GDC × NetEase Games Passion of gamers

March 21-25,2022
San Francisco,CA

Finding Harmony in Anime Style and Physically Based Rendering

Chen Zhou
NetEase Games

#GDC22
#NetEase Games

Introduction

- NetEase Games TianXia Division
- From 2014 – now

- Technical lead
- Game Engine & Graphics Development
- Online mobile games

Extraordinary Ones: Mirage

work in progress

Outline

Background knowledge on Anime Style

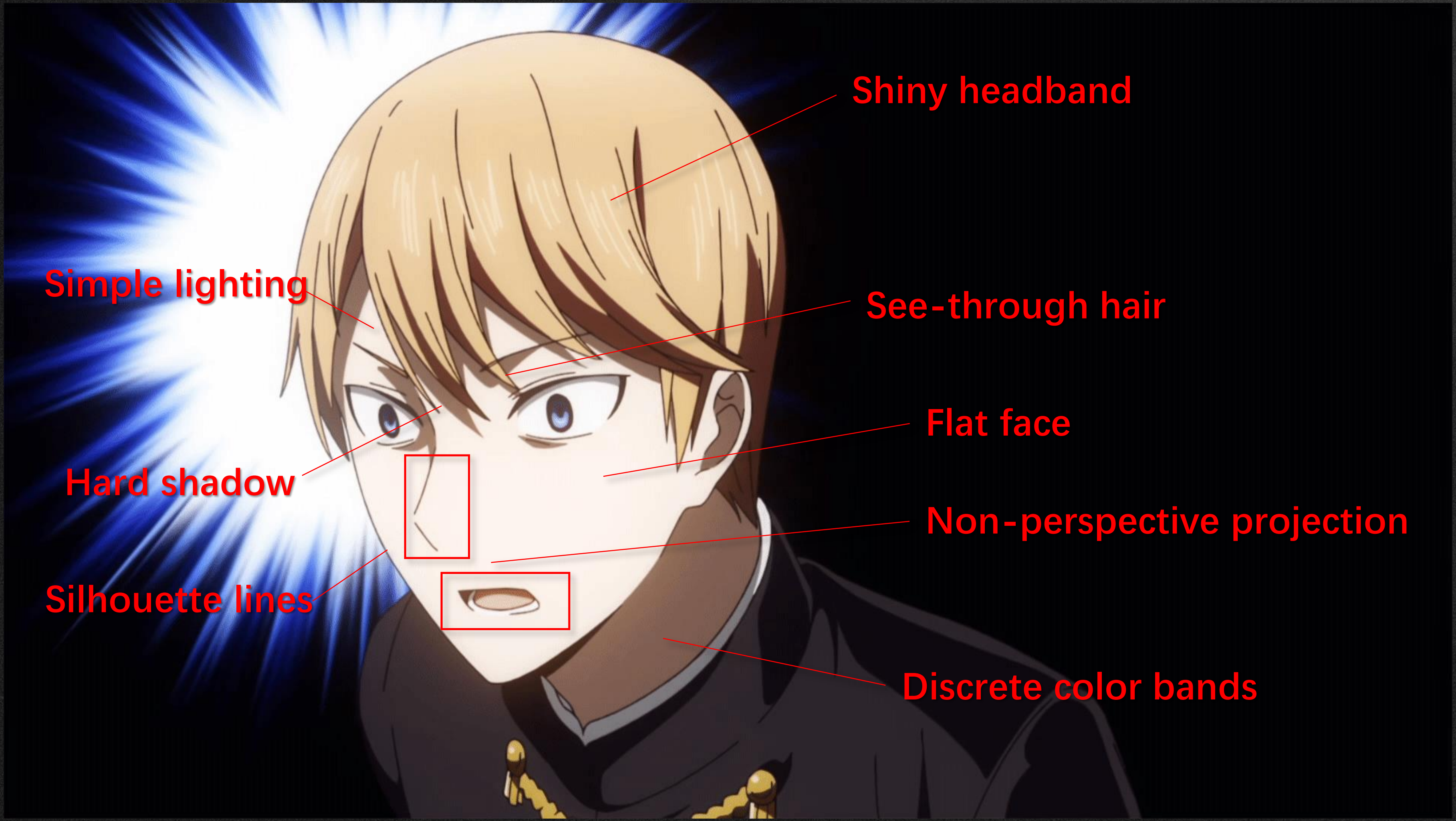
- Typical characteristics
- Cel Shading and its limitation
- Possibility of combining PBR with Cel Shading

Our goals and approaches

- The render pipeline
- Lighting, shadow and customized shading models
- LookDev

Conclusions

Anime Art Style

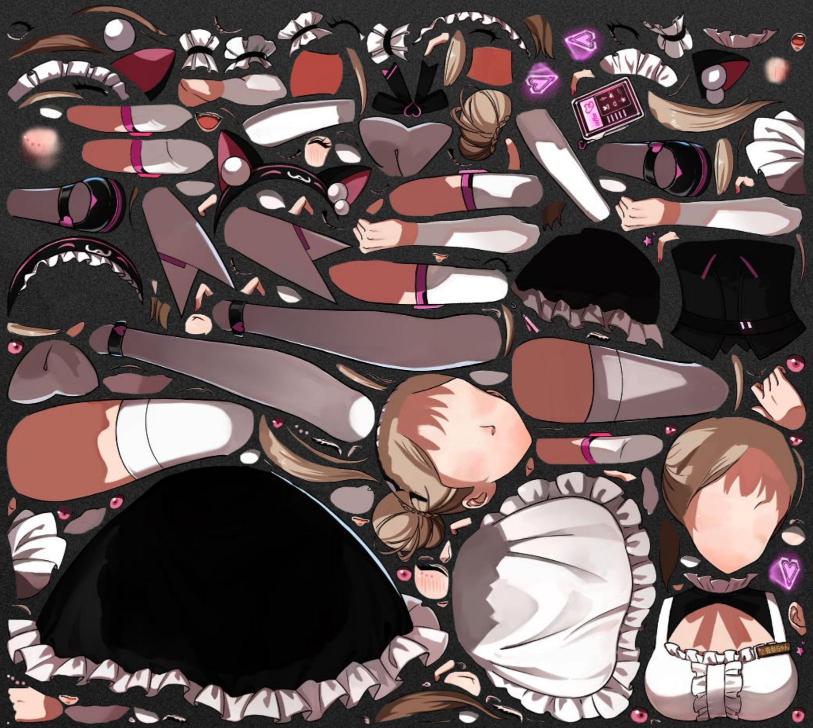


from *“Kaguya-sama: Love Is War”*

2D Sprites

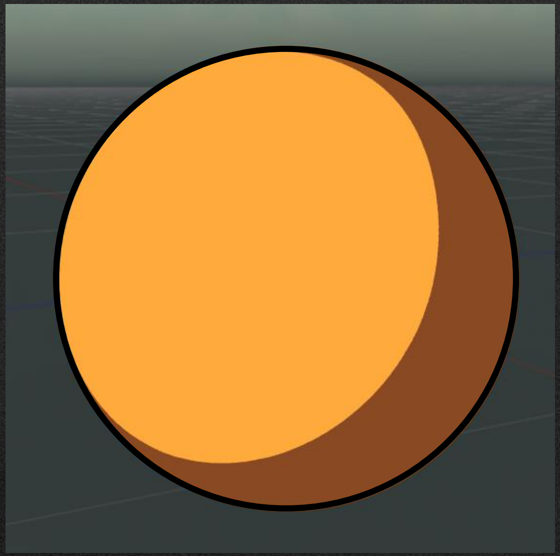
- 100% controlled by concept artists
- Sliced sprites with morph animation and texture switching
- Unified lighting from scene ambient map
- Performance friendly

- Local lights
- 2D Rigging



Cel Shading

- Given base color & shadow color
- Step threshold by NDotL
- Outline by edge detection or procedural geometry silhouetting



Cel Shading Character Details

- Fixed or per-character lighting
- Ramp(lookup) texture or smoothstep function
- Modified vertex normal for lighting
- Smooth normal for outline expansion
- Pre-integrated facial shadow
- Matcap specular lighting
- Rim light by edge detection
- Customized tone mapping color enhancement
- …

"Extraordinary Ones: MOBA"

Cel Shading Limitations

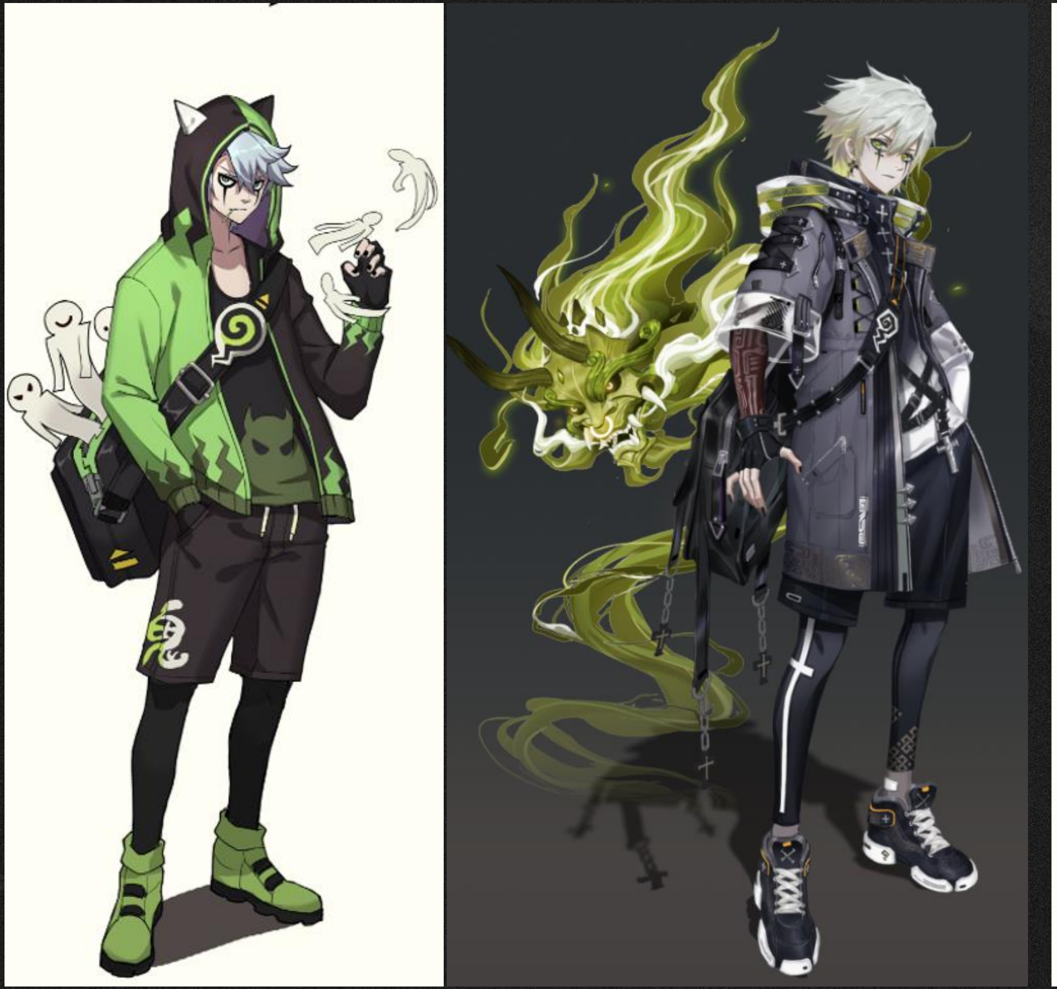
- Suitable for character
- Limit the environment design
- Hard to present complex scene
- No uniform standard
- Hard to introduce advanced modern rendering techniques

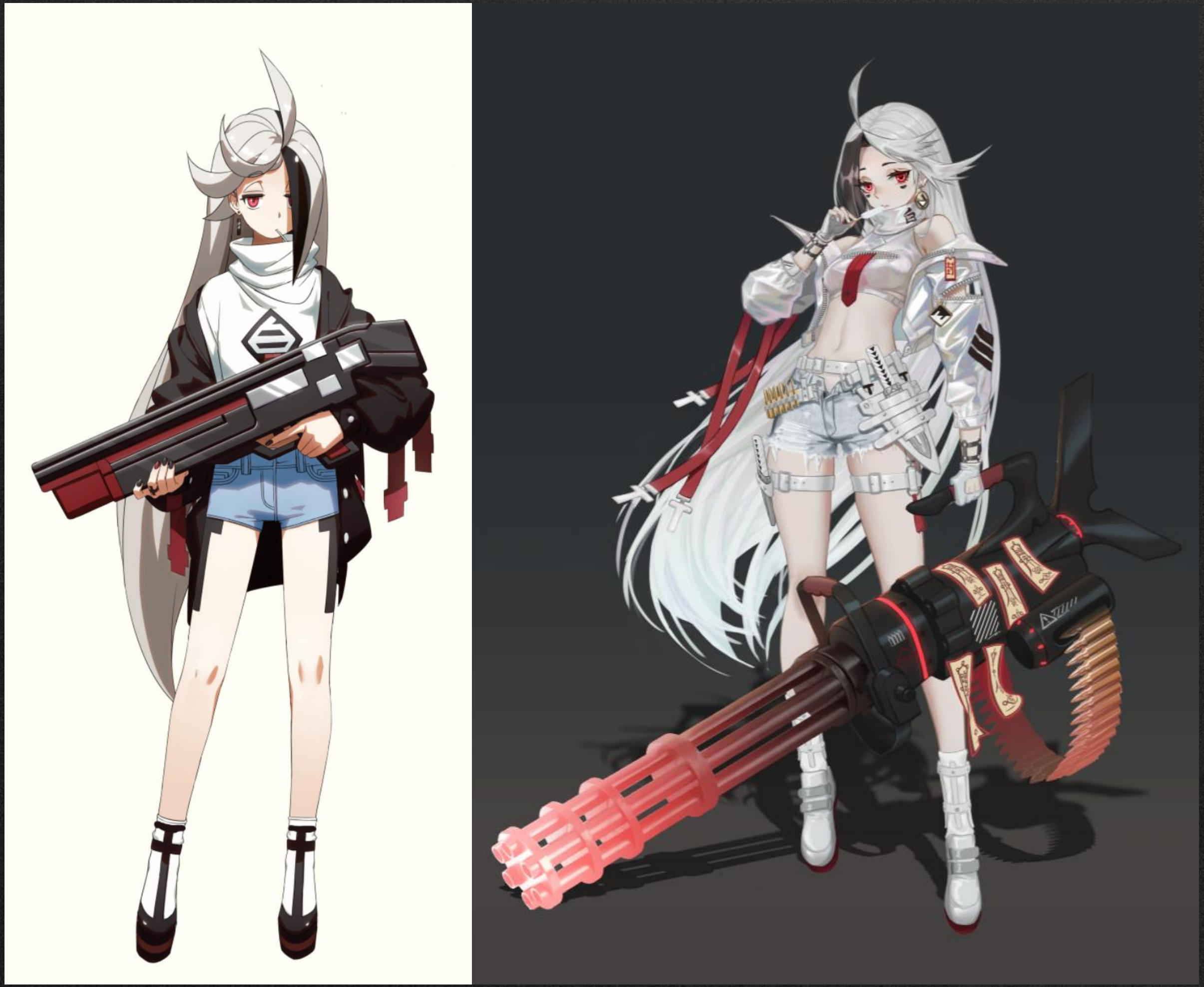
Physically Based Rendering

- Photorealistic rendering
- Decoupling material and lighting
- Abundant material expression quantitatively

- Standardized production process

Integrate With Complex Materials

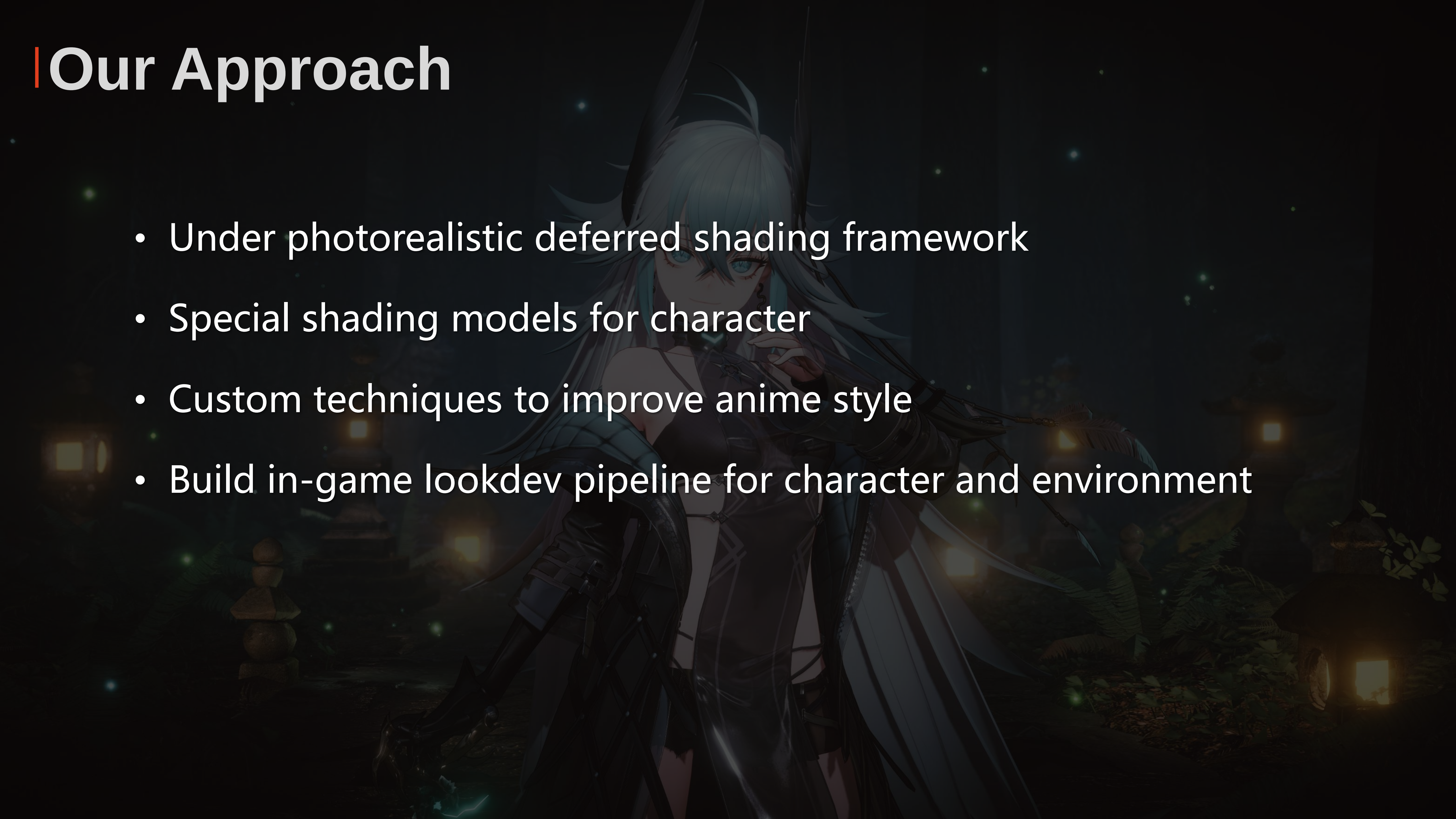




Goal

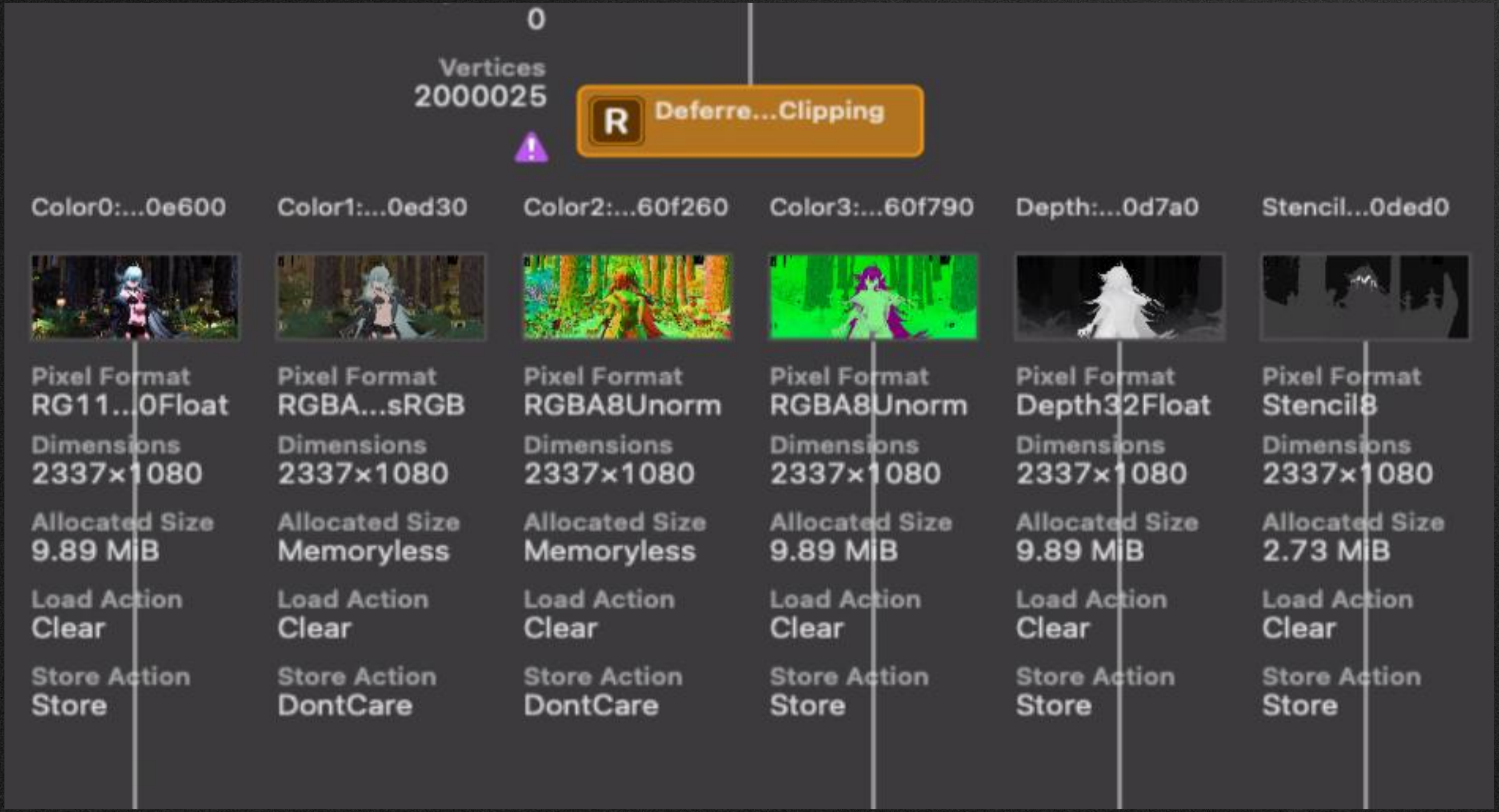
- Combine anime style and PBR
- Variety of materials suit all lighting environment
- Introduce modern rendering technologies
- Flexible to mobile and PC

Our Approach



- Under photorealistic deferred shading framework
- Special shading models for character
- Custom techniques to improve anime style
- Build in-game lookdev pipeline for character and environment

GBuffer Layout



0

Vertices
2000025

Deferre...Clipping

Color0:...0e600	Color1:...0ed30	Color2:...60f260	Color3:...60f790	Depth:...0d7a0	Stencil...0ded0
Pixel Format RG11...0Float	Pixel Format RGBA...sRGB	Pixel Format RGBA8Unorm	Pixel Format RGBA8Unorm	Pixel Format Depth32Float	Pixel Format Stencil8
Dimensions 2337×1080	Dimensions 2337×1080	Dimensions 2337×1080	Dimensions 2337×1080	Dimensions 2337×1080	Dimensions 2337×1080
Allocated Size 9.89 MiB	Allocated Size Memoryless	Allocated Size Memoryless	Allocated Size 9.89 MiB	Allocated Size 9.89 MiB	Allocated Size 2.73 MiB
Load Action Clear	Load Action Clear	Load Action Clear	Load Action Clear	Load Action Clear	Load Action Clear
Store Action Store	Store Action DontCare	Store Action DontCare	Store Action Store	Store Action Store	Store Action Store

GBufferA[R11G11B10]	: SceneColor.rgb
GBufferB[R8G8B8A8_SRGB]	: BaseColor.rgb, Metallic
GBufferC[R8G8B8A8]	: N.xyz, Roughness
GBufferD[R8G8B8A8]	: ShadingModelID, GILightingLum(CustomData), LinearDepth.xy

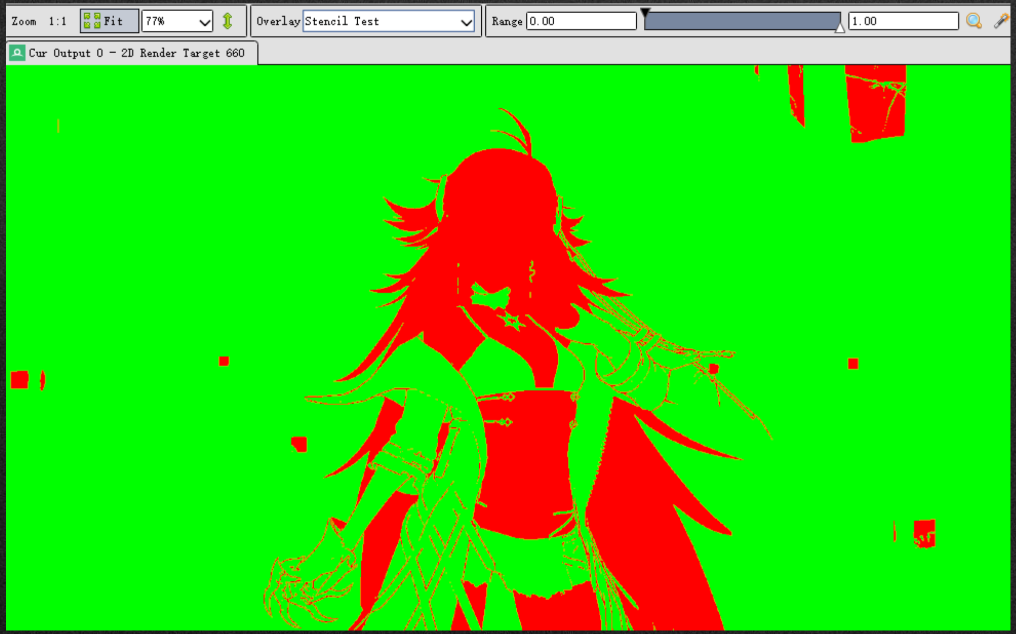
Main Light

- Hybrid Forward + Deferred lighting

- GBuffer Gen
  - StaticLighting: LightMap, LightProbe
  - Emission
  - Anime Shading Models
    - Hair, Skin, Eyes, …
    - Indirect + direct main light

- Stencil mask for forward-shaded

- Sample CSM, EnvMap, ReflectionMap



Zoom 1:1 Fit 77%

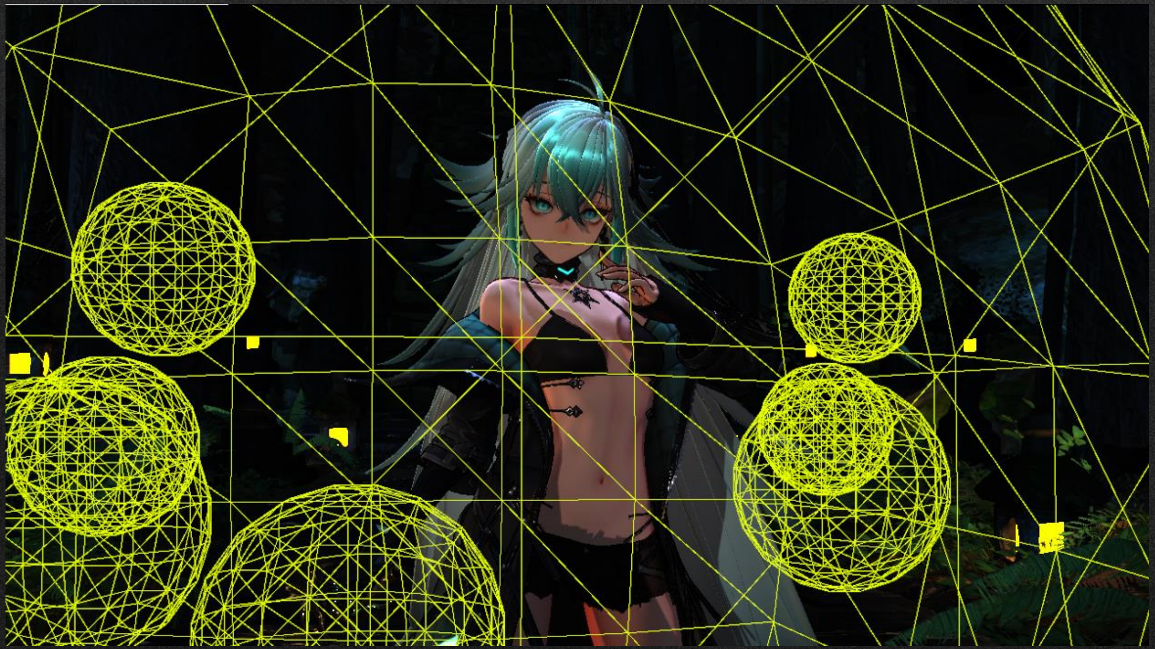
Overlay Stencil Test

Range 0.00 1.00

Cur Output 0 – 2D Render Target 660

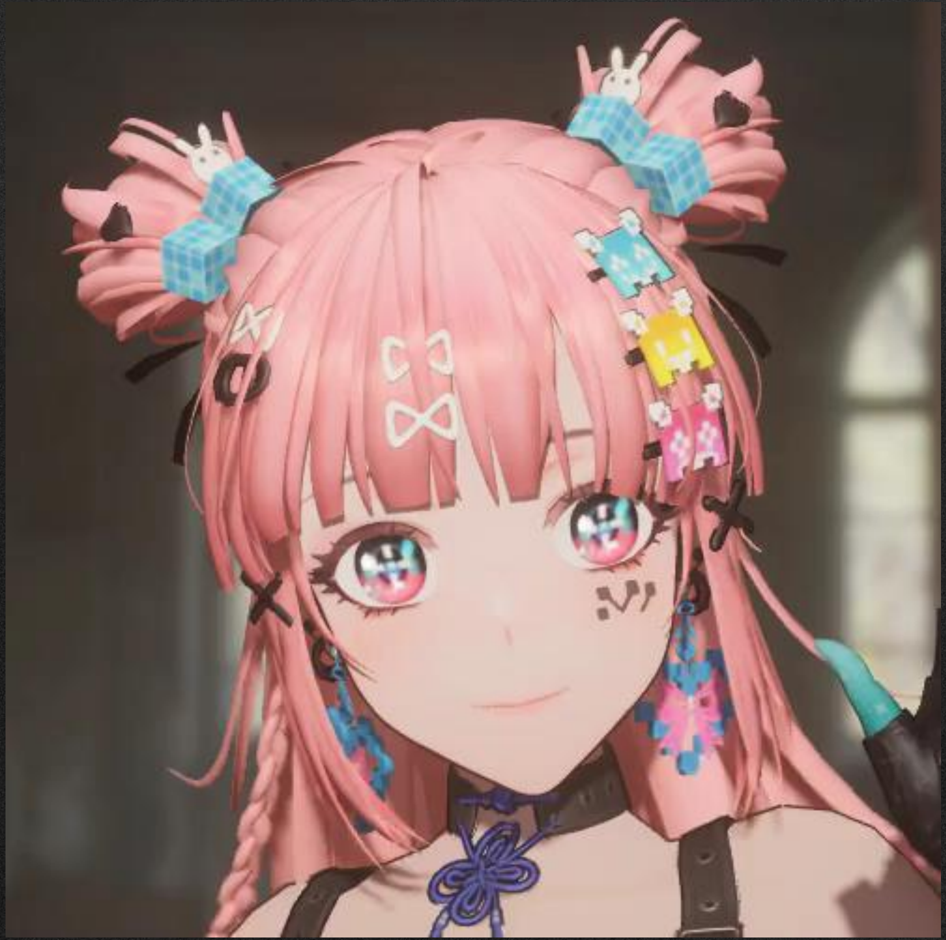
Dynamic Light

- Point/Spot/Rect lights in single subpass
- Sample cached shadowmap
- Batched simple point lights
- Raster order groups

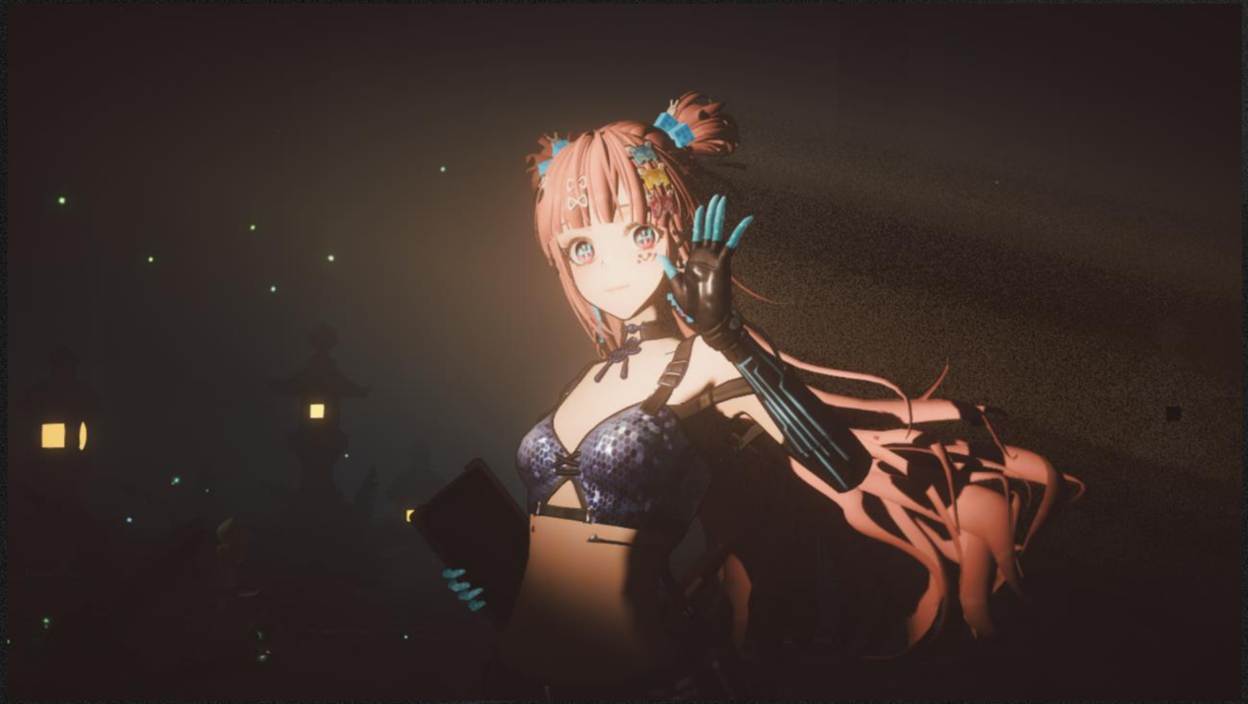


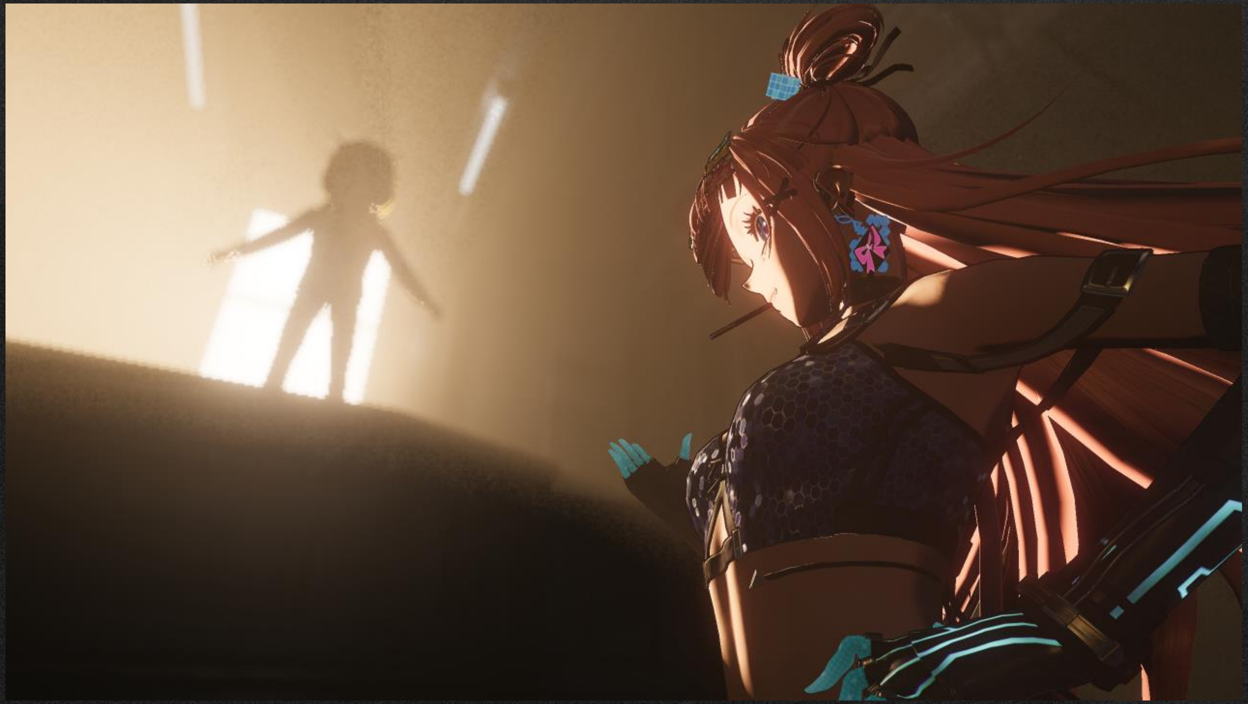
Flat Face

- Shift normal to face vector
- Curve intensity texture controllable by artist
- Works with multiple local lights
- Lower degree of spherical harmonics



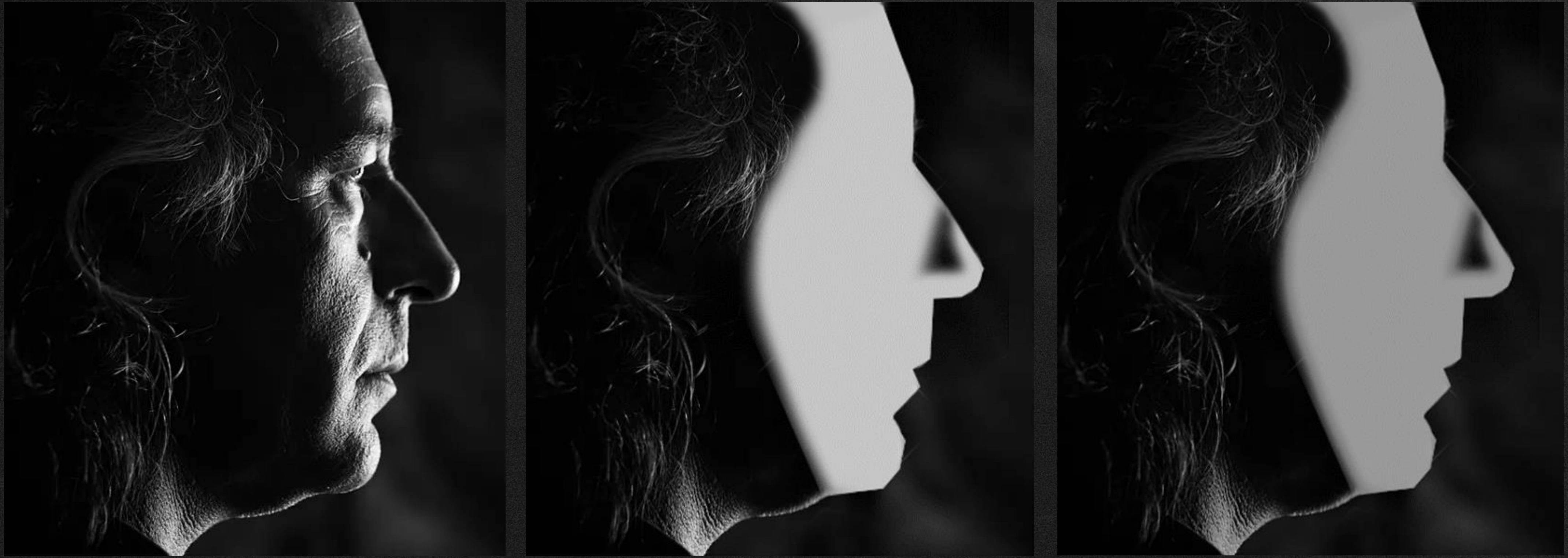
Light Leak





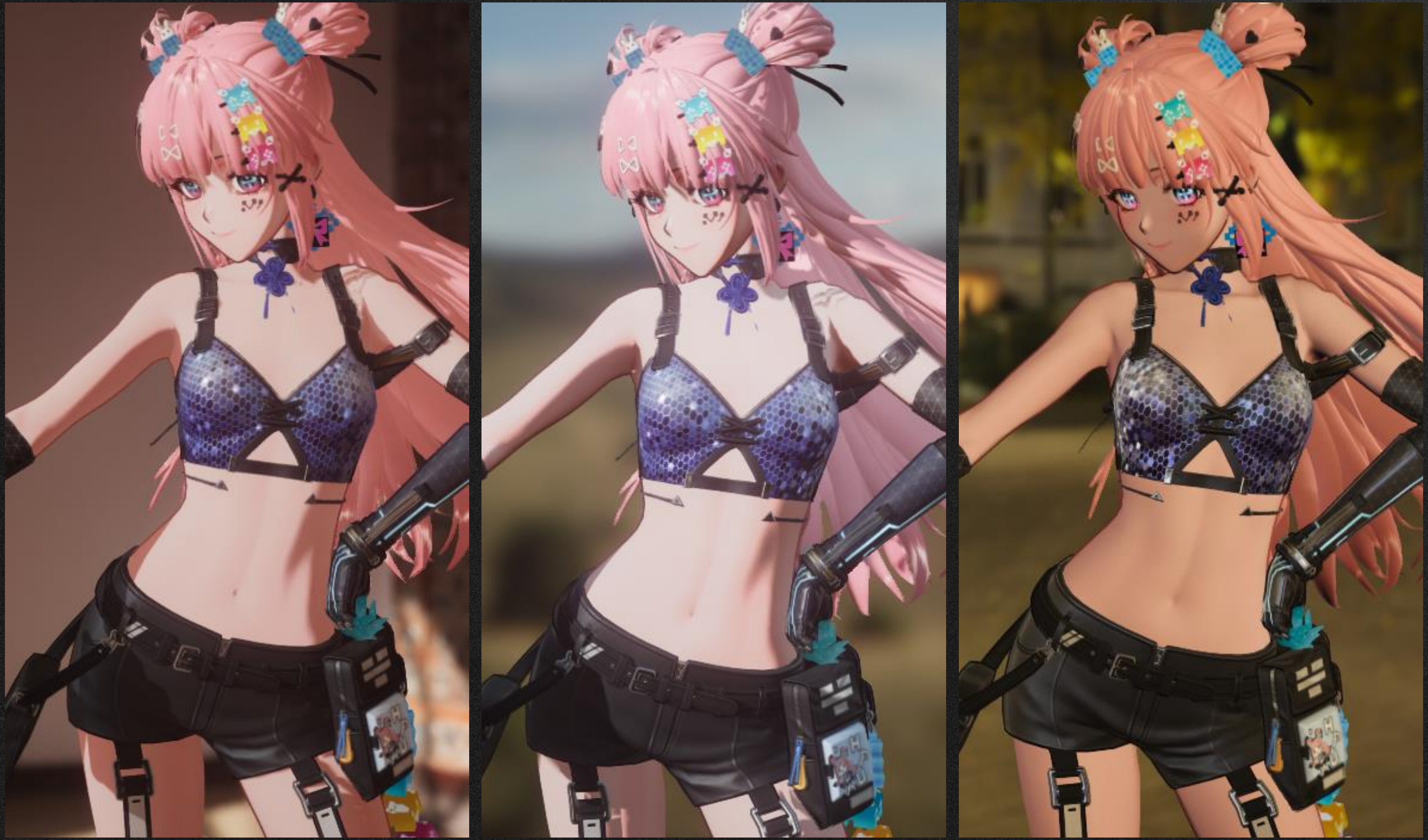
Reweighted Light

- Wrapped irradiance for non-shadow local lights in BxDF
- Statistical coverage precomputation for main light



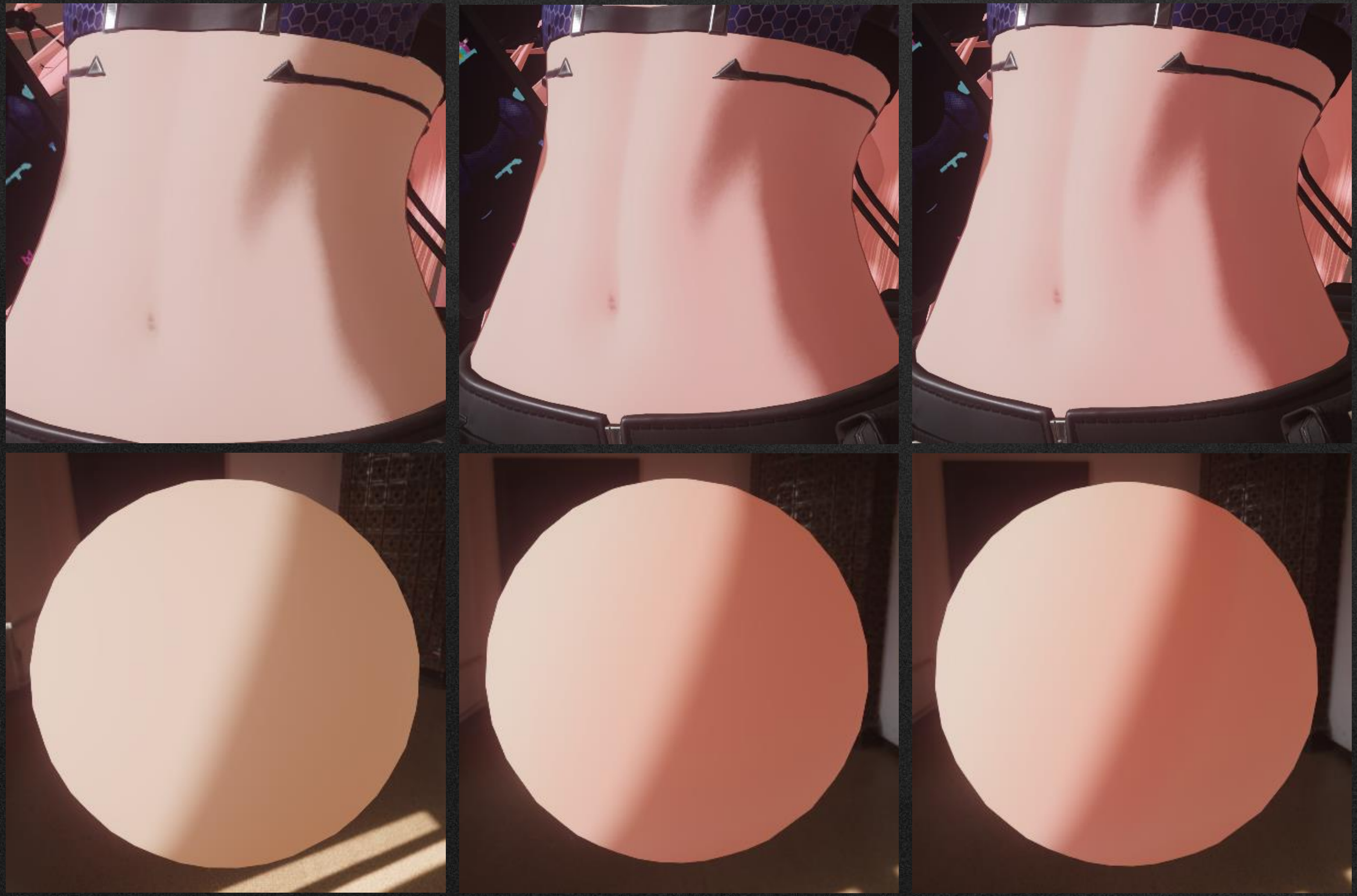
Reweighted Light

Manipulate Skin Color



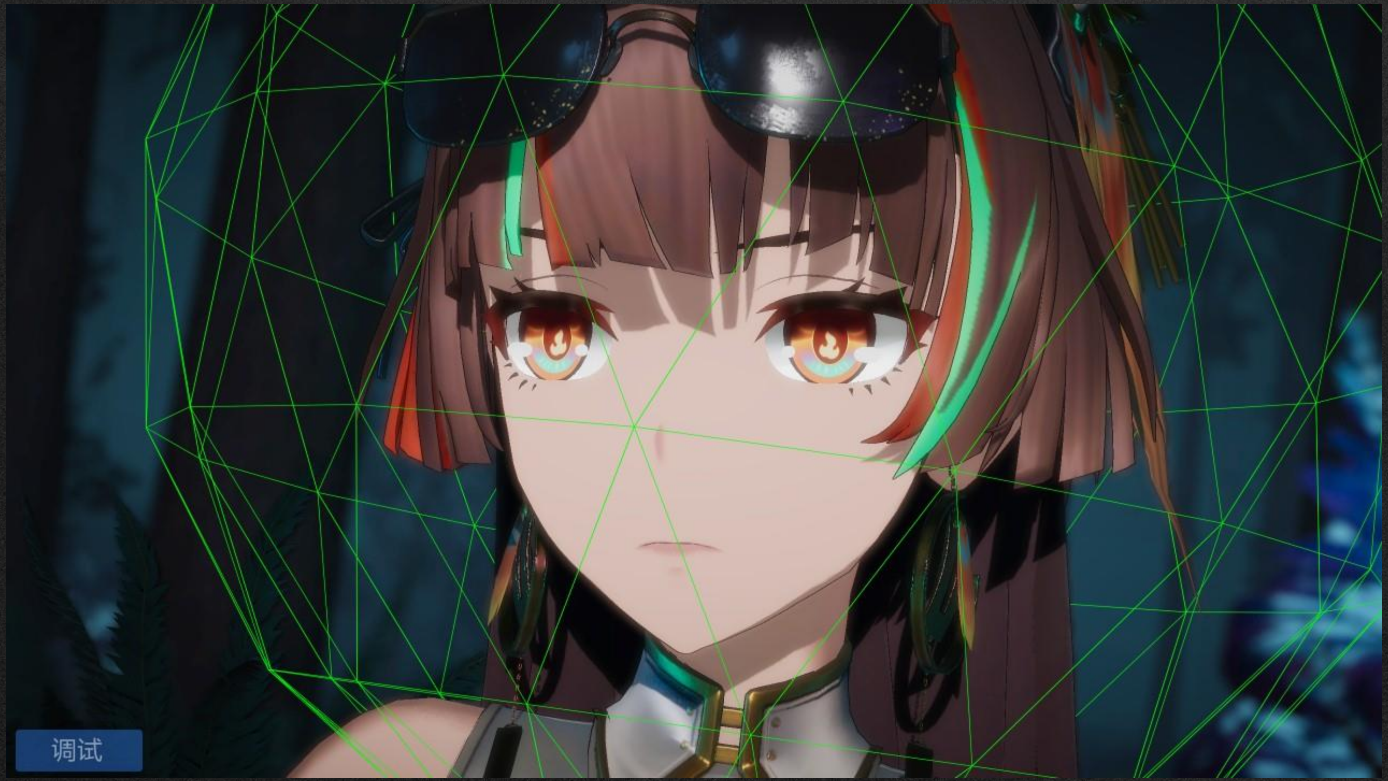
Manipulate Skin Color

- Hard transition from light to dark
- Shift hue by the luminance of direct light
- Increase saturation for dark area and the edge by all light saturation
- Structural detail enhancement



Shadow

- CSM
- Self-shadow hierarchical relationship
- Extremely high quality for close-ups
- Hard-outlined shadow



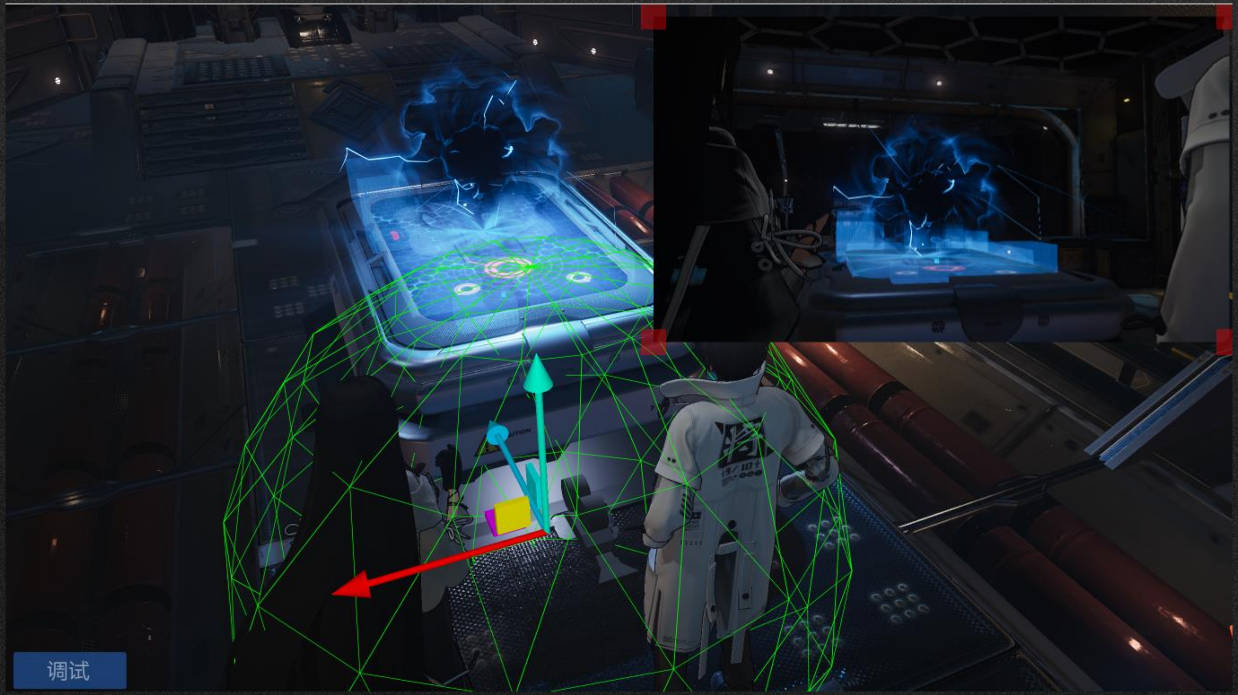
0.2

0.4

0.8

Adaptive Shadow System

- For cutscenes
- Frame pivot bone capsules in screen space
- Adjust center and size of frustum
- One click for edge cases

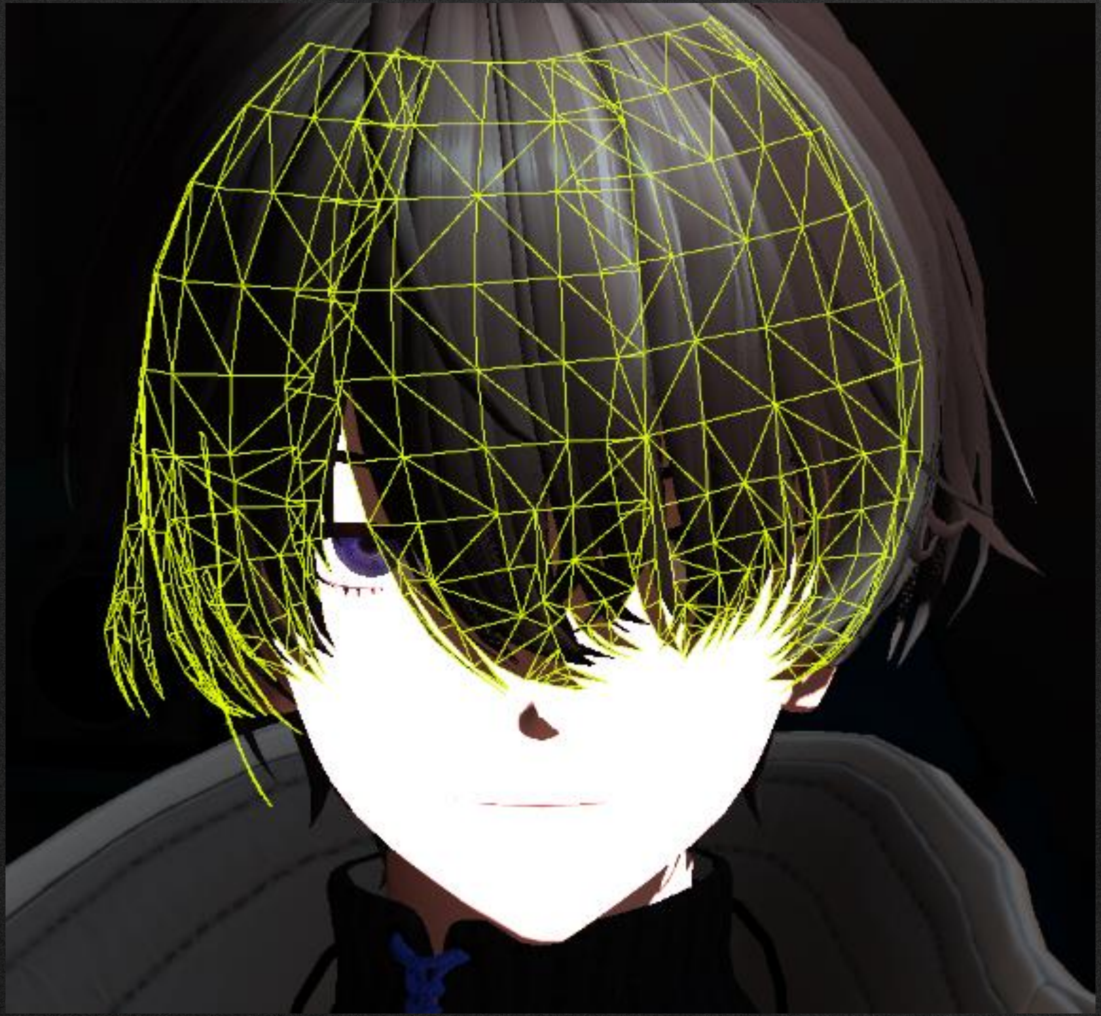


NetEase Games

Hair Shadow Proxy

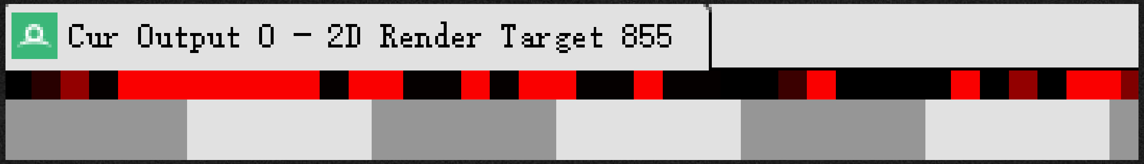
- Work with TOD
- Same skinning data
- Slight vertex position offset

- Fetch GBuffer and recalculate indirect light only
- Ambient occlusion

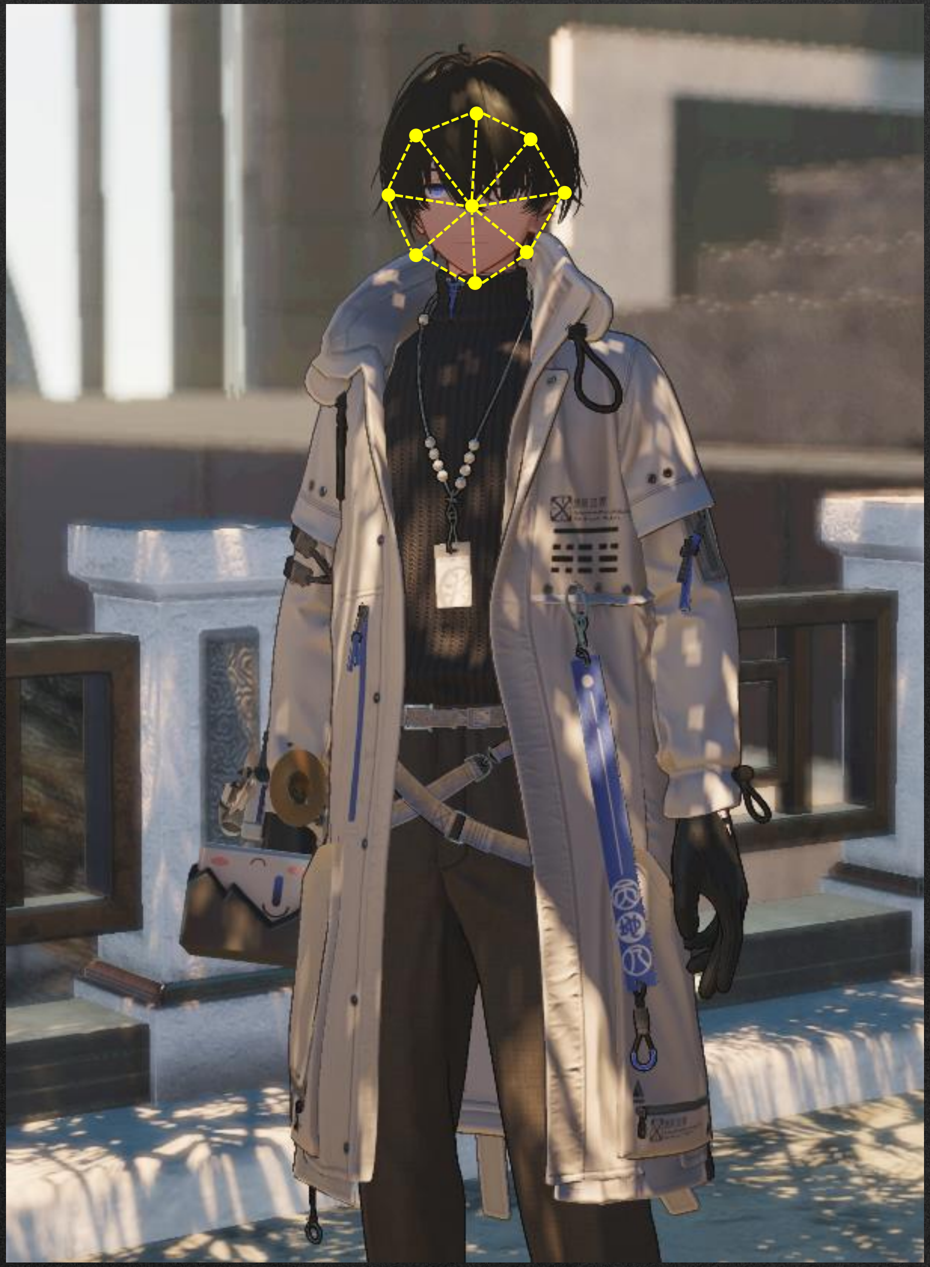


Partial Shadow

- Shadow from environment
- Unified in-shadow value for face
- Precomputed shadow mask for each face with a generated polygon
- 8 floats for each pixel:
  - *nose_pos, radius, face_dir, is_same_character*
- Temporal shadow transition

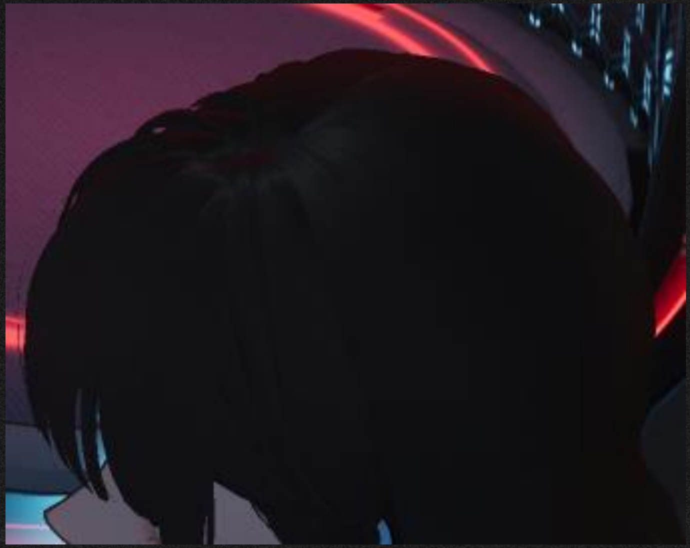


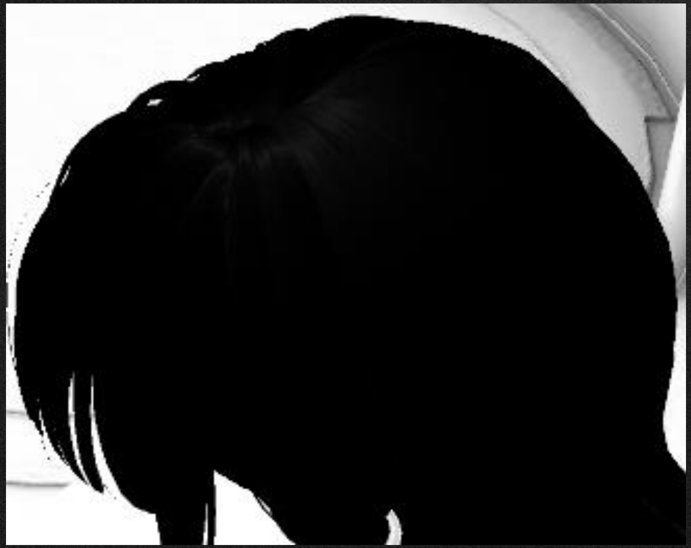
Cur Output 0 – 2D Render Target 855

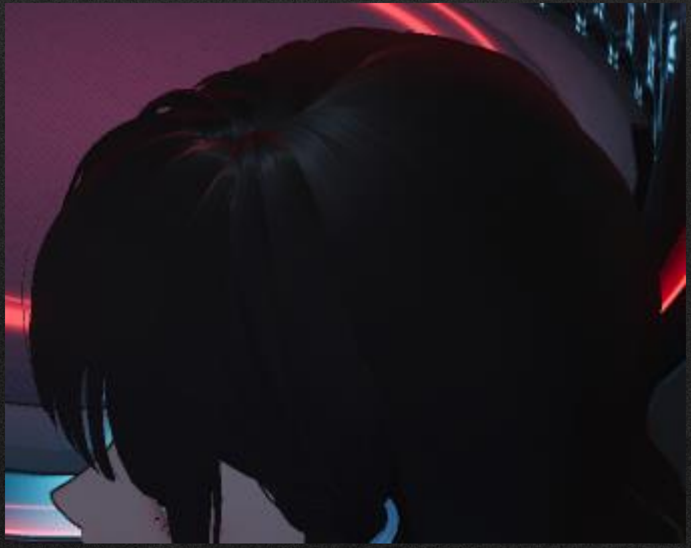


Hair Anisotropic Specular

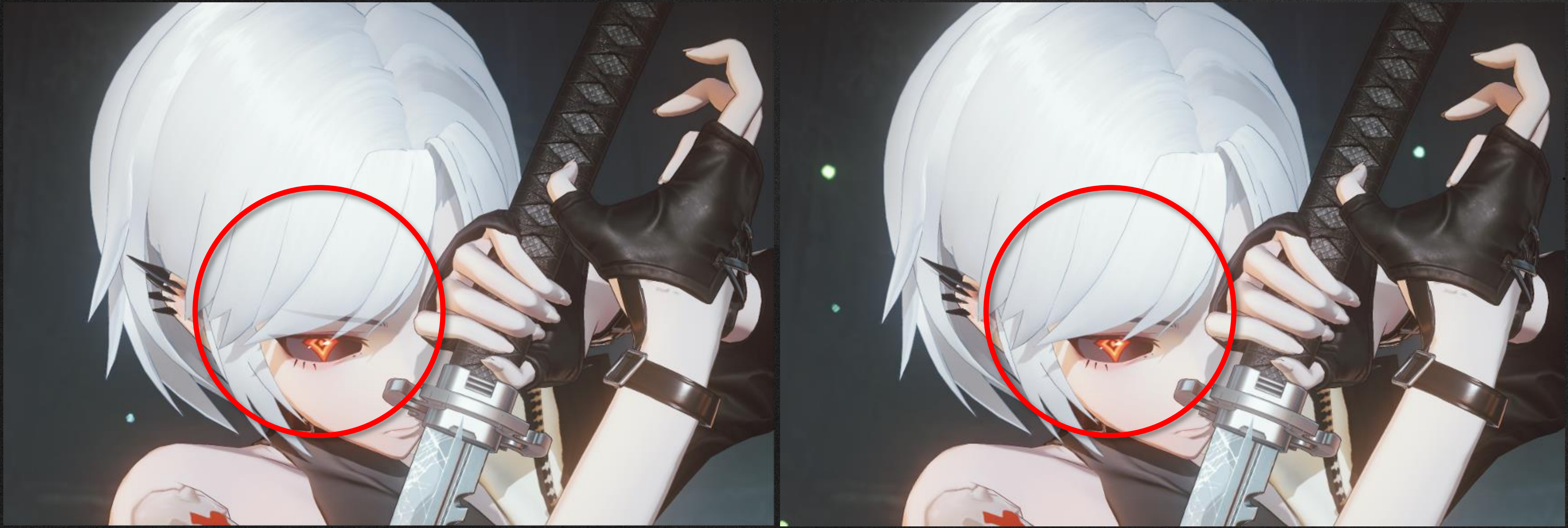
- Kajiya-Kay model
- Single shinny headband for any local lights
- Light-irrelevant specular mask in GBuffer





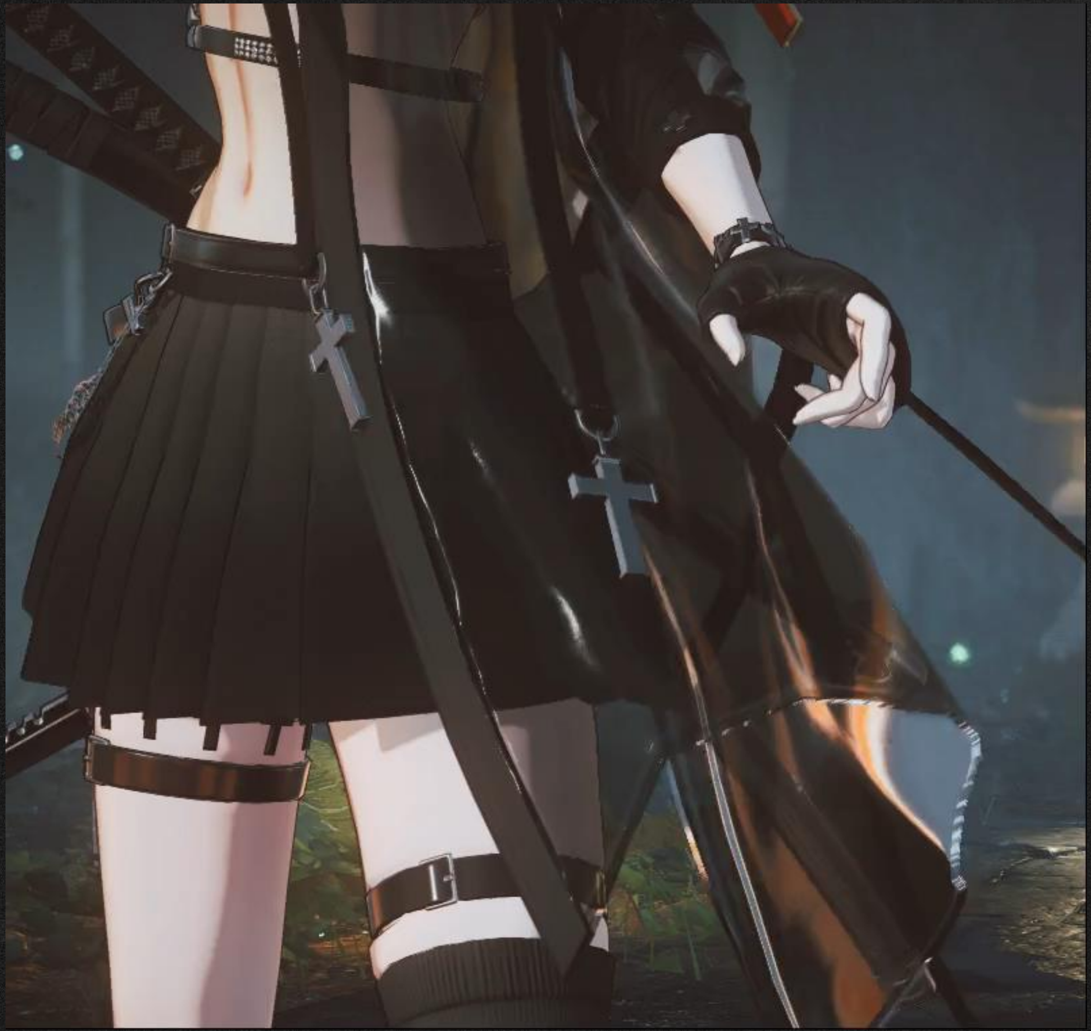


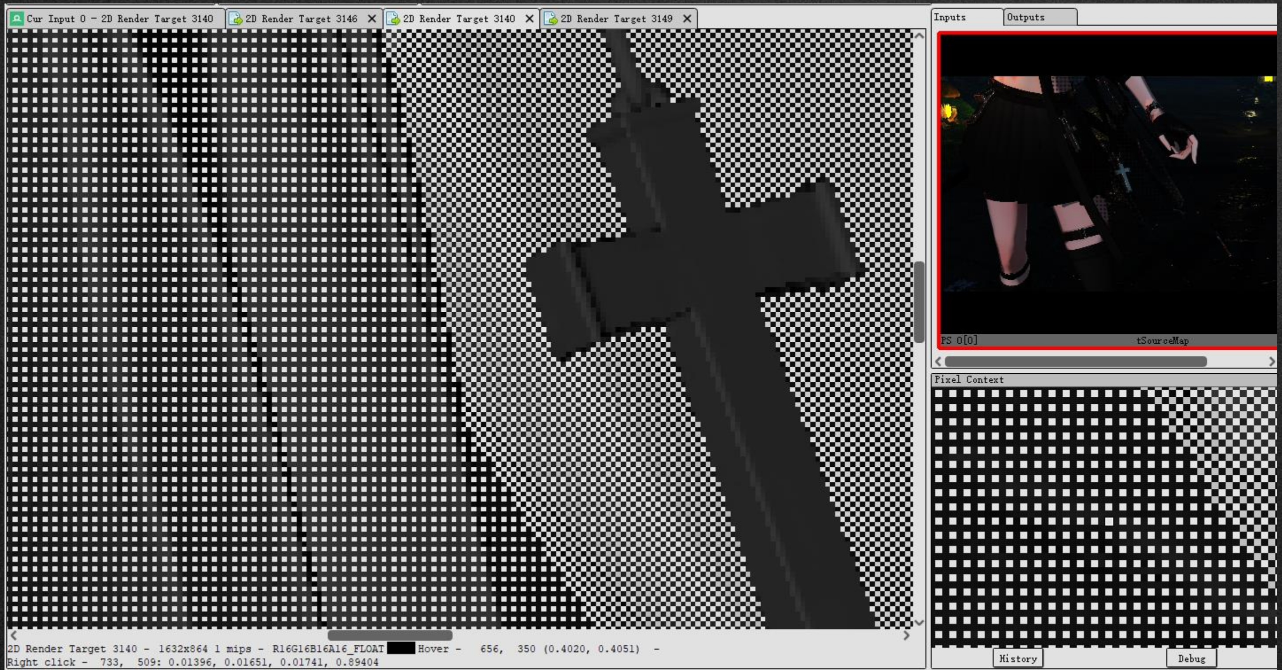
See-Through Hair



- Conveying personality
- Programmable blending in GBuffer
- Separate blend mode

Multi-layered Transparency





```
2D Render Target 3140 - 1632x864 1 mips - R16G16B16A16_FLOAT ■ Hover -   656,  350 (0.4020, 0.4051)  -
Right click -  733,  509: 0.01396, 0.01651, 0.01741, 0.89404
```

- Translucent materials with consistent lighting
- Shading model ID with dither patterns
- Correct multi-layer blending in convolution blur
- Stencil masked merge

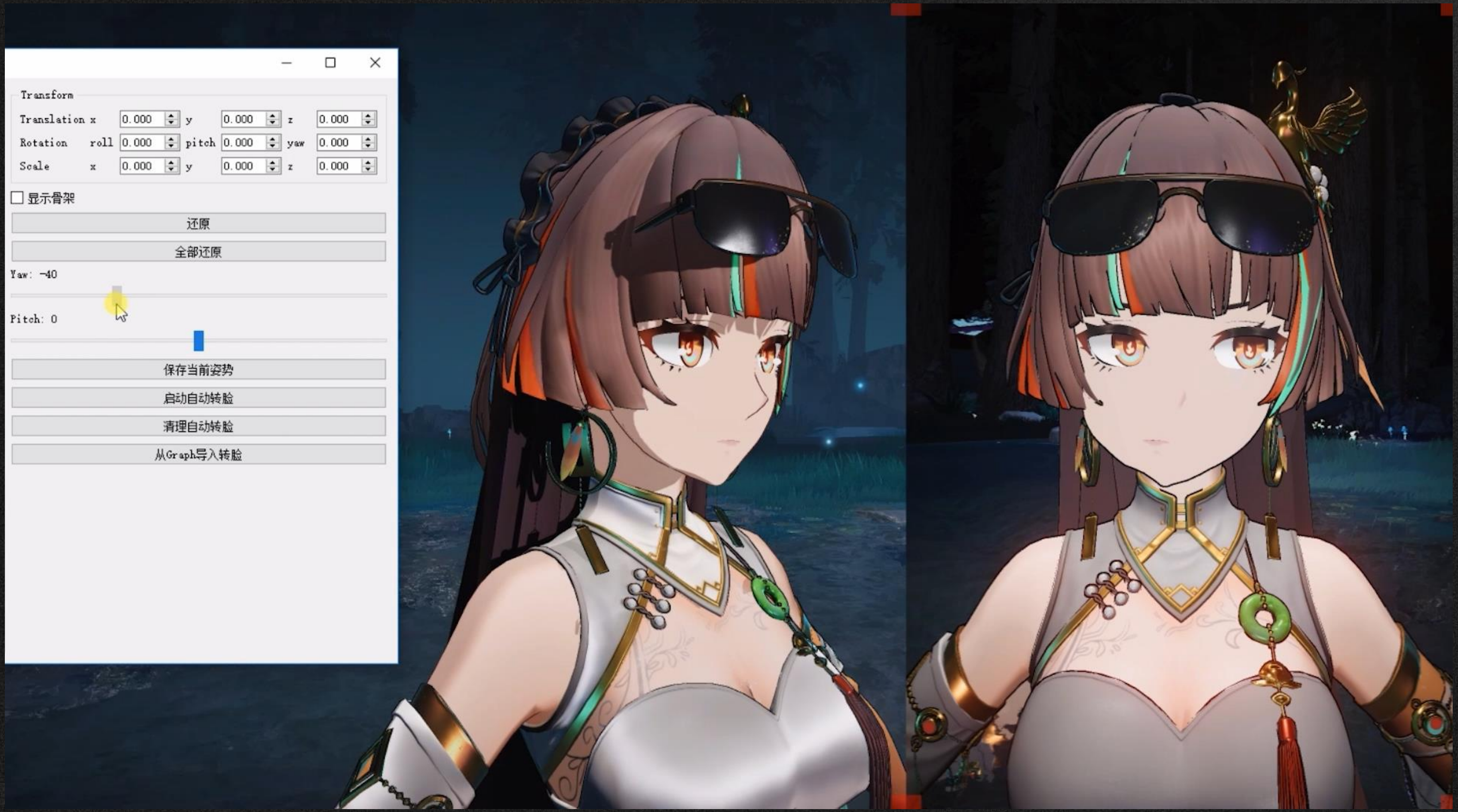
Silhouette Lines

- Extrude normal in clip space
- Consider render target size
- Smoothed vertex normal in color

- Edgeline filling in GBuffer for lighting and post processes

- Work with TAA (Velocity Buffer)

Adaptive Facial Modifier



Transform

Translation x 0.000 y 0.000 z 0.000

Rotation roll 0.000 pitch 0.000 yaw 0.000

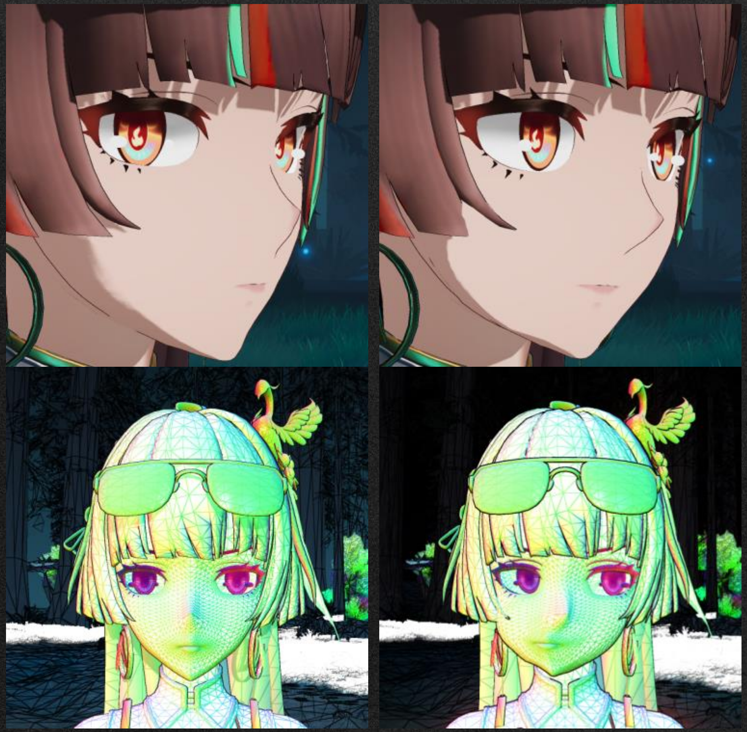
Scale x 0.000 y 0.000 z 0.000

□ 显示骨架

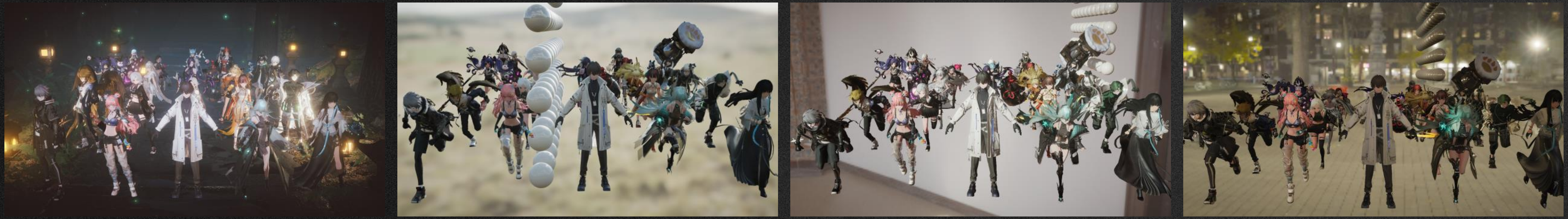
Yaw: -40

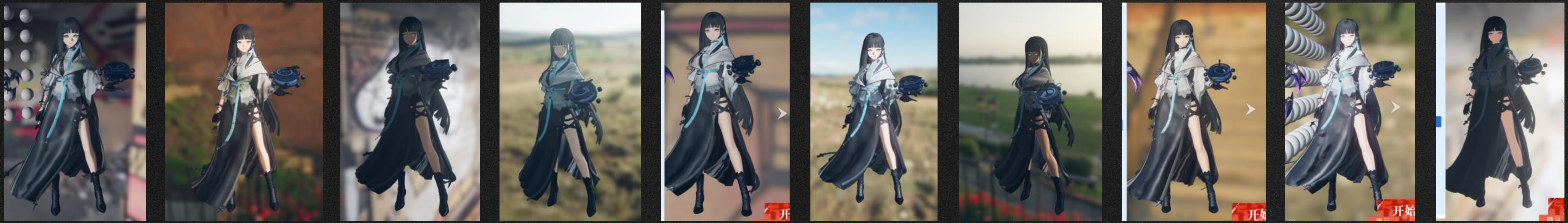
Pitch: 0

- Non-perspective projection
- Poses setup from fixed angles
- Adjust facial matrices



In-game LookDev Pipeline

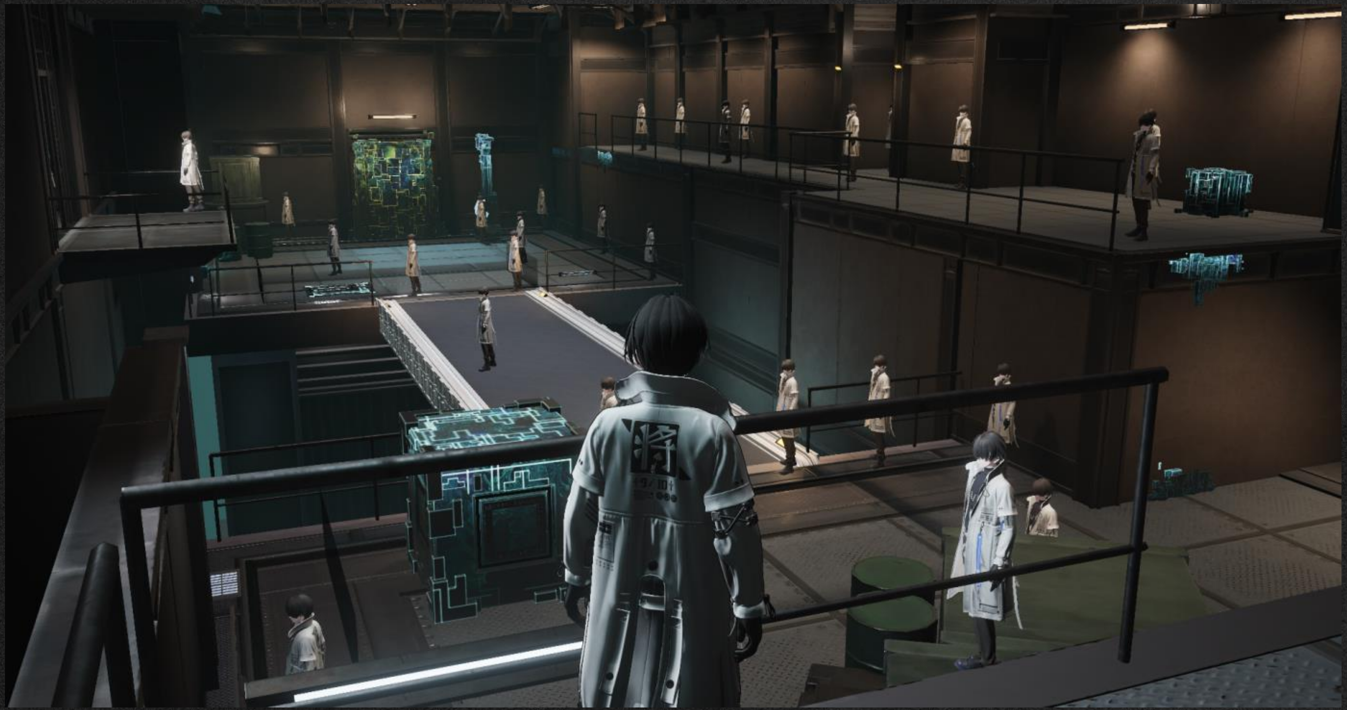




- For new character and environment assets validation
- Singleton check: Harmonious of various shading models coexistence in all environments
- Parade check: Harmonious of multiple characters in the same picture

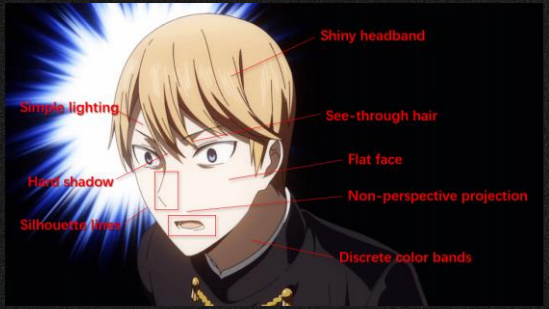
In-game LookDev Pipeline

- Pile characters on top of navmesh
- Rotation or random animations
- Update with camera touring for large levels
- Definite feedback



Summary

- Different approaches of anime style visual creation.
- Key techniques to build anime style notable features.
- Inspirations on stylized rendering.



What makes characters feel like they are anime?

Sprites and Cel Shading. Limitations.

Render pipeline, lighting, shadow, custom shading models, animation and lookdev.

THANKS FOR WATCHING

China: https://hr.game.163.com/recruit.html
Overseas: https://www.neteasegames.com/careers

Twitter

Facebook

Youtube

#GDC22
#NetEase Games