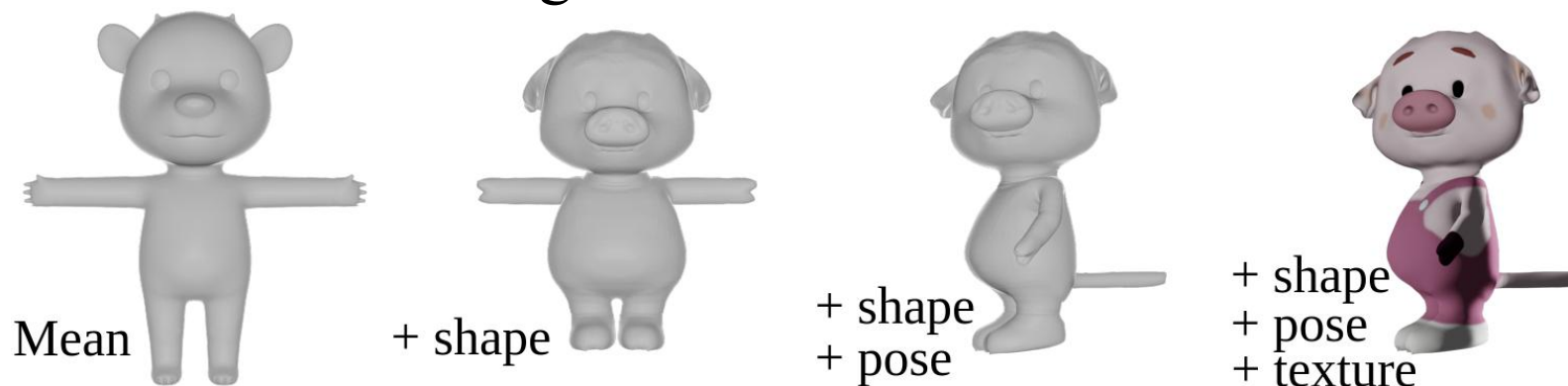
Our predefined template

Mesh correspondence

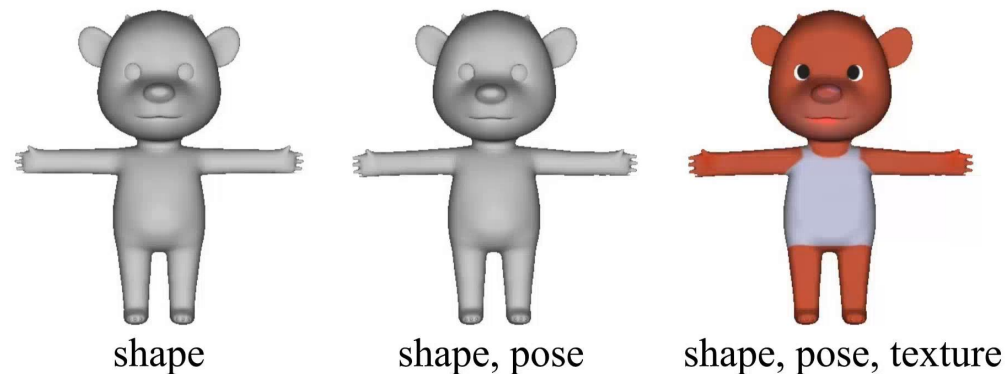


# *RaBit* (The First 3D Parametric Model for Biped Cartoon Character Modeling)

- Shape: SMPL-like linear blend shape model
- Texture: neural UV-texture generator



*RaBit*, SMPL-Like Parametric Model for Biped Characters



Interpolating on *RaBit*'s parametric space

# *RaBit* (The First 3D Parametric Model for Biped Cartoon Character Modeling)

- Shape: SMPL-like linear blend shape model
- Texture: neural UV-texture generator



Sampling on *RaBit*'s parametric space

# *BiCarNet* (The SVR baseline for reconstructing 3D biped cartoon characters)

- Given a single masked image of cartoon characters, *BiCarNet* could reconstruct the corresponding 3D shape, pose, and texture (Single-View Reconstruction)



Input



# *BiCarNet* (The SVR baseline for reconstructing 3D biped cartoon characters)

- *BiCarNet* is capable of generating vivid 3D cartoon characters with only a single-view image input



Results of *BiCarNet*

# *BiCarNet* (The SVR baseline for reconstructing 3D biped cartoon characters)

- Results on shape reconstruction

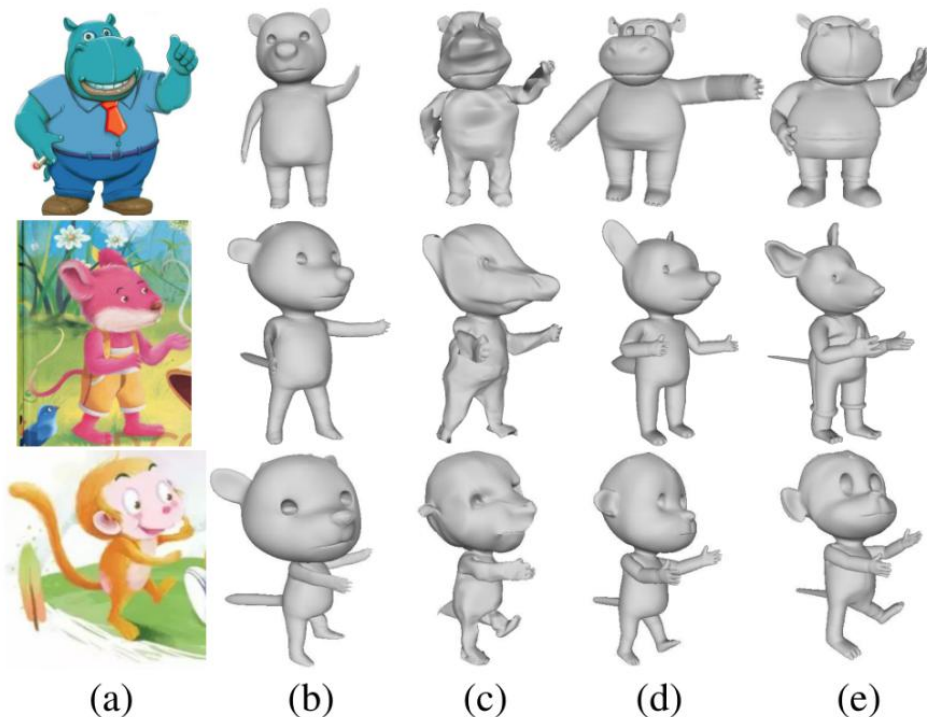


Figure 7. **Qualitative results of shape reconstruction.** From left to right, each row contains (a) the input image, reconstructed meshes of (b) Mesh Graphormer, (c) DecoMR, (d) our method, and (e) the GT mesh.

Method	MPVE ↓	MPJPE ↓	PA-MPJPE ↓
DecoMR [59]	85.74	81.23	47.23
Mesh-Graphormer [36]	63.31	47.15	34.12
Ours (HMR [28] + <i>RaBit</i> )	<b>51.46</b>	<b>37.80</b>	<b>25.97</b>

Table 1. **Quantitative results of shape reconstruction.** Our method achieves the best results in terms of MPVE, MPJPE and PA-MPJPE. Note that all metrics are measured in a unit  $10^{-3}$ m.

# *BiCarNet* (The SVR baseline for reconstructing 3D biped cartoon characters)

- Results on texture inference

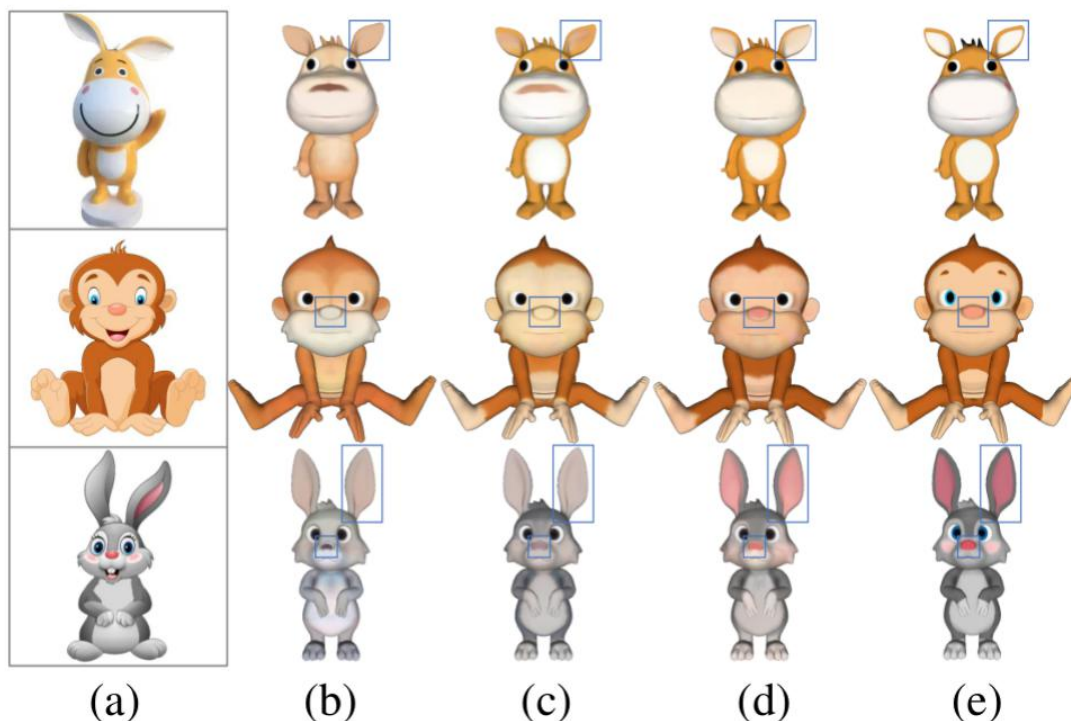


Figure 8. **Qualitative comparisons on texture inference.** The input image (a) is followed by the textured models from (b) PCA, (c) *BiCarNet* w/o PSR, (d) *BiCarNet* and (e) the ground truth. Note that we use the same shape and focus on the difference of textures.

Method	MSE( $\times 10^{-1}$ ) $\downarrow$	PSNR( $\times 10^2$ ) $\uparrow$	FID $\downarrow$
PCA	0.2309	0.2254	0.4642
<i>BiCarNet</i>	<b>0.1093</b>	<b>0.2458</b>	<b>0.1133</b>
<i>BiCarNet</i> w/o Fuser	0.1108	0.2397	0.1407
<i>BiCarNet</i> w/o PSR	0.1346	0.2361	0.4024

Table 2. **Quantitative results on texture inference.** PCA denotes linear modeling method for texture and the last two rows indicate the results of *BiCarNet* respectively without two designed module. Our *BiCarNet* outperforms others methods in all metrics.

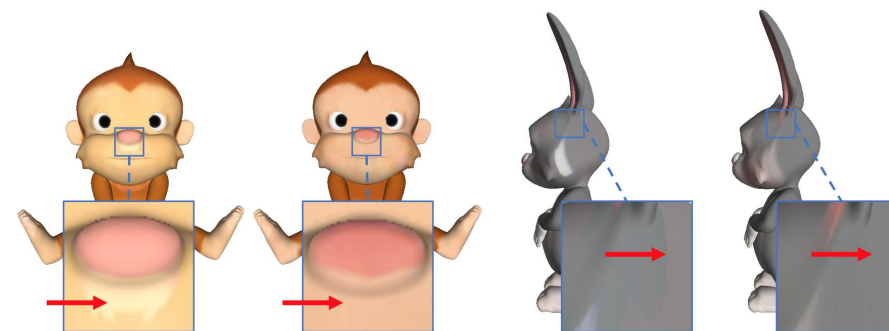
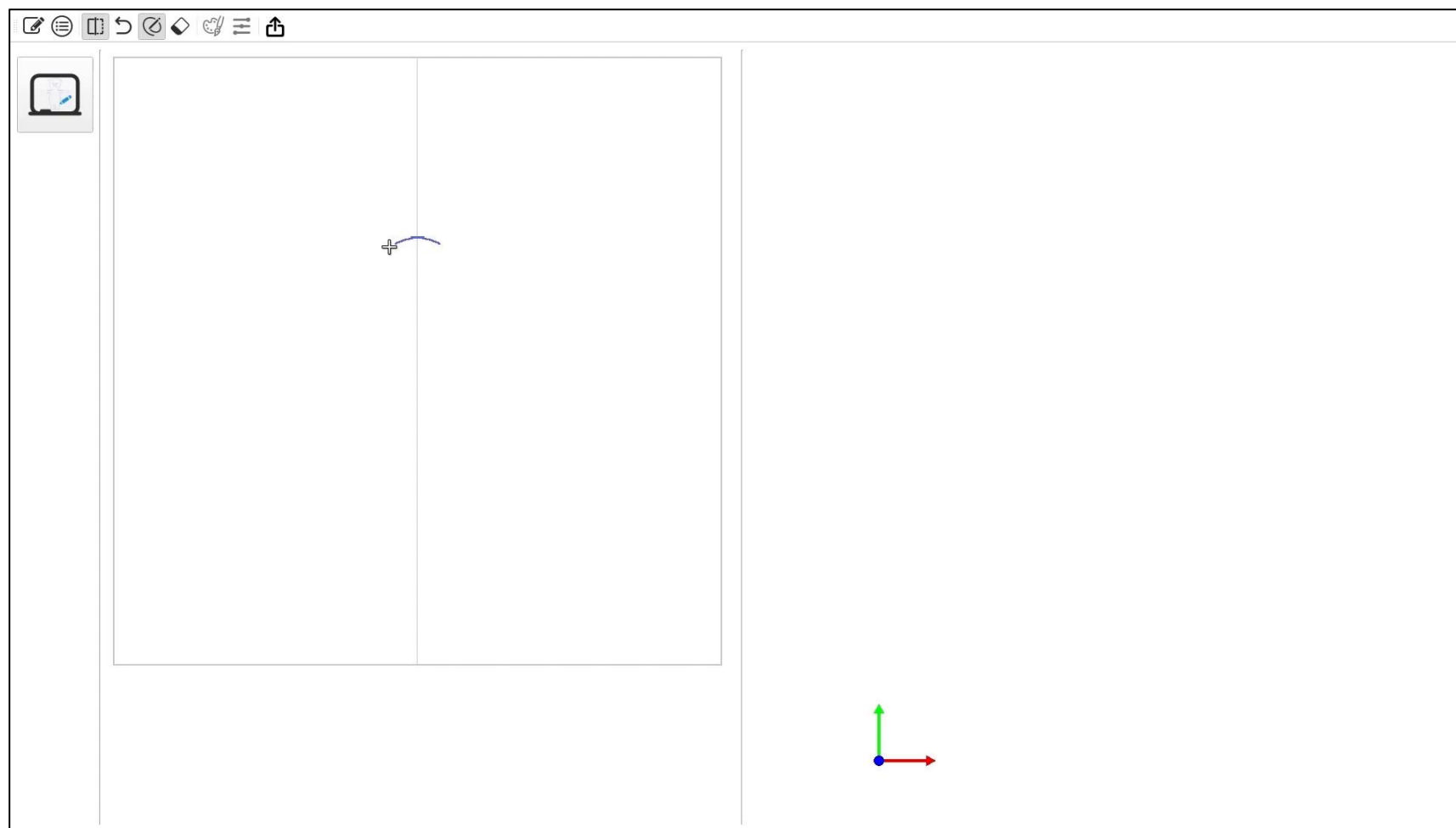


Figure 9. **Qualitative ablation on Fuser in Texture inference.** Left: *BiCarNet* w/o Fuser. Right: *BiCarNet* with Fuser.



# Other Applications: Sketch-Based Modeling

- Enables amateurs to get involved in 3D characters modeling in a simple and intuitive fashion



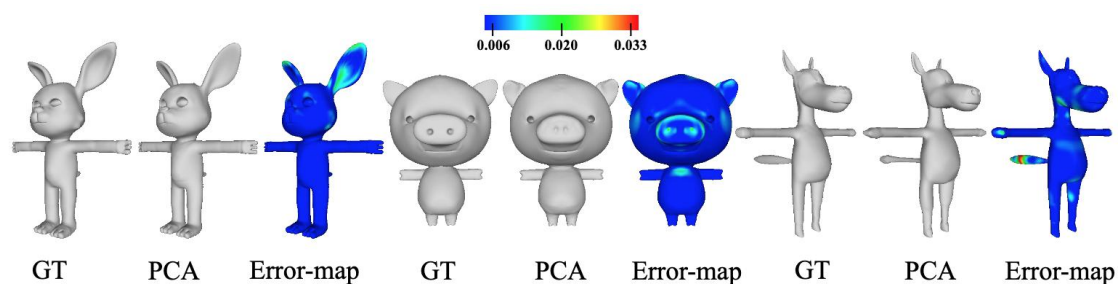
# Other Applications: 3D Character Animation

- Transfers motion of a human video to animate characters

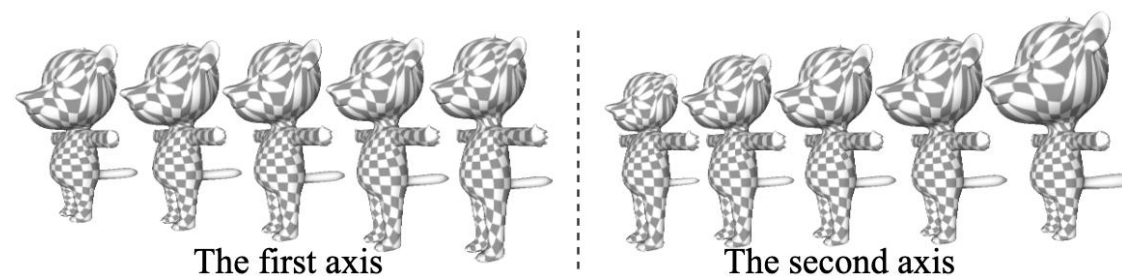


# Conclusion

- *3DBiCar*, the first large-scale 3D biped cartoon character dataset
- *RaBit*, the first 3D full-body biped cartoon parametric model
- *BiCarNet*, the SVR baseline for reconstructing 3D biped cartoon characters
- Two other applications, i.e., **sketch-based modeling** and **3D character animation**, also demonstrate the promising potential of 3DBiCar and RaBit
- Limitation
  - Identical skeleton and skinning weights used by models in *3DBiCar* would cause **unnatural results** during animation
  - Although *RaBit* is able to express the basic geometry of diverse shapes with low-dimensional vectors (a), it struggles to represent **local geometric details** and may lead to **undesirable entanglement** (b)
  - *BiCarNet* may fail to recover **fine geometry** and **faithful texture**



(a) Comparison of shapes reconstructed by *RaBit* with GT



(b) The first two axes of shape space in *RaBit*





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with a Topological-consistent Dataset

# Thanks for watching!



CVPR Virtual Platform



Project Page



GAP Lab

<https://gaplab.cuhk.edu.cn/projects/RaBit/>

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