

EA Sports UFC: The Fight for Believable Characters

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GAME DEVELOPERS CONFERENCE™ CHINA
SHANGHAI INTERNATIONAL CONVENTION CENTER
SHANGHAI, CHINA · OCTOBER 19-21, 2014

Believable Characters



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**MAY CONTAIN CONTENT
INAPPROPRIATE FOR CHILDREN**

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new

new team

new franchise

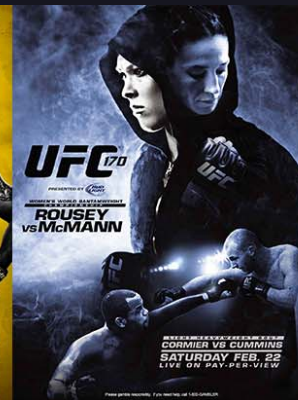
new hardware

new engine



UFC[®]

ULTIMATE FIGHTING[®]
CHAMPIONSHIP[®]









Hardware

1994



Gen Zero* – 3D



Star Fox, Nintendo – February 1993 – SNES

*using EA's terminology

Gen 1 - Geometry



Gran Turismo, Sony Computer Entertainment – December 1997 – PlayStation

Gen 2 - Textures



Metal Gear Solid 2, Konami – November 2001 – PS2

Gen 3 - Shaders



Fight Night Round 4, Electronic Arts – June 2009 – Xbox360

GEN4



NBA 2K14, 2K Sports – October 2014 – PlayStation 4

GEN4



NBA 2K14, 2K Sports – October 2014 – PlayStation 4

GEN4



static

dynamic

GEN4 – DYNAMIC MOTION



Grand Theft Auto V, Rockstar Games
L.A. Noire, Rockstar Games

Beyond: Two Souls, Sony Computer Entertainment
Assassin's Creed IV: Black Flag, Ubisoft

Creative Pillars

Creative Pillars

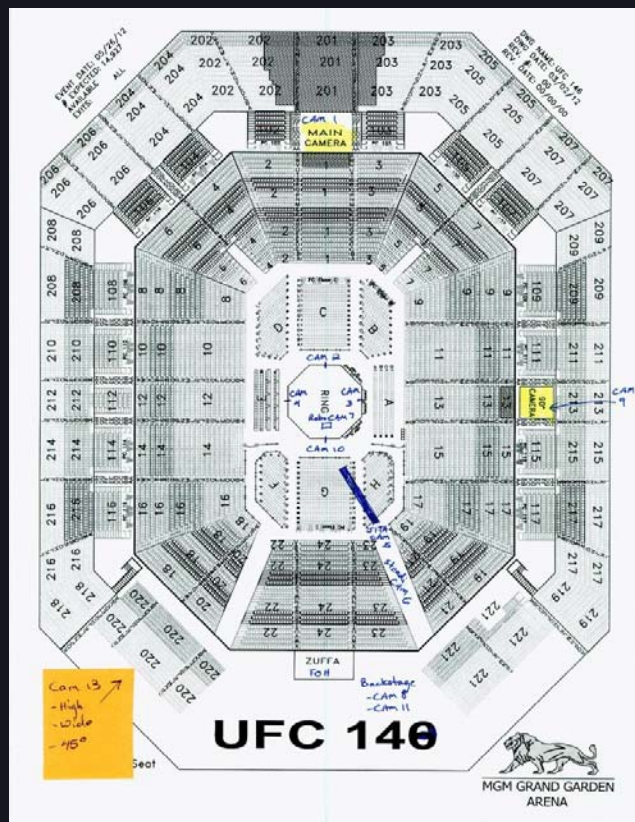
- ACTION

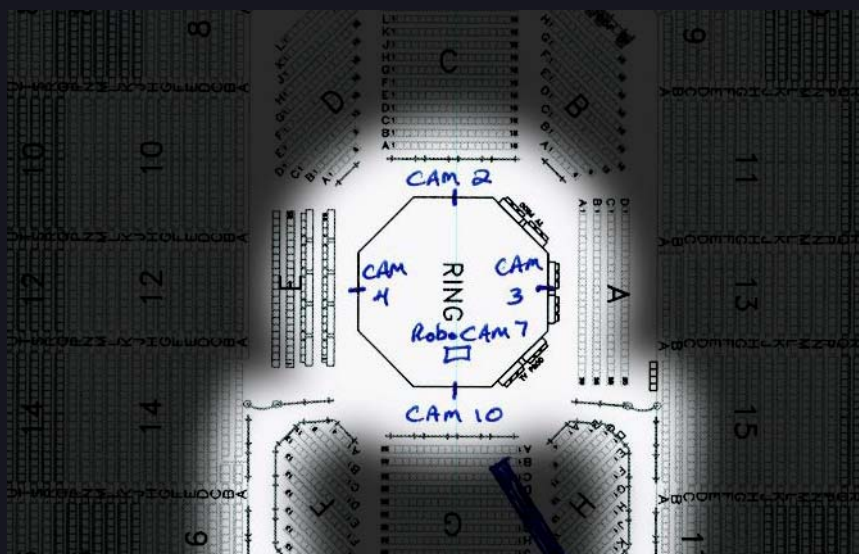
- Impact and Emotion
- Image fidelity
- Convincing collisions, soft bodies

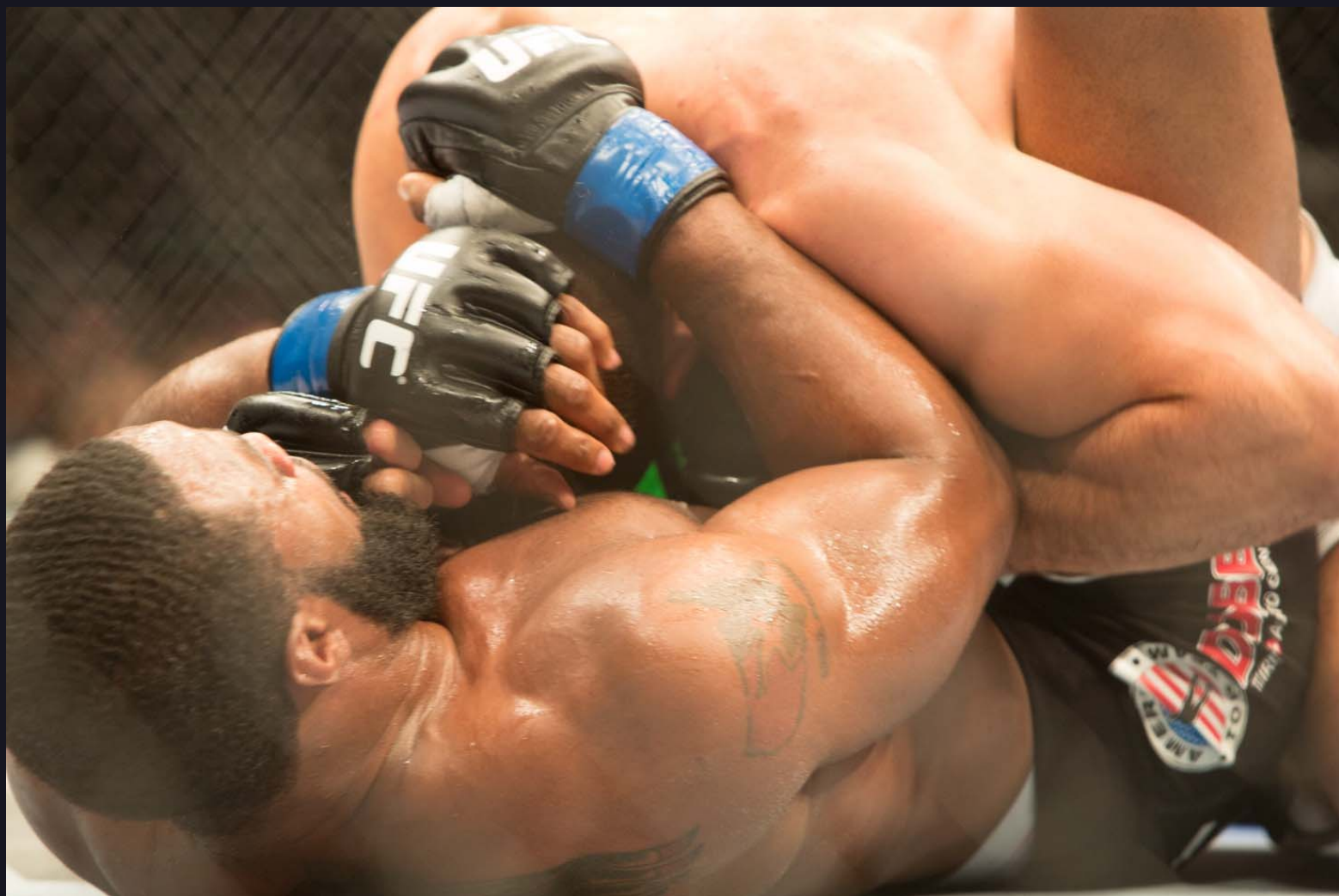


Feature List

What Matters Most

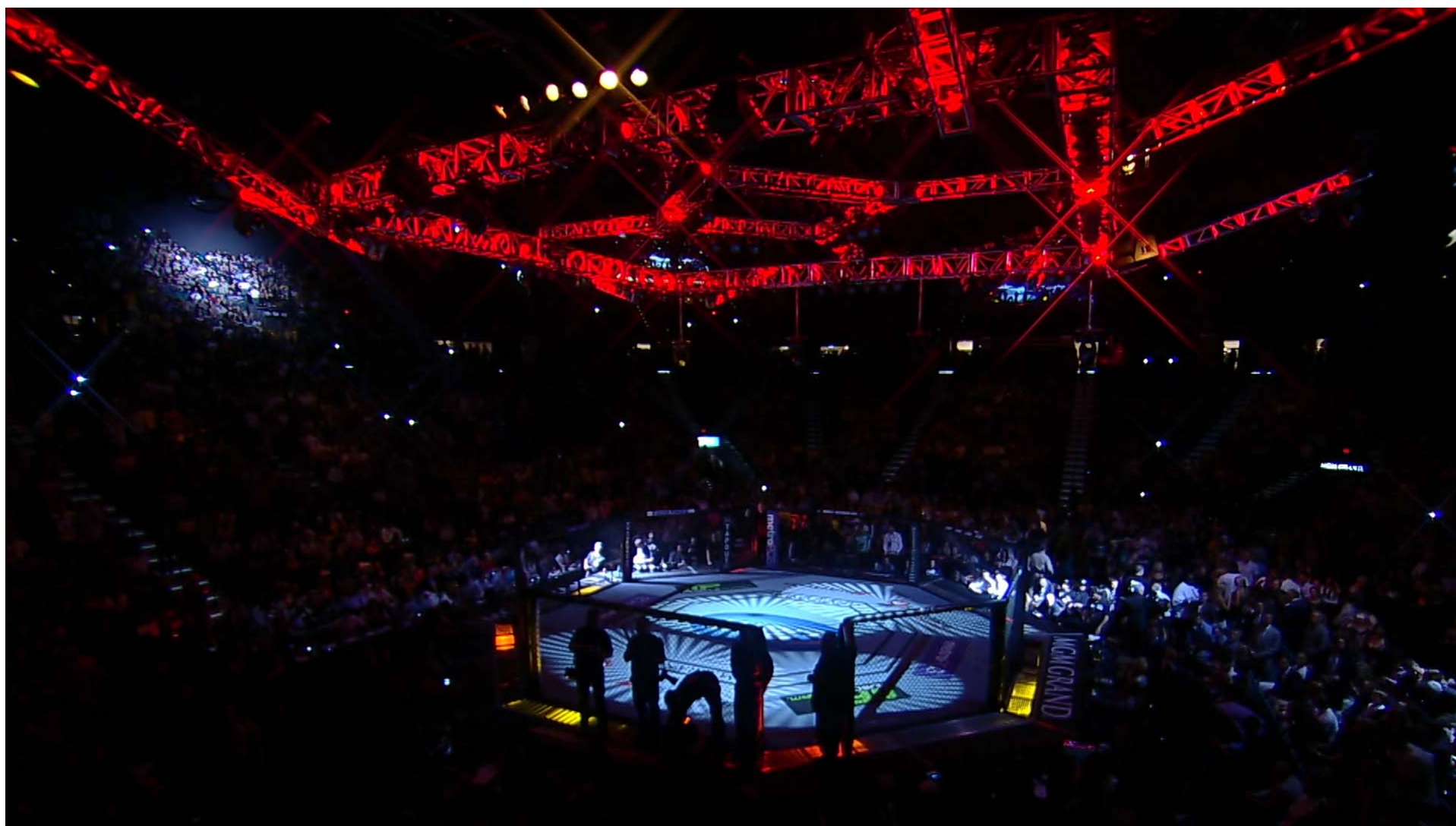






Broadcast Look & Feel







Spot-lights
moving across
cheering crowds



Many colour changes

The Octagon is
the focus



Light Shows





Focus on highly detailed characters
with unique animations



'Cheat' with everything
else in the background

Intro sequences



Picture-in-picture
jumbotrons



Keep crowd in
the back-ground



The main characters
are the focus

Intro sequences

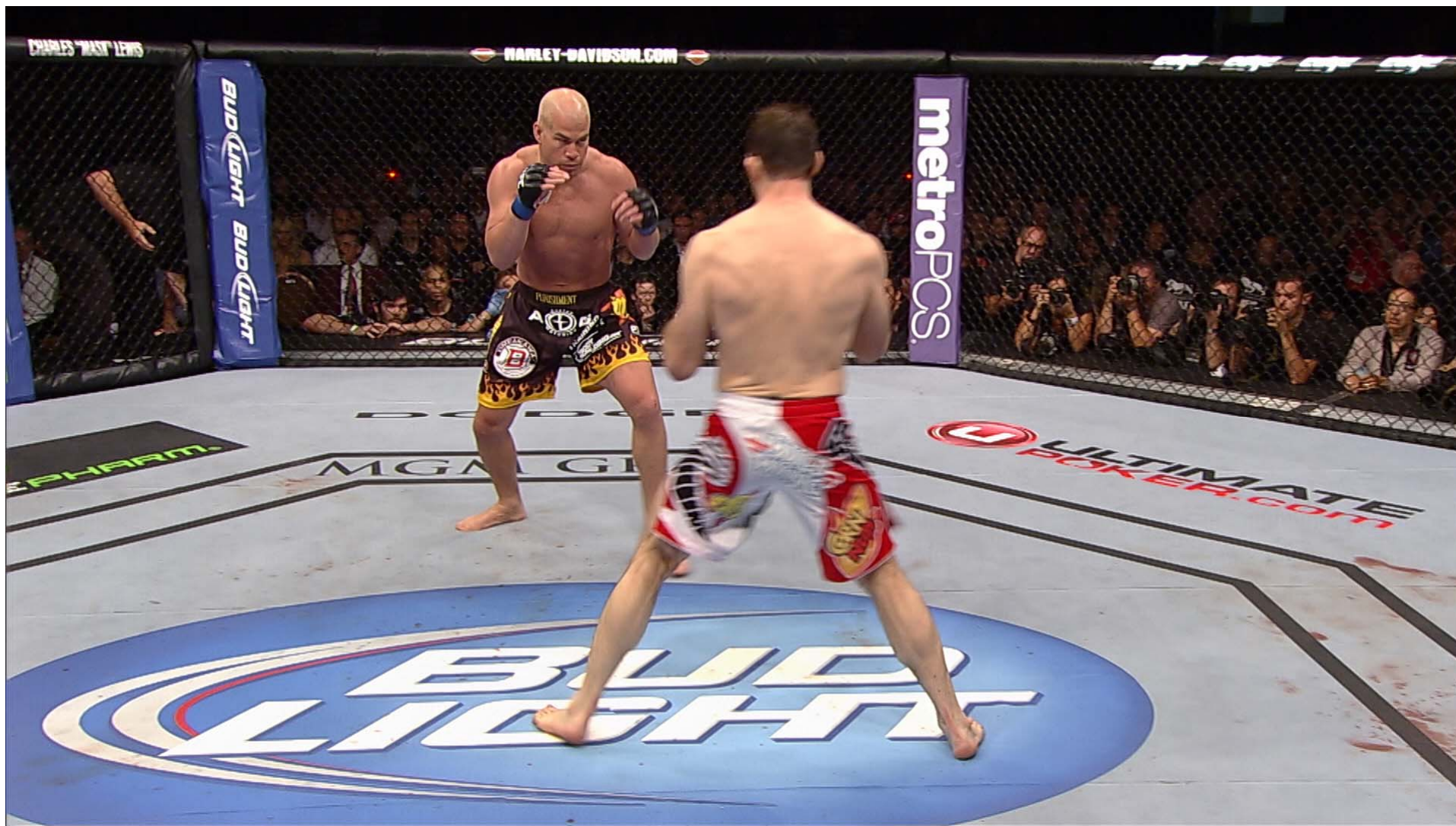




Show off differences
in fighter physiques

Make iconic moments
of top quality

Intro sequences



Fresh fighters:
focused facial anims.
'Dry' skin
Energetic motions



Motion blur
emphasizes speed



Gameplay





The bounce and jiggle
of fat helps create
a soft human feel



Fleshiness



Many highly detailed characters
with unique facial animation



Post Fight

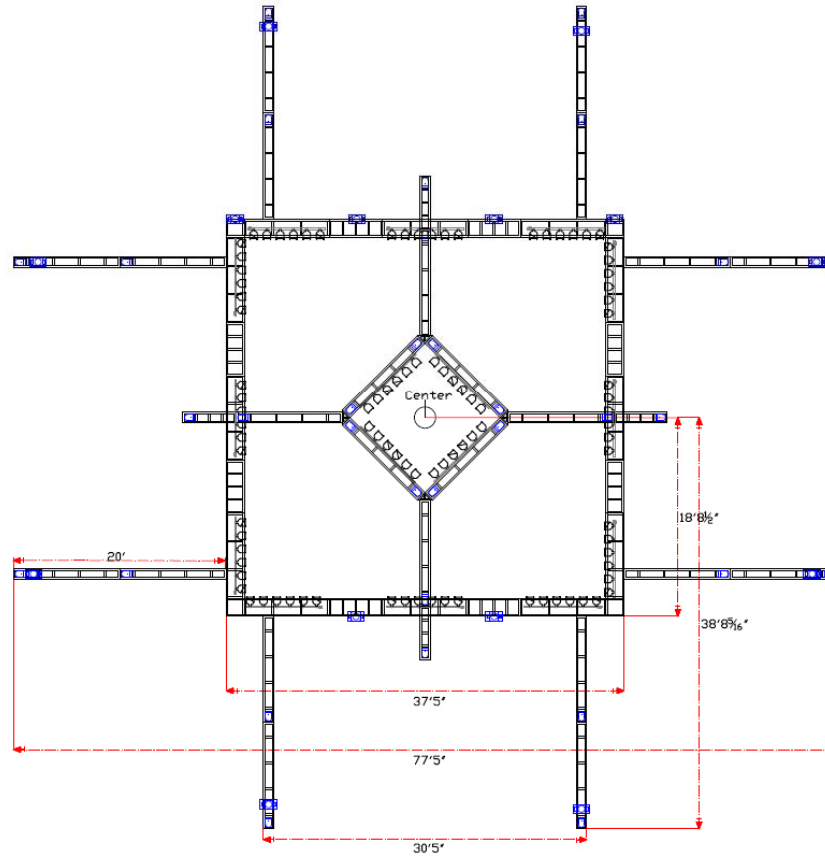
ETARs & VTARs - Lighting



Lighting



ULTIMATE FIGHTING CHAMPIONSHIP



DRAWING TITLE: LIGHTING PLAN, ELEVATION AND CAMERA POSITION PLAN

LIGHTING LEGEND	
SYMBOL	DESCRIPTION
	PARALLEL BEAM LIGHT
	SOURCE PAR WIDE
	SOURCE PAR MEDIUM
	SOURCE PAR NARROW
	SOURCE ELIPHSICAL
	NONE (HOLD)
	NONE (YELLOW)

- NOTES:
1. ALL DIMENSIONS ARE NOT TO ANY SCALE.
 2. ALL DIMENSIONS TO HAVE ROUNDED TO THE NEAREST 1/4\"
 3. ALL DIMENSIONS TO HAVE ROUNDED TO THE NEAREST 1/4\"
 4. ALL DIMENSIONS TO HAVE ROUNDED TO THE NEAREST 1/4\"
 5. CONSOLE TO BE ADJUSTED TO THE HEIGHT OF THE FIGHTER.
 6. PLACEMENT AND SPACING OF LIGHTS & INSTRUMENTS TO BE DETERMINED BY THE LIGHTING DESIGNER.

THESE DRAWINGS ARE THE PROPERTY OF THE LIGHTING DESIGNER. ANY REUSE OR MODIFICATION OF THESE DRAWINGS WITHOUT THE WRITTEN PERMISSION OF THE LIGHTING DESIGNER IS PROHIBITED.

DATE: 11/10/04	SCALE: 1/4\" = 1'-0\"
SHEET NO.: 1 OF 1	

Light readings



Lee Rosenbaum
Technical Artist
EA Canada



Lee Rosenbaum,
Technical Artist
EA Canada

UFC LIGHTING AND CROWD



Warm lit crowd falling into shadow.
Sharp focus not appealing.



Crowd fall off into shadow & DOF works here. Cage acts as a separation layer.
The black shorts are the darkest value in the scene. A good thing.



Great separation when foreground crowd is not in view.



Out of focus cool light sources in bkgrd read well avoiding pure blacks
Foreground blurred out cage adds a nice abstract depth to image

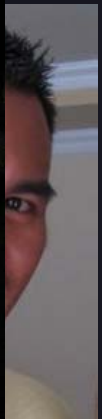


Pockets of light (many colored) from spot lights break up crowd & bkgrd.

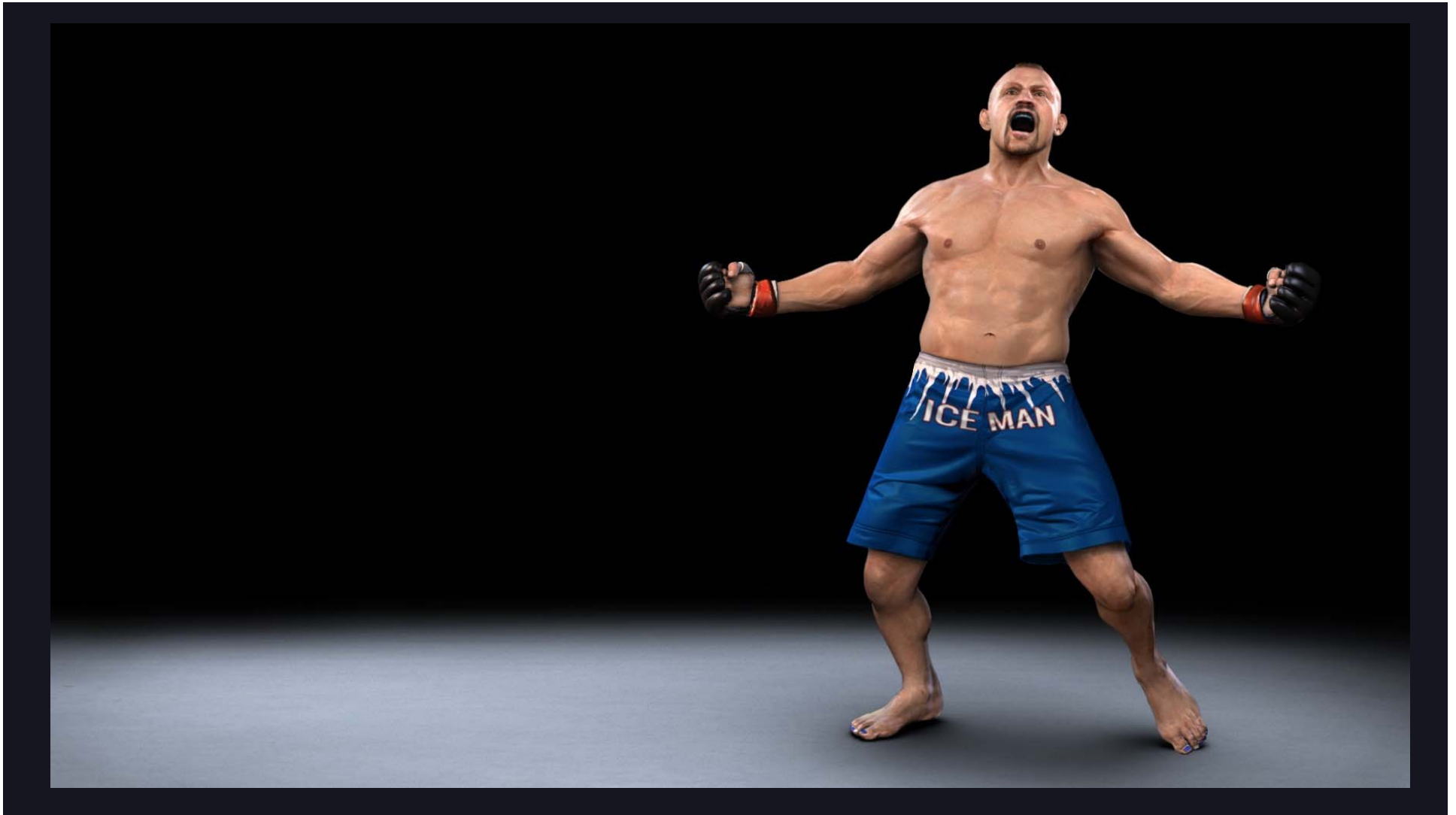
NOTE- that this lighting effect only occurs between rounds and before & after fights

Leveraging this treatment "slightly" might break up bkgrd and add interest. But do not over apply. Treatment on left is authentic.

ETARs & VTARs - Characters



artist

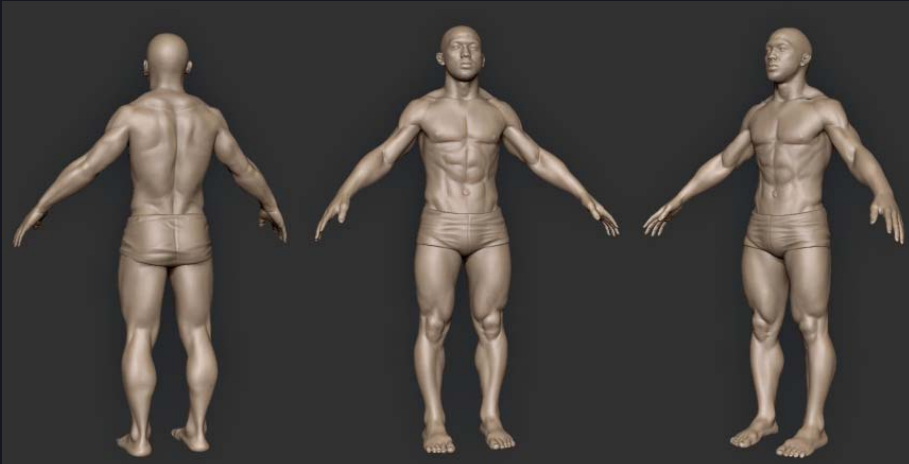






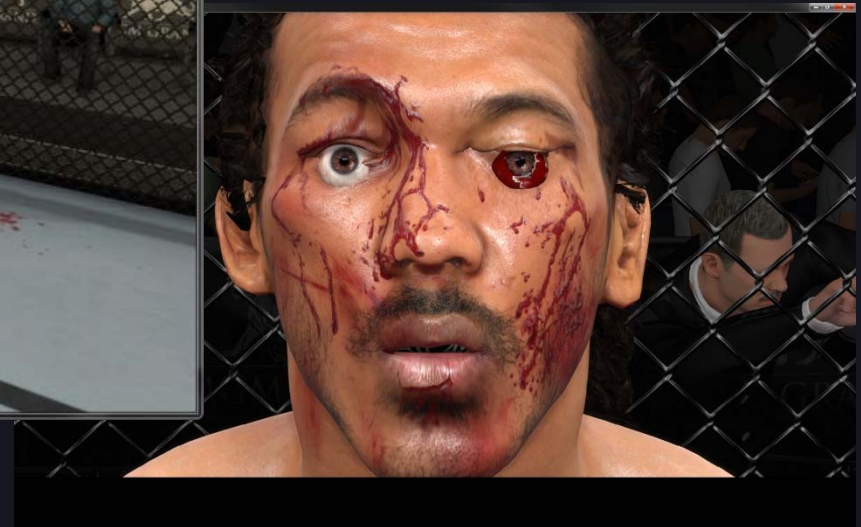








WIP Hendo – 8 months before ‘street’





UFC

BENSON HENDERSON

BORN: COLORADO SPRINGS, CO, USA



BENSON HENDERSON

ALL-AMERICAN WRESTLER

FORMER WEC LIGHTWEIGHT CHAMPION

VERY FAST

The Basics



challenges

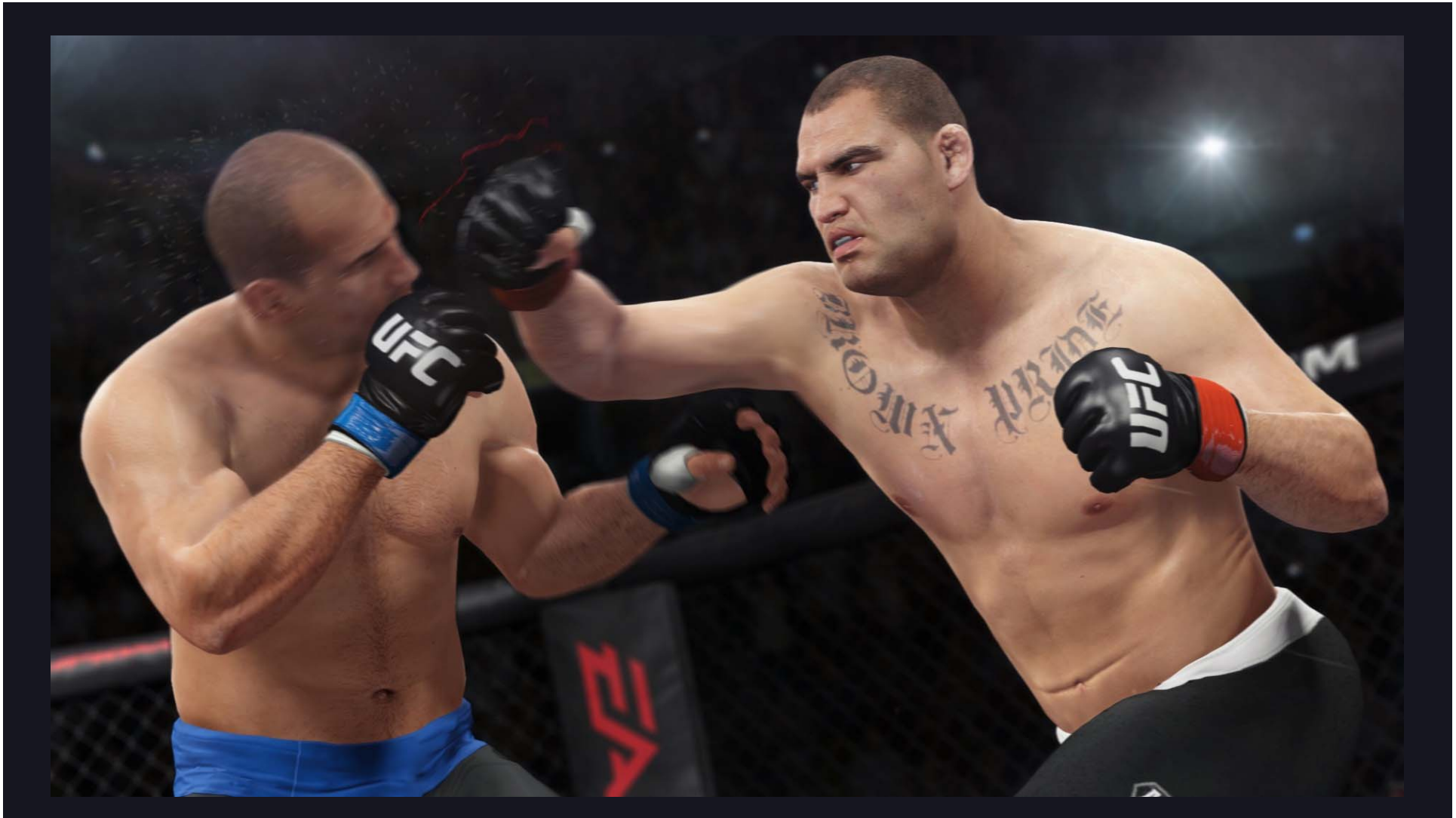


Challenges



Challenges



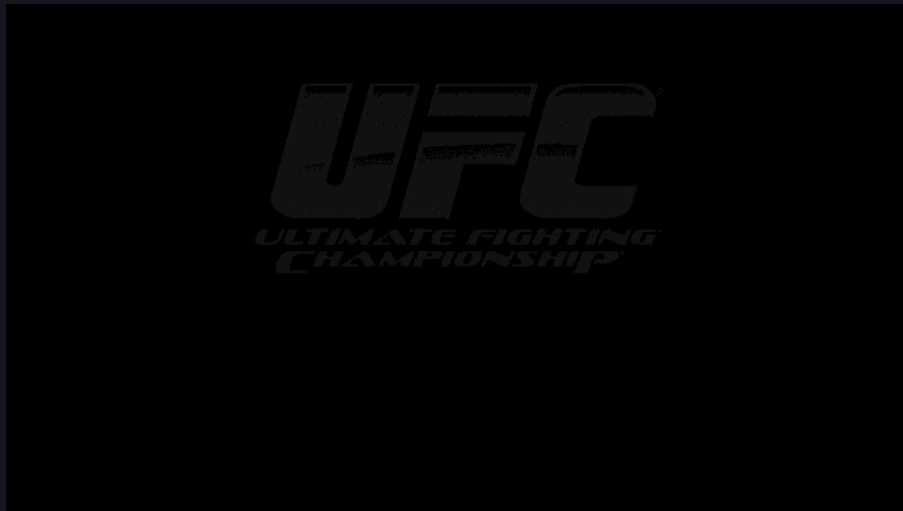


ETARs & VTARs - Motion

Reactive motion: Punch ripple, Flesh deformation



'Ambient' motion: breathing, Jiggle, Flex



Choke moment







Emotion

Extreme expressions
Organic feel







UFC - Facial Wrinkle WIP/Prototype



PRE-ALPHA
UFC
FIGHTER EMOTION DEMO

Putting it all Together



real emotion, real contact

ETARs & VTARs - Damage



Tells the Story



Photography by Kevin Lynch







Photography by Kevin Lynch



Creative Pillars

- ACTION
 - Impact and Emotion
 - Image fidelity
 - Convincing collisions, soft bodies



Interaction and Deformation Technology

Interaction and Deformation

- Character proximity and interaction is of paramount importance to UFC
- Beyond animation : creating a better puppet
- Our new GPU can do more than *just* shade...



New Platforms with new GPU

- Legacy work in Fight Night Series (PS3 and Xbox360)
- New PS4, new XboxOne, limited access – incomplete
- More powerful? Not sure how much
- New functionality – Newer GPUs are not only *faster*, also more *flexible*
- Resist temptation to rewrite everything

Full Body Contact



Challenges

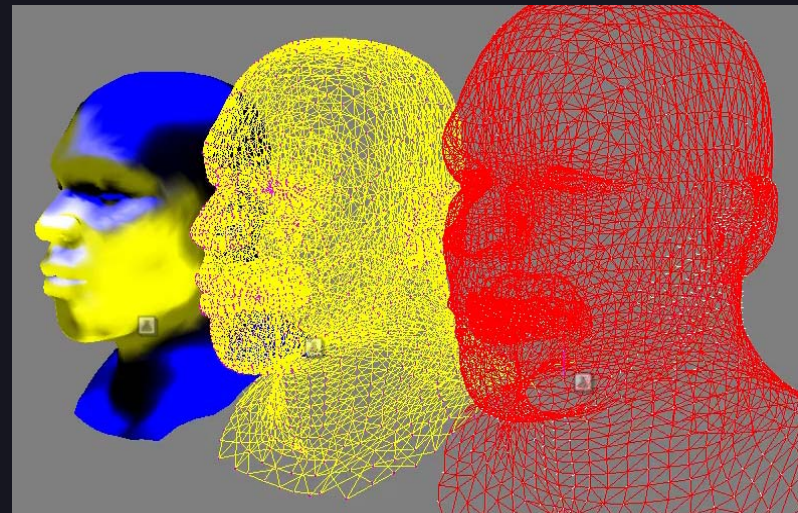
- ~30k unique render faces in each character
- Dynamic Characters - Morph Shapes, 200+ bones
- Mesh vs. Mesh collision is inherently expensive
- Far too many poses, positions, and dynamic results to *pre-bake* the deformations
- Computationally Extreme*

A detour

GPU and Compute

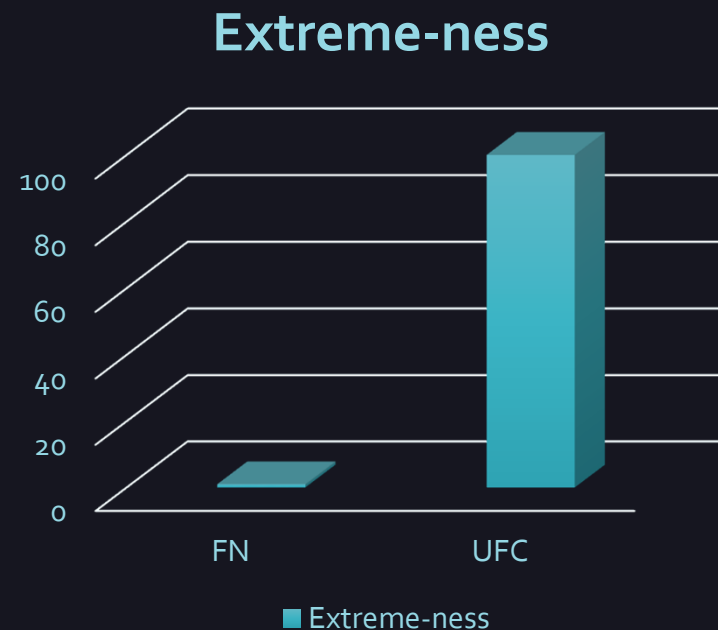
“Computationally Extreme”?

- Fight Night was extreme
 - Dense meshes
 - 3 out of 6 XBox360 cpu cores
 - 4 PS3 SPUs
 - Dedicated to skin morphs, cloth, and face simulation
- Fight Night was built around spending BIG on characters



Computationally Extreme!

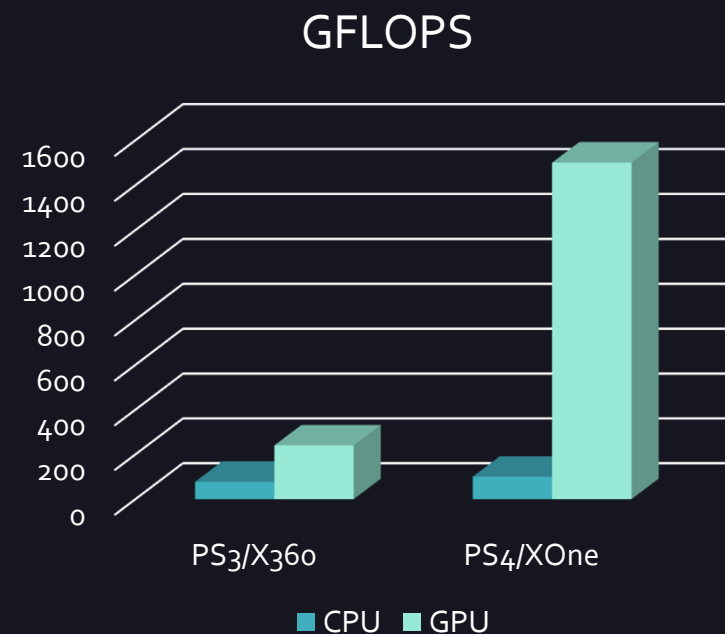
- Full Body Contact solution may be summarized as a simplified, posed Mesh-to-Mesh Collision algorithm
- ...and because it is a *search* it is *easily* 100x as expensive as linear processing used in Fight Night



Comparing Generations

- Modest CPU improvement*
- Respectable GPU improvement**
- *But no SPUs*
- *And not 100x faster*

So how can we afford this?



Graphics Core Next (GCN)

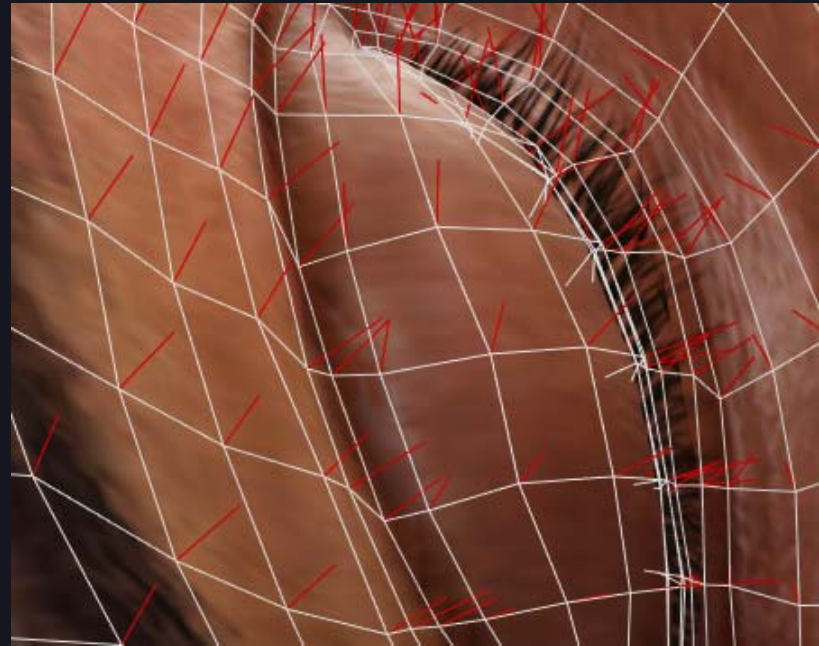
- Not *just* a Graphics-PU and not *just* faster
- Sophisticated General Purpose Compute Engine
- Language and API's to implement any program
- 100 to 170GB/s with latency mitigation
- Natively Parallel and achievably so
- 768 to 1152 threads
- Easy to use
- (But still the only hardware to shade pixels)

It's not just about shading

GPGPU Applied

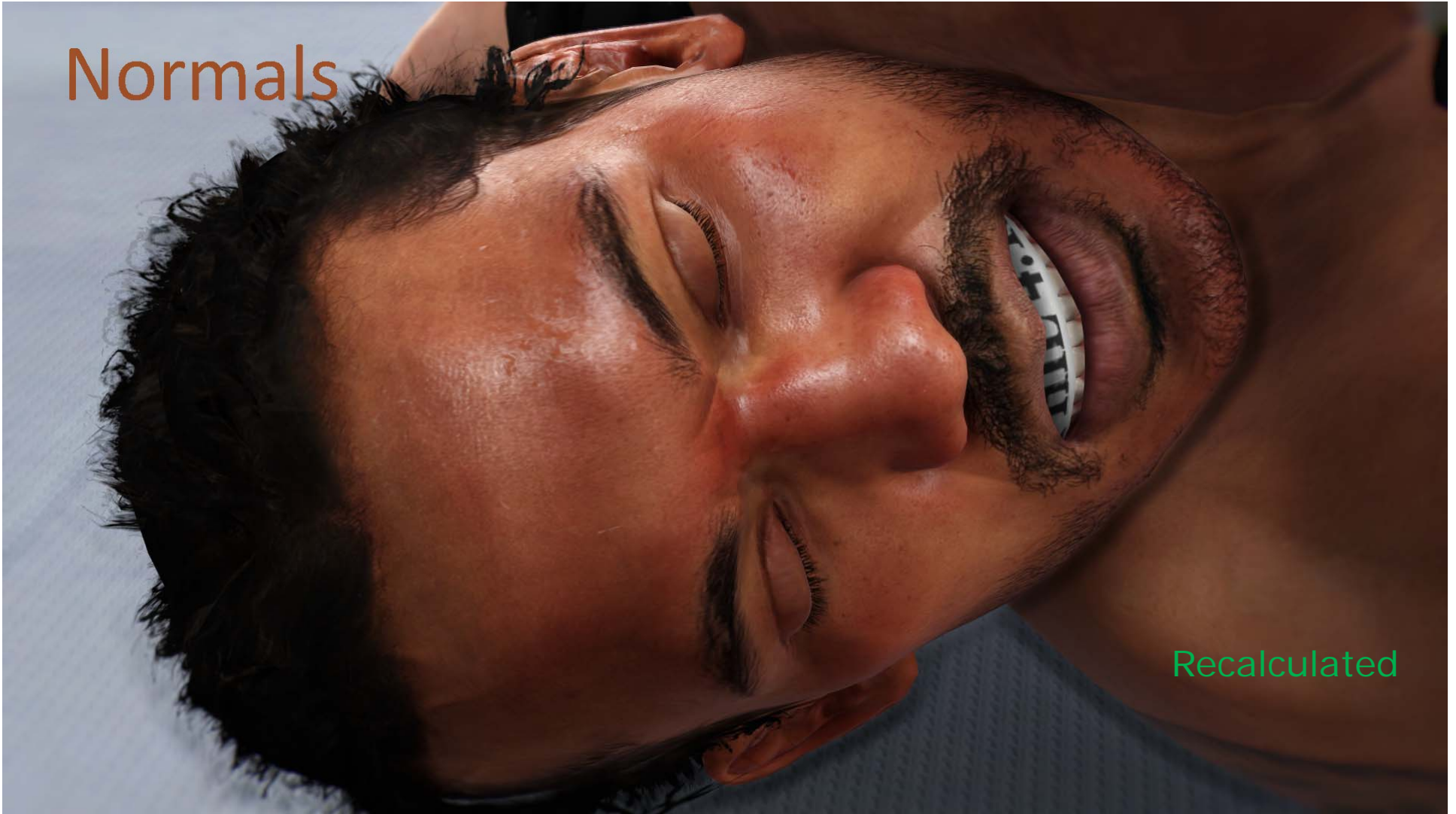
Dynamic Mesh Normal

- Merging and welding vertex data from multiple render meshes
- Generating Face Adjacency
- Generating accurate vertex normal from the dynamic surface shape

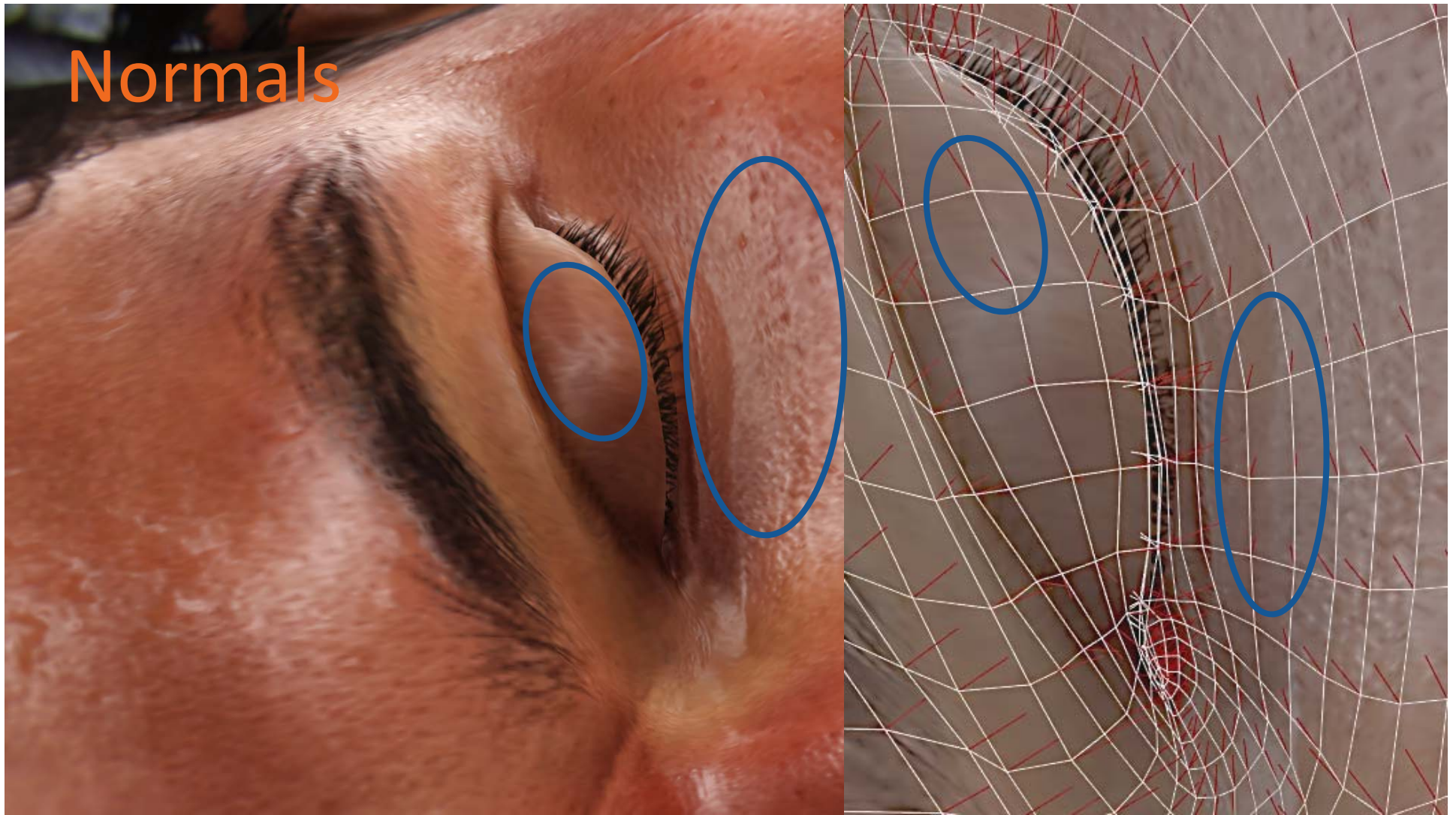


Normals

Recalculated



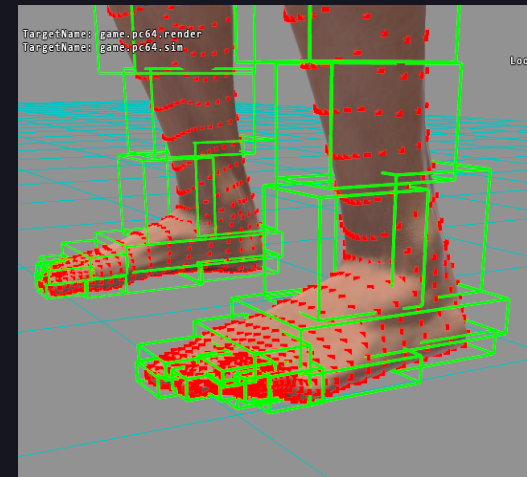
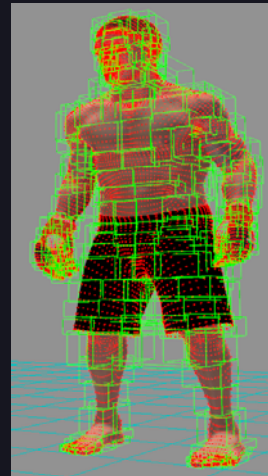
Normals

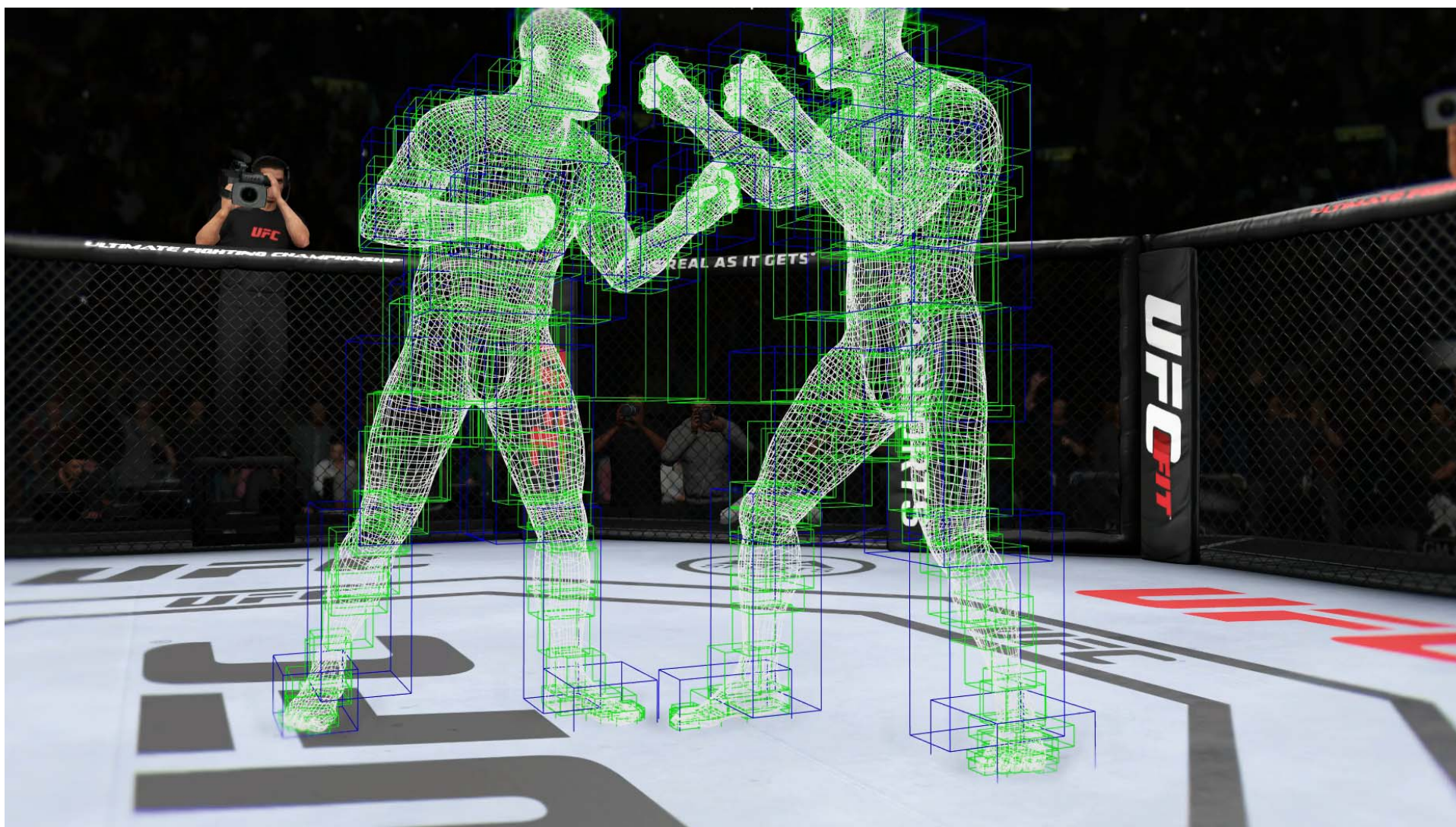


GPU Accelerated

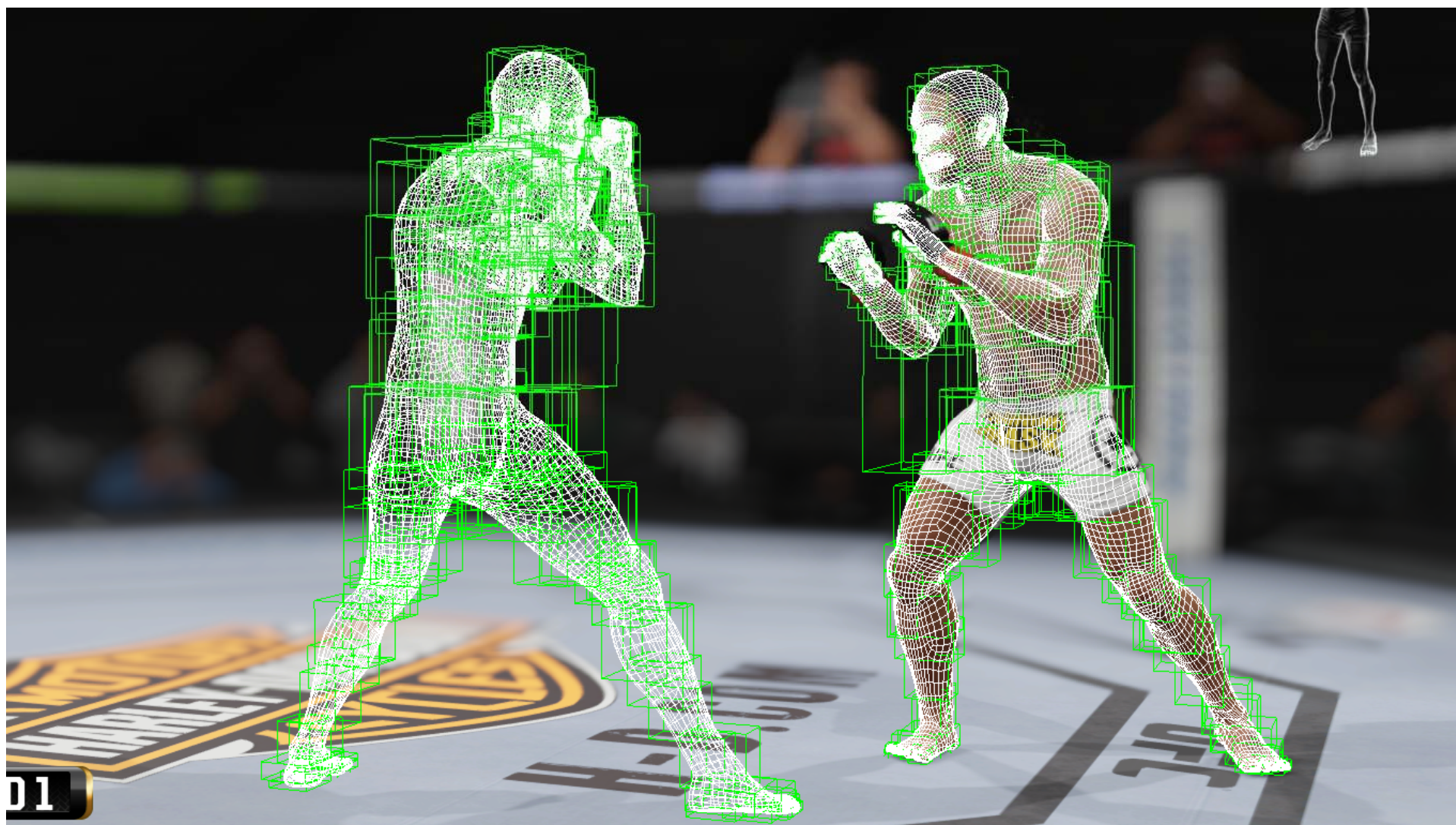
Collision

- Balanced AABB tree built over combined character meshes on load
- Refitted every frame for fast broad phase collision
- Clear applications in physics



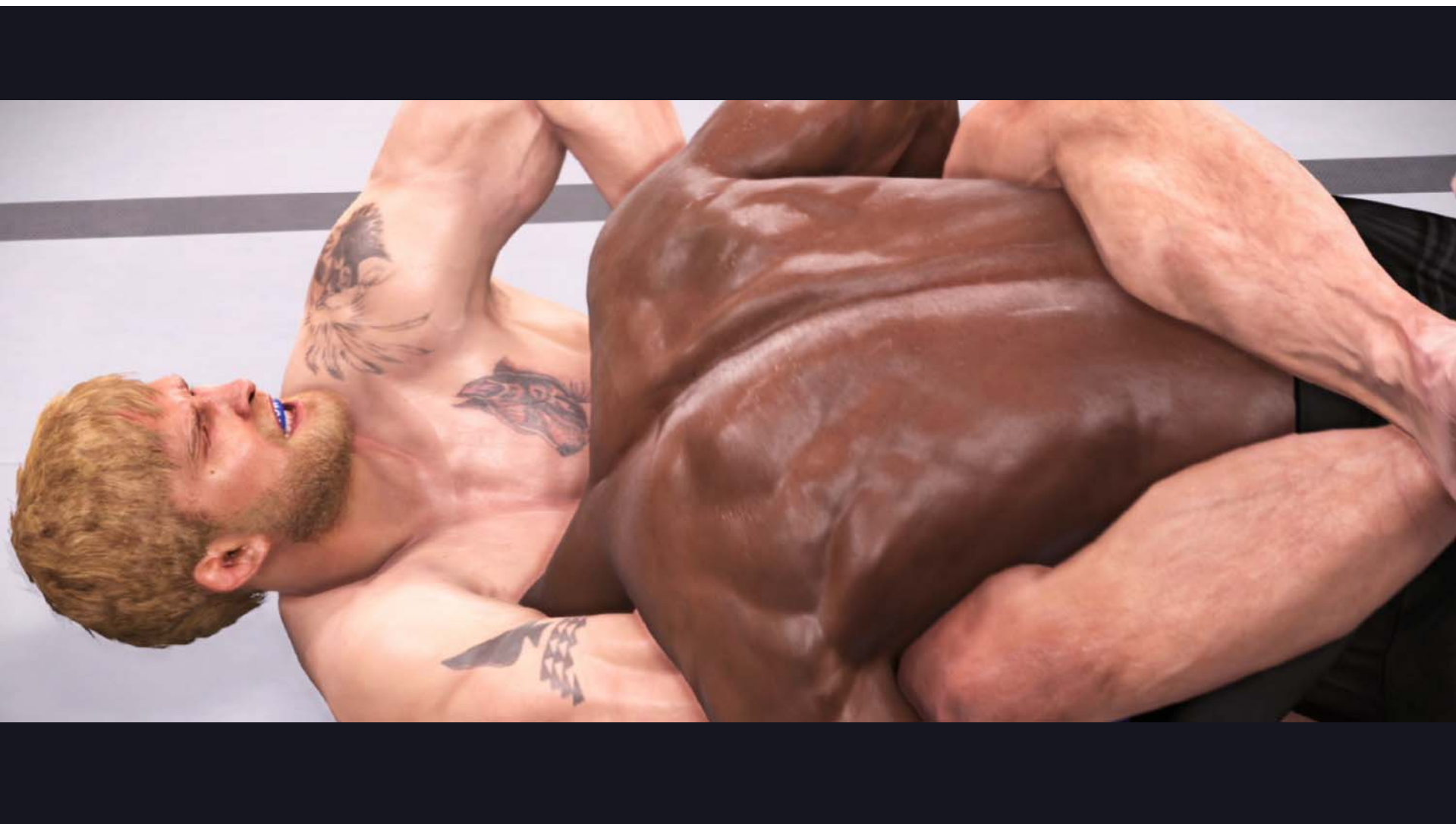






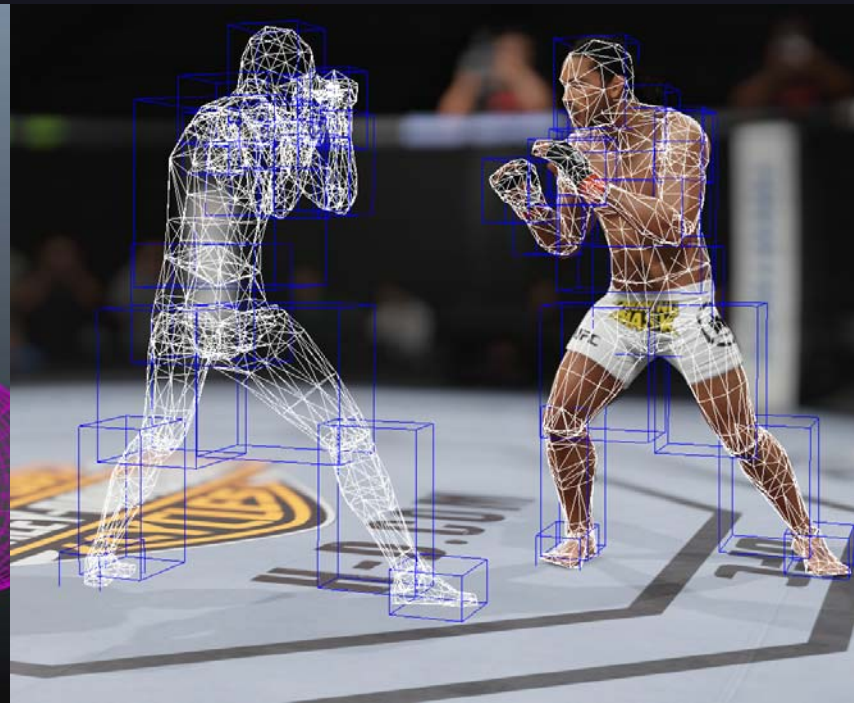
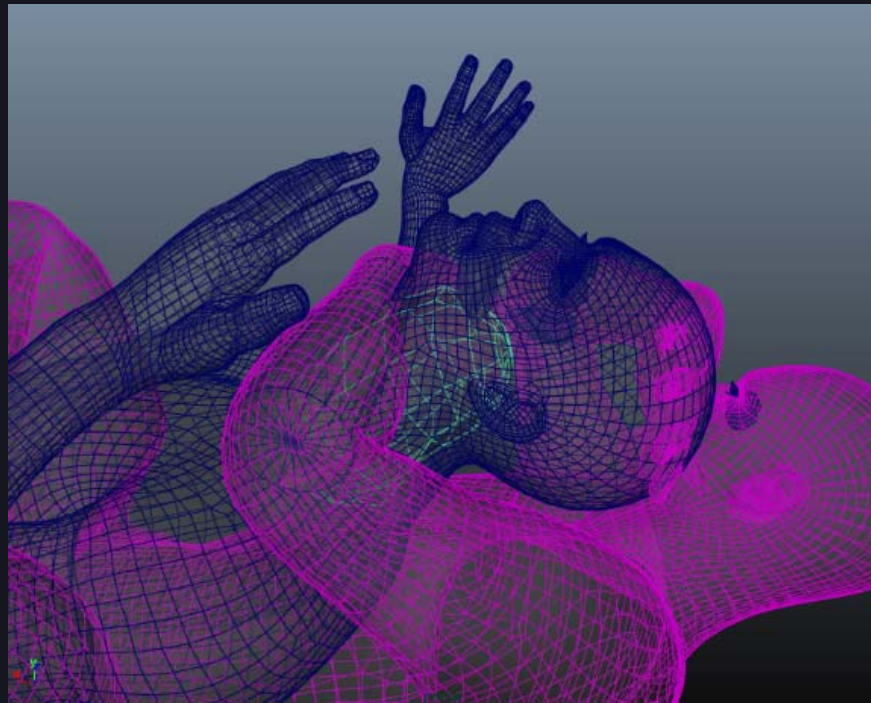
Contact Deformation



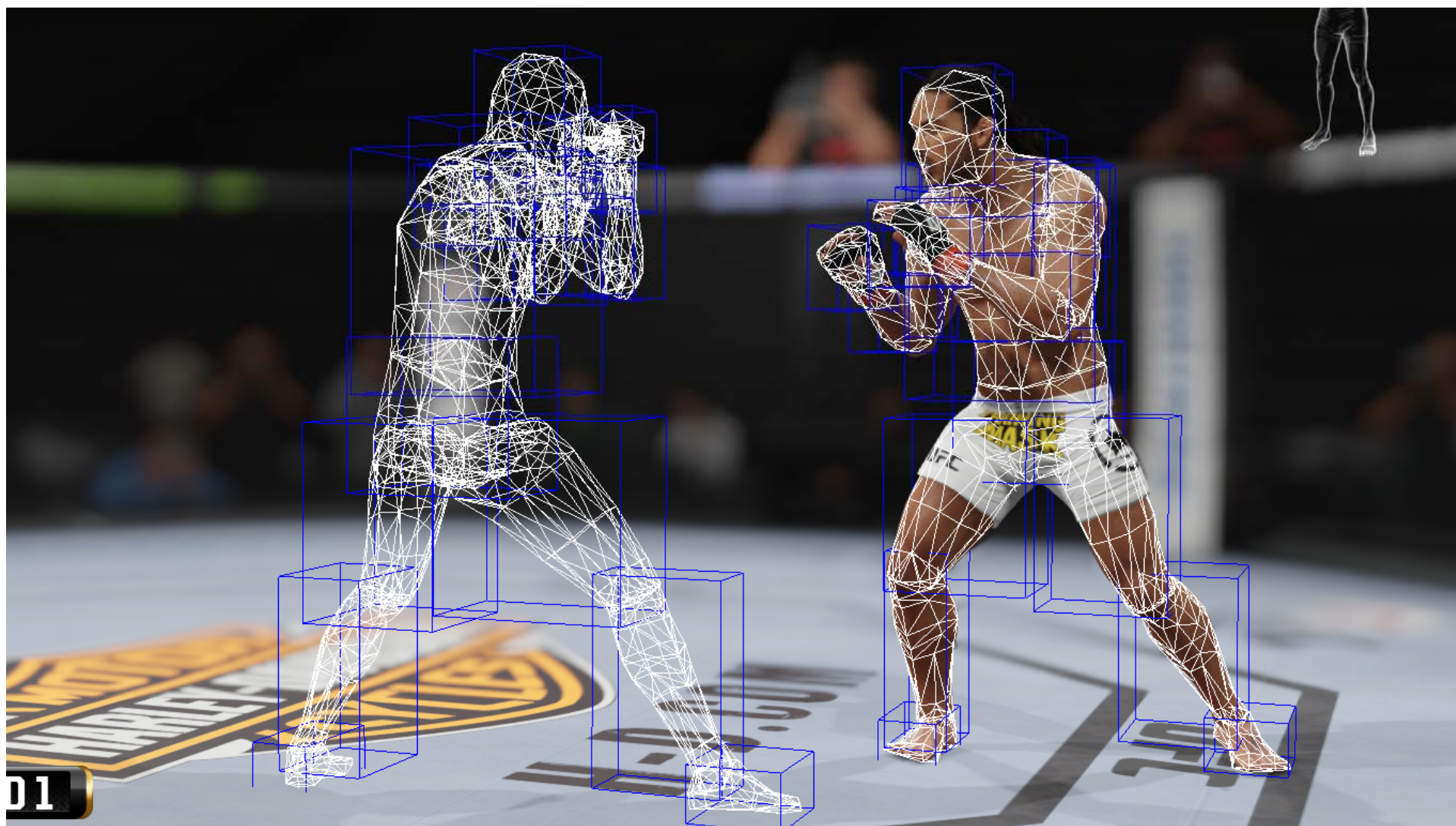


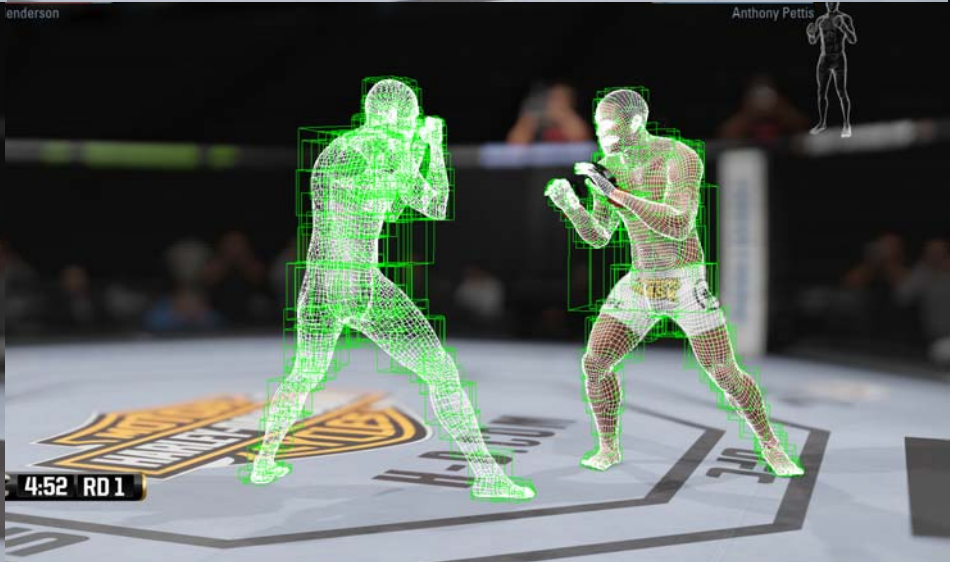
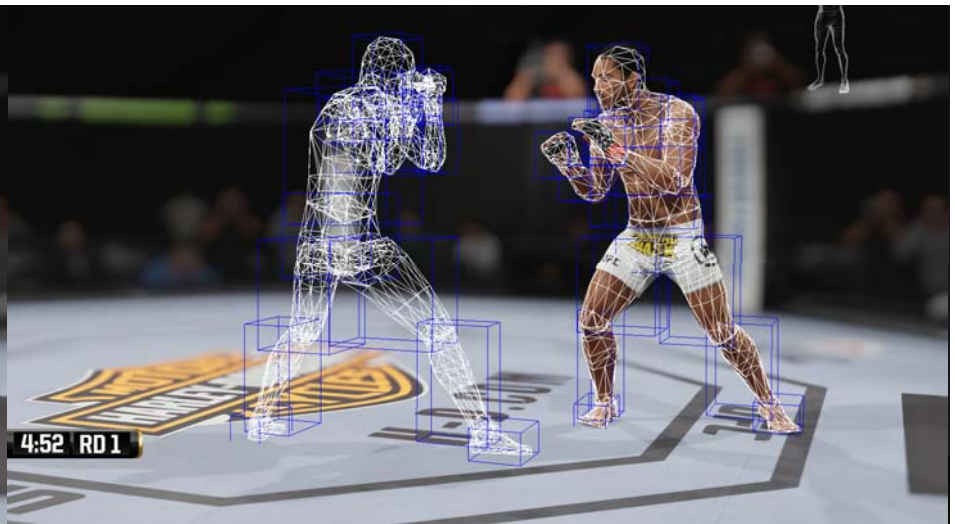


Contact Deformation

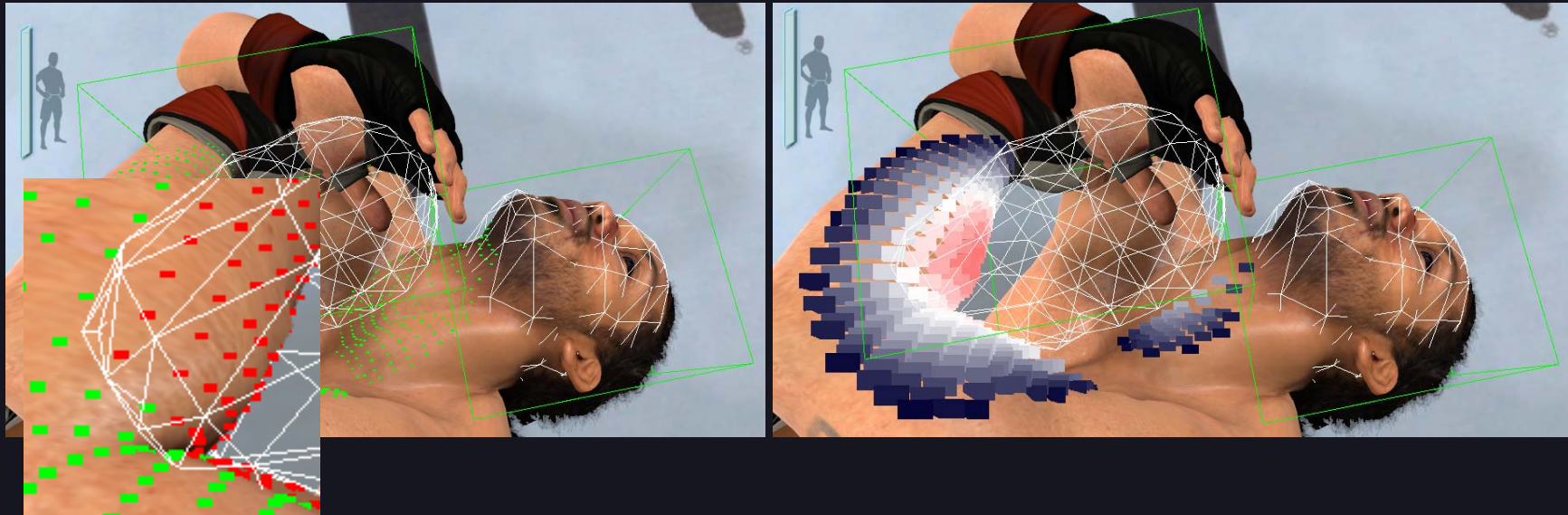


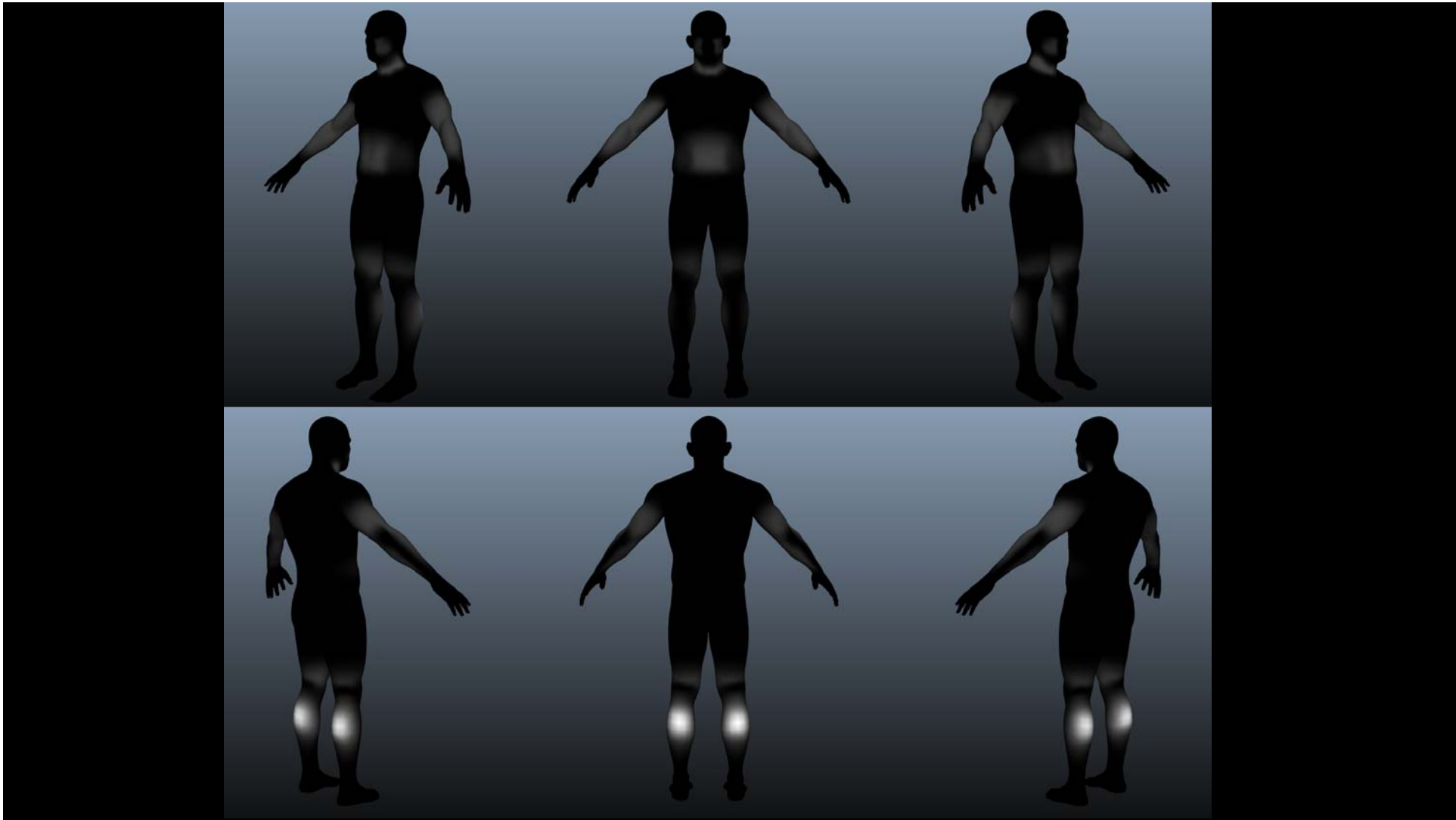


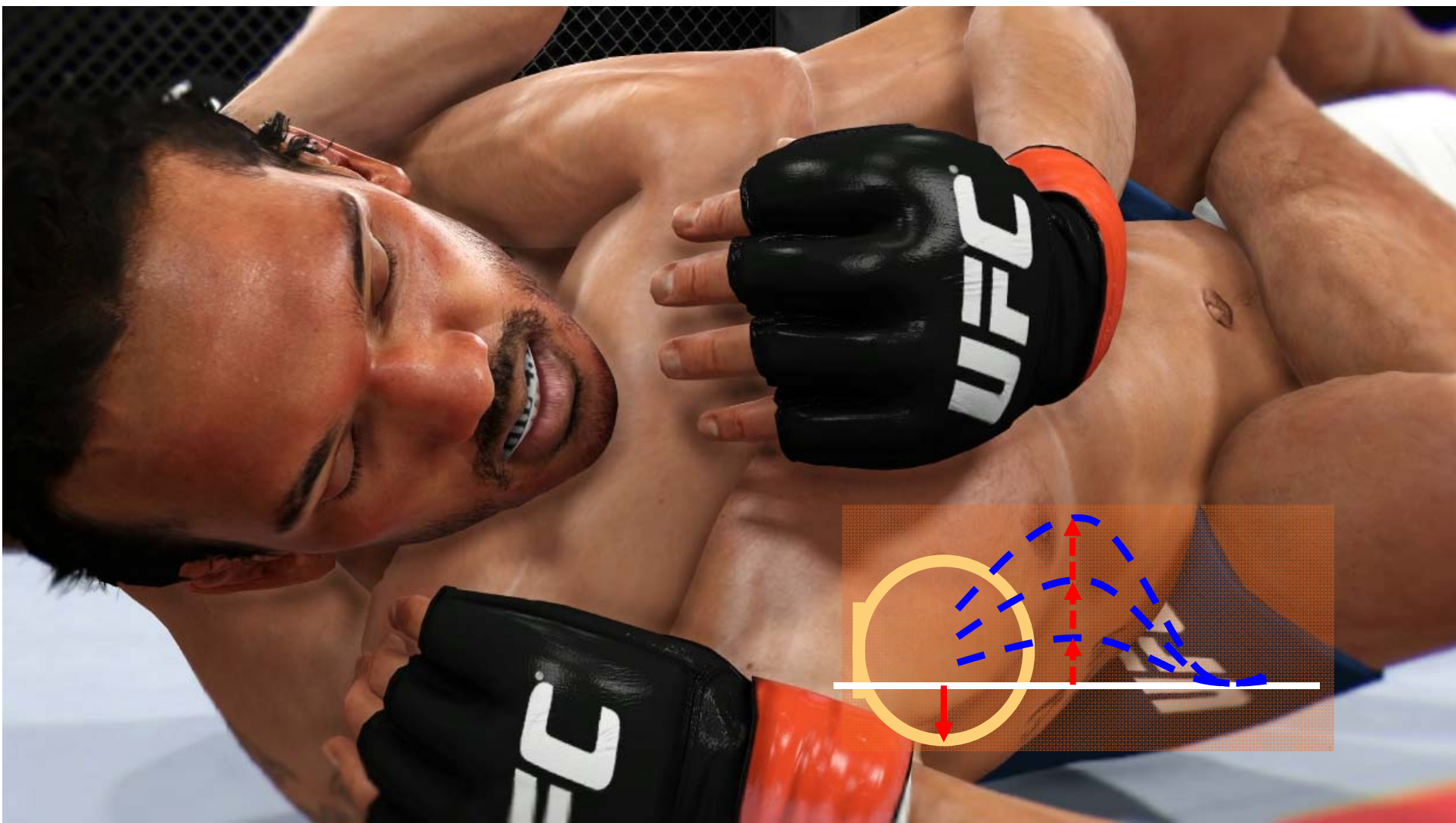


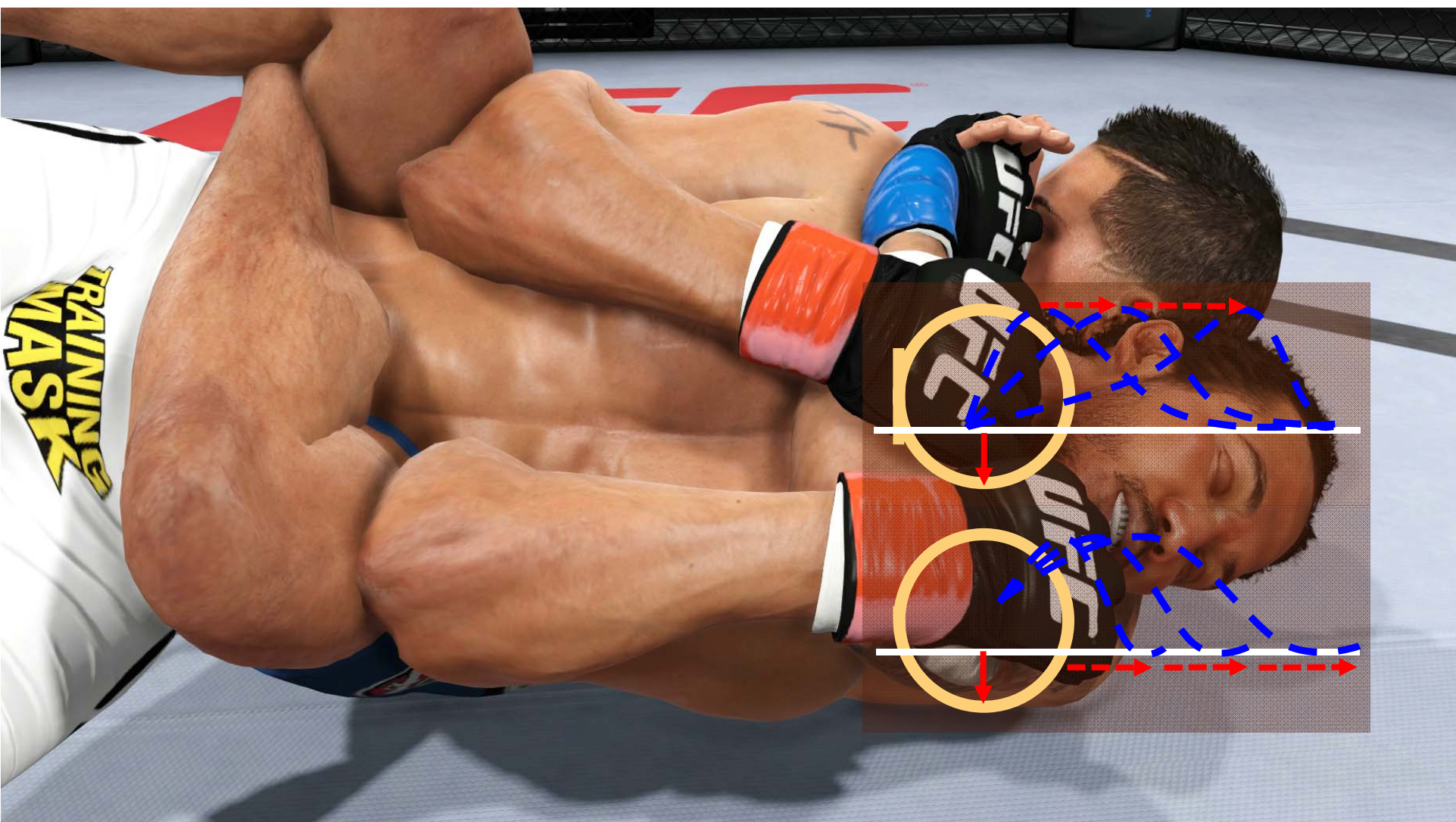


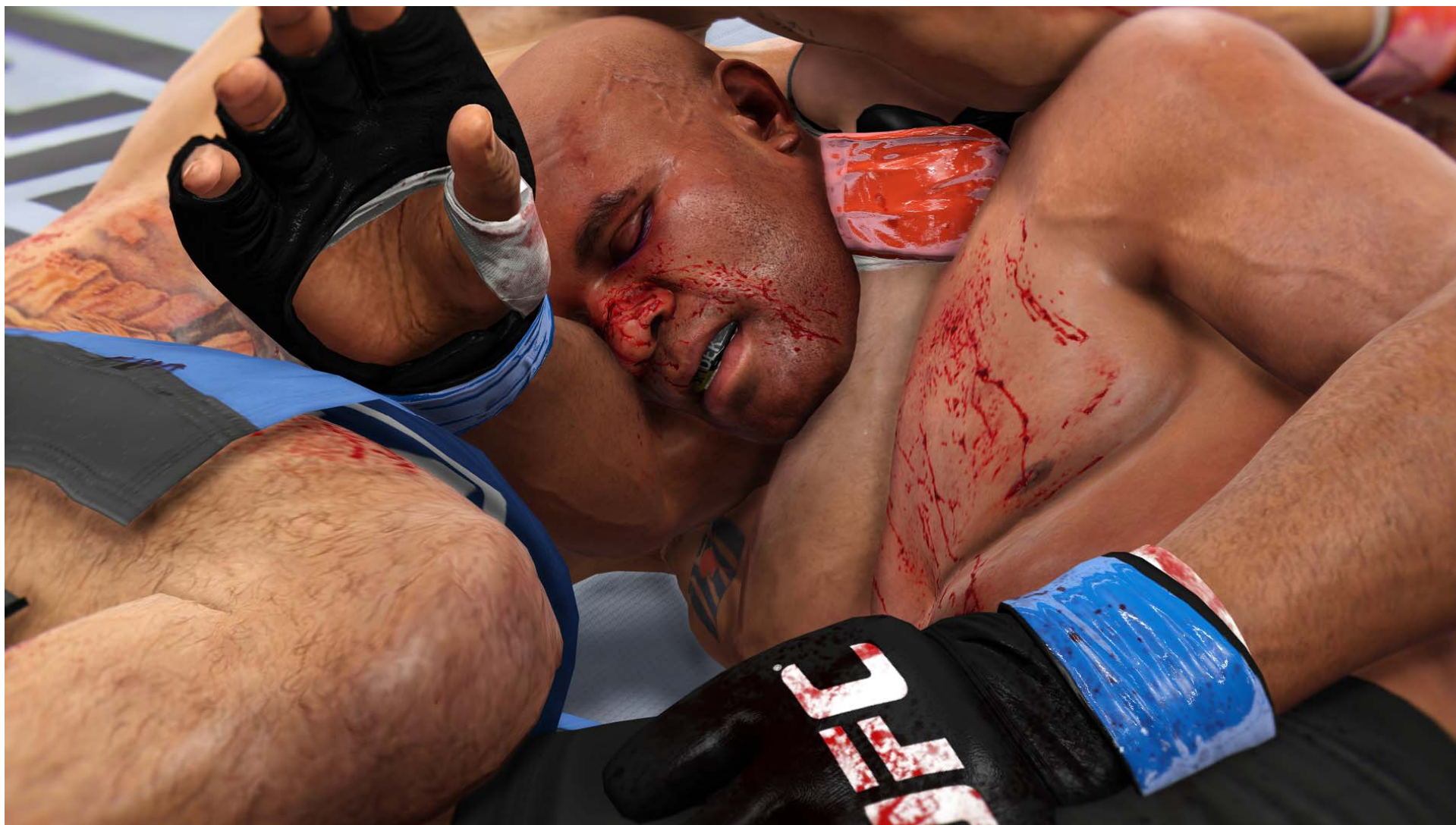
Contact Deformation







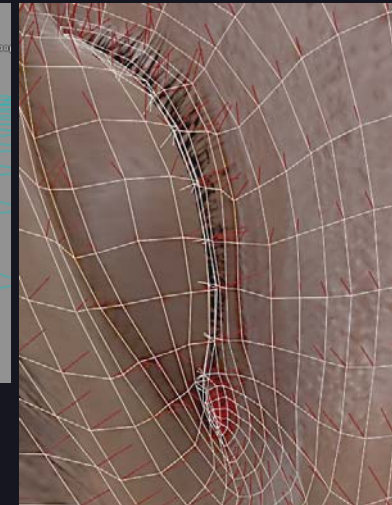
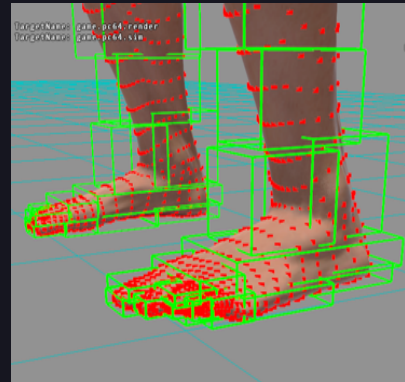






GPGPU Recap

- The GPU is not just for shading
 - It is for any large data set
 - The availability of GPGPU abilities, even on existing low-power devices, is a game changer
 - Put it to work where it matters most for your game



A screenshot from a UFC video game showing a fighter in a cage. The fighter is shirtless, wearing black shorts with a yellow logo, and has black gloves with orange accents. He is in a defensive stance, looking towards the left. In the background, another fighter is partially visible. The cage has a chain-link fence and banners for 'UFC.COM' and 'EA SPORTS' are visible. The text '5 Minute Break' is overlaid in white on the bottom left.

5 Minute Break

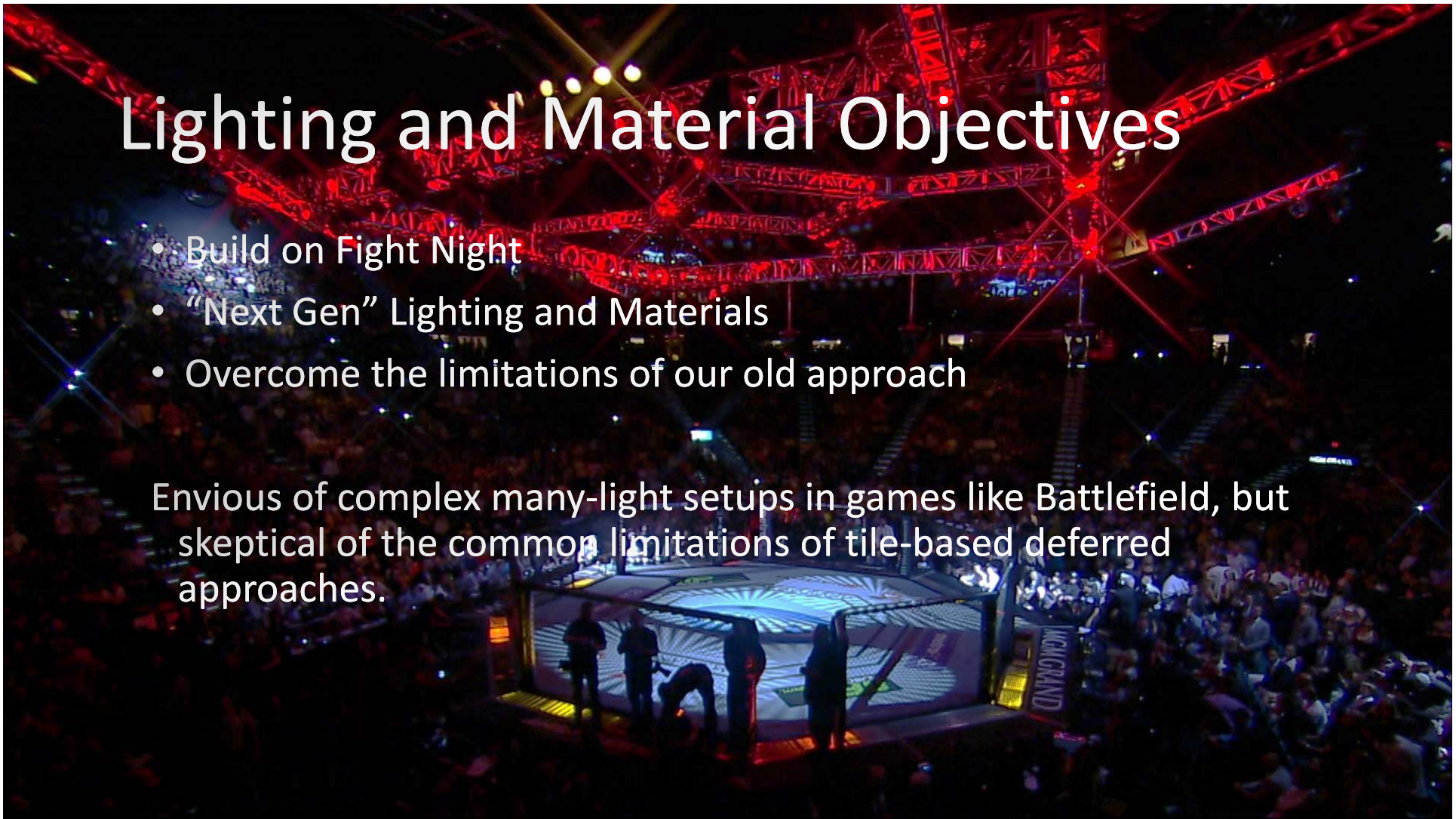
Getting to *Next-Gen*, Dynamic Lighting

Lighting and Material

Lighting and Material Objectives

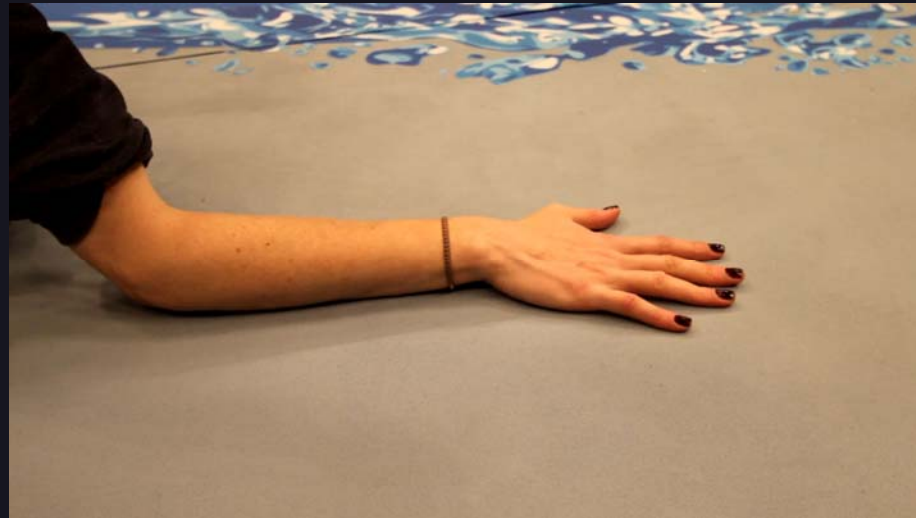
- Build on Fight Night
- “Next Gen” Lighting and Materials
- Overcome the limitations of our old approach

Envious of complex many-light setups in games like Battlefield, but skeptical of the common limitations of tile-based deferred approaches.



Lighting and Material Objectives

- Multiple Occluded Light sources
- High Pixel Quality



Jenny's real hand, real Octagon, and real Fight Lighting

Examples



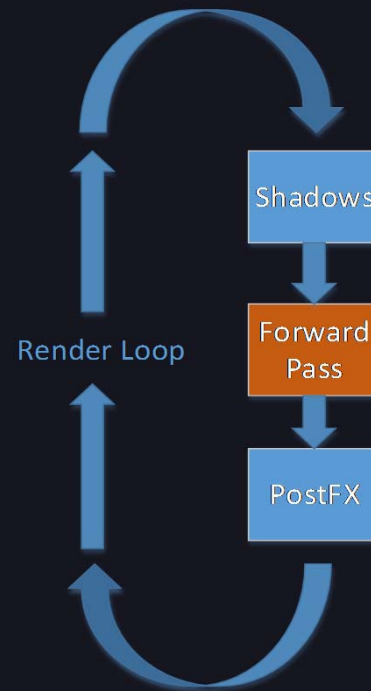
Getting to *Next-Gen*, Dynamic Lighting

Runtime Strategies



Traditional *Forward* Rendering

- Fight Night series
- Most PS3, Xbox360 and Mobile games



Traditional *Forward* Rendering

Advantages

- Supported by most Hardware
- MSAA
- Single Pass (low bandwidth)
- Arbitrary BRDF
- *Unrestricted* shader authoring
- Combined access to all material and lighting properties
- Easy to optimize for single lighting environment

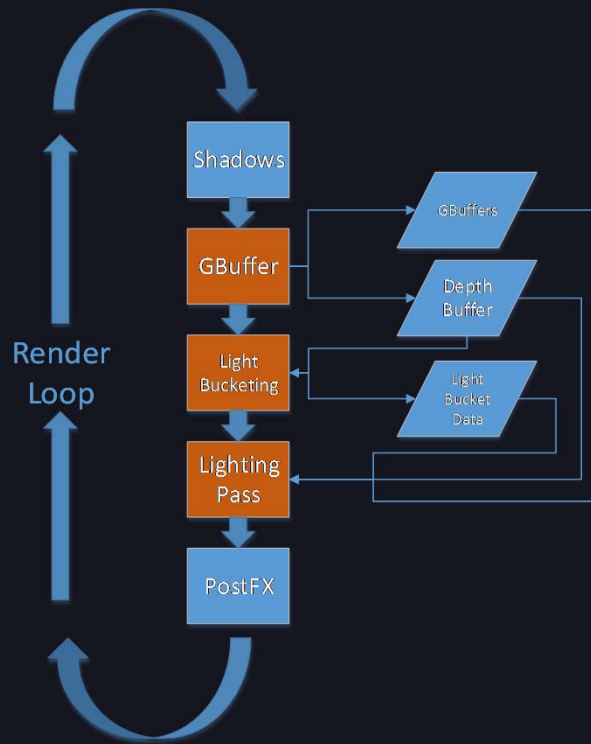
Disadvantages

- *Unrestricted* shader authoring
- Typically limited number of lights
- Material and Lighting combined
- Difficult to replace lighting setup without retuning material
- Difficult to enforce consistent lighting model



Deferred / Tiled Rendering

- Modern technique
- Many lights
- Dynamic changes in lighting environment
- Large worlds



Dead Space



Battlefield

Deferred / Tiled Rendering

Advantages

- No hard limit on light count (or high)
- Lighting environment is easily changed or animated
- Each light can be shadowed
- Low Overdraw : Efficient Attribute buffer update behaves like depth-pre-pass
- Lights cost only where they are applied
- Fixed attribute buffer design helps formalize consistent BRDF

Disadvantages

- Large attribute buffers require high bandwidth
- MSAA supported only in newest hardware, memory intensive
- Requires advanced post AA
- Difficult to support diversity of BRDF – multilayer materials are problematic
- Transparency, if handled, is a separate solution

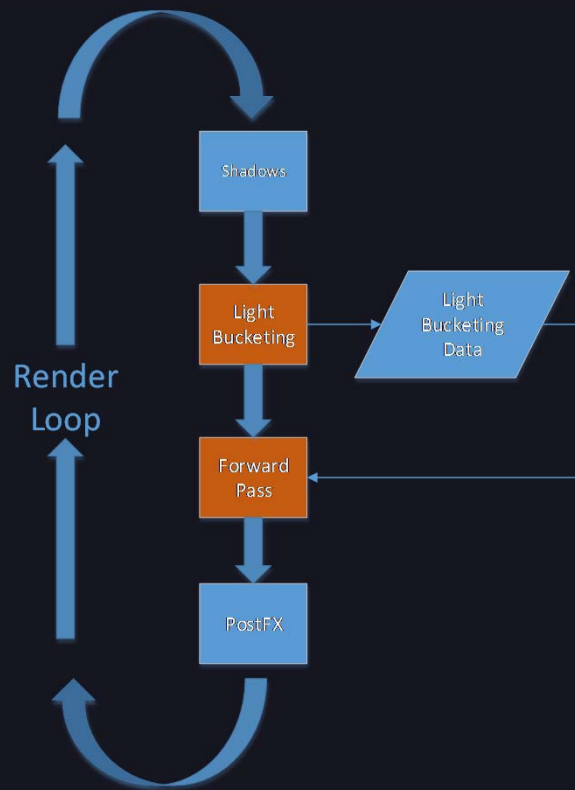
Forward+



See: Jay McKee, MTS Engineer, AMD – GDC 2012 “Leo”

Forward+

- Attempt to get the best of both worlds
- Large dynamic light sets
- Independent light shadows
- Any BRDF or VFX shader



Forward+

Advantages

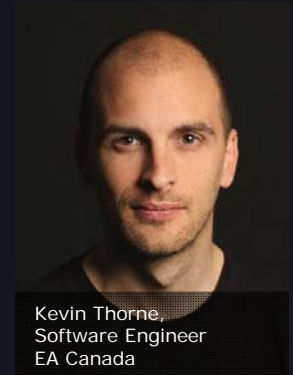
- Single Pass Material and Lighting
- ... enabling complex BRDF and VFX shader
- MSAA and A2C is trivially supported
- Most traditional Forward shaders should be easy to update
- Cross compile for simple Forward only
- All lights can be dynamic, no hard limit
- Per light shadows

Disadvantages

- Overdraw needs to be managed
- Micro-triangles, wasted quad fragments
- Longer shaders combine light and material. GPR pressure
- Potentially complicated Light Bucketing
- Some efficiencies of Tiled Rendering lost*
- Per-fragment light lookup*
- Modern GPU only
- Gradient ddx/ddy

UFC is Forward+

- **Degrades** to Gen3/Mobile simple Forward rendering
- **Scalable** – add/remove/modify lights on fly
- **Reuse** existing materials (FIFA, Fight Night, NHL)
- **Consistent** lighting data for whole scene
crowd, world, fighters
- **Cage** - Aliasing and Transparency
- **Skin** –Multilayered Materials

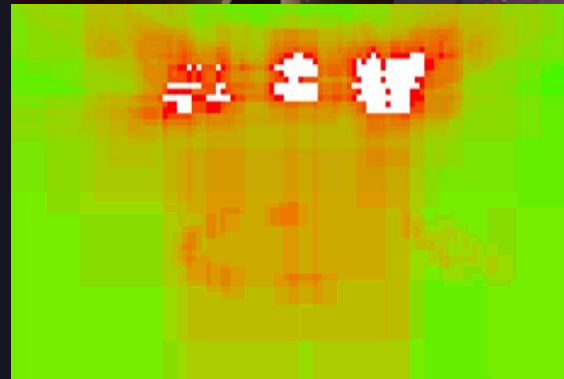


UFC Forward+ : Bucketing

- The process of generating a list of lights to use when shading a fragment
- Essential for performance
- Many strategies



Scene



Light count
by 2D tile
(heat map)

Tiled 16x16 pixel

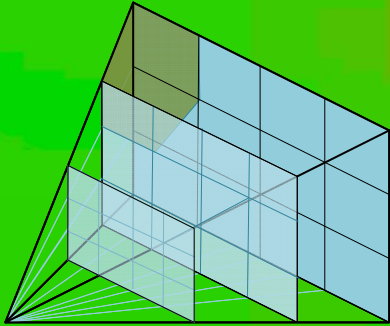


White : 16+

Red : 15

Green : 4

Tiled 64x64 pixel
16 Depth Slices



White : 16+
Red : 15
Green : 4

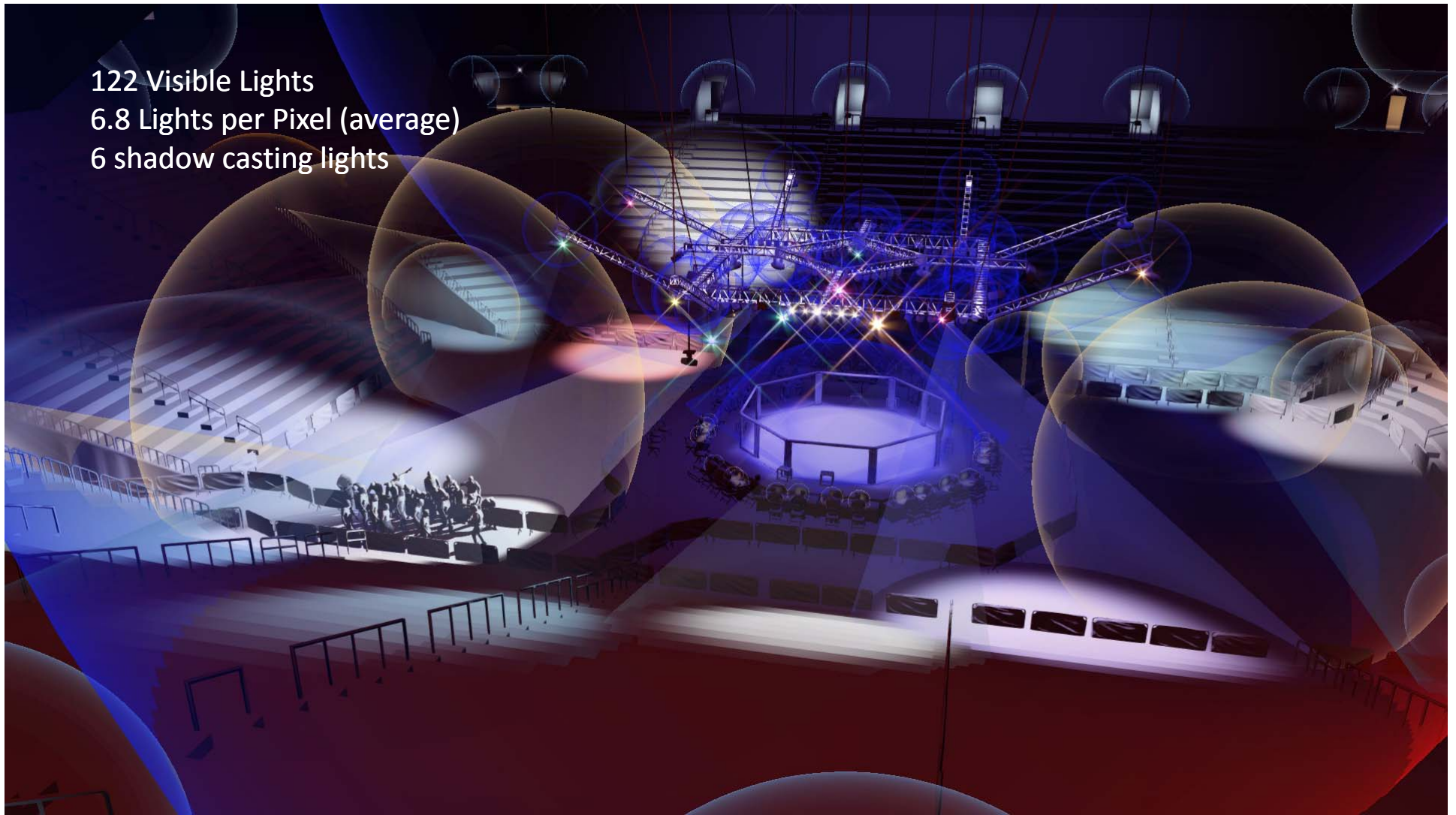


Tiled 64x64 pixel
16 Depth Slices
Explicit Character buckets

White : 16+
Red : 15
Green : 4



122 Visible Lights
6.8 Lights per Pixel (average)
6 shadow casting lights

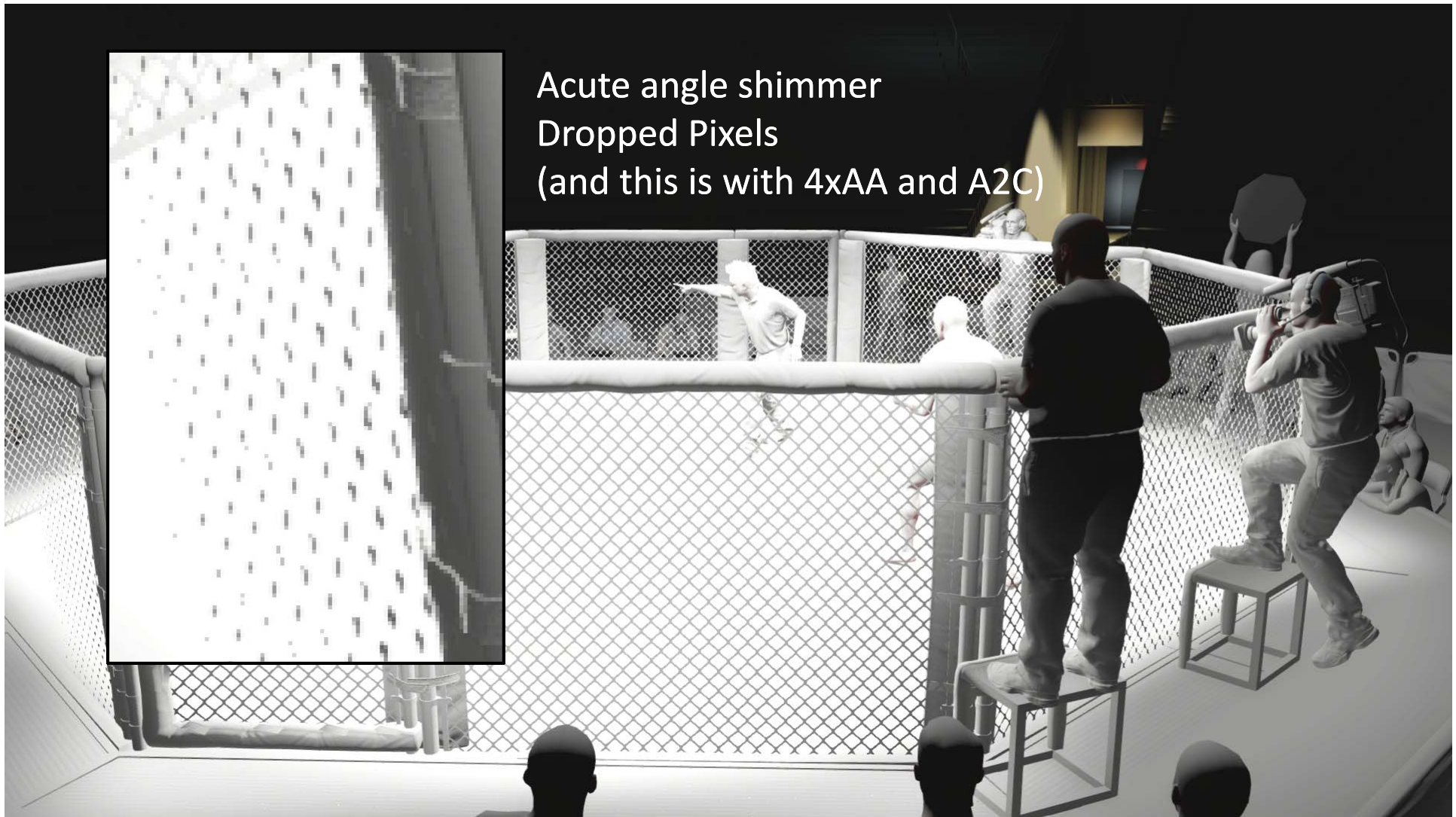
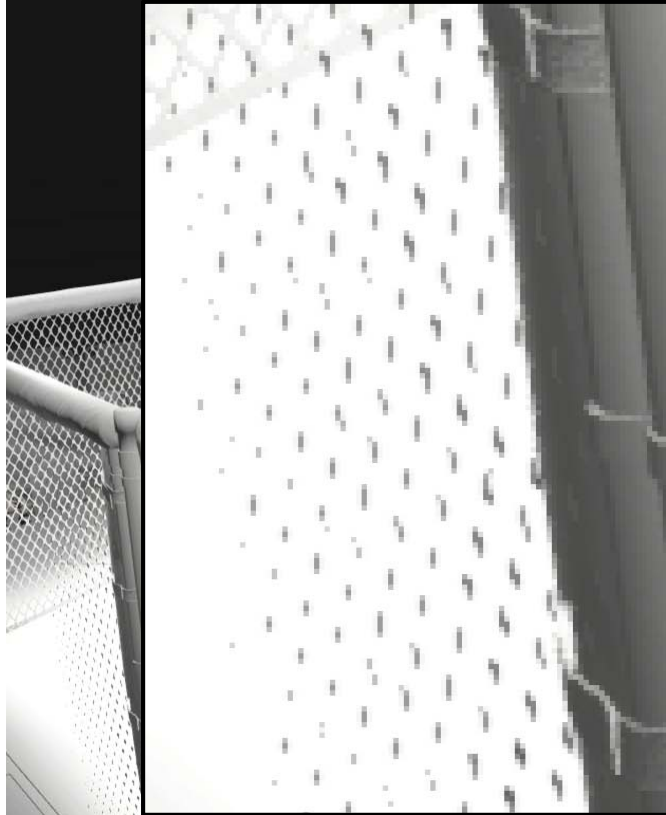


Alpha/MSAA is important to UFC

Opaque only shading example



Acute angle shimmer
Dropped Pixels
(and this is with 4xAA and A2C)



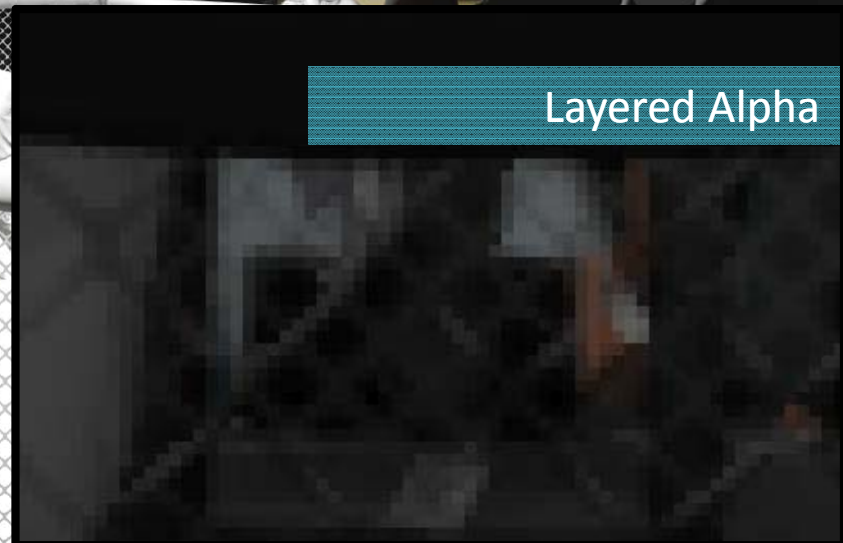
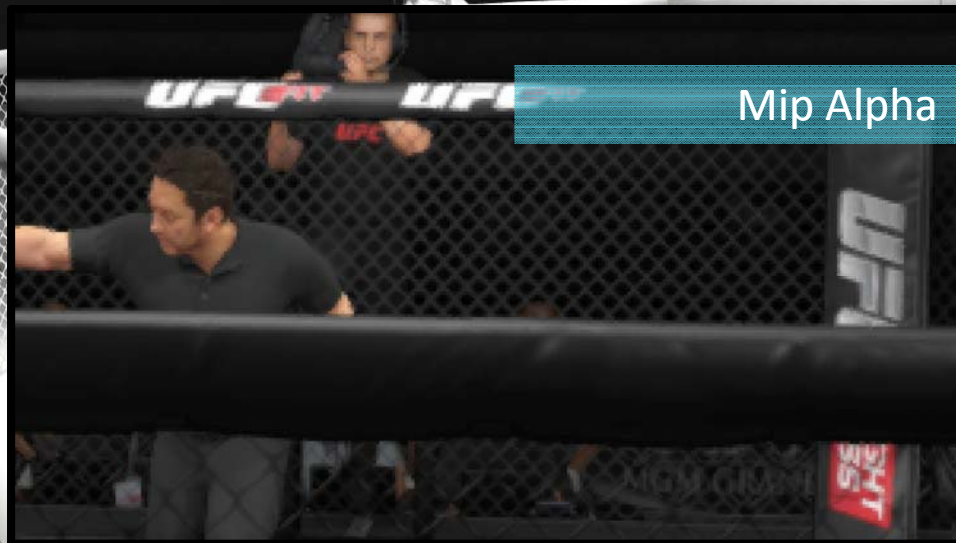
Mip Swimming at Distance
Jagged alpha-test edges on diagonal



Forward+ with
4xMSAA

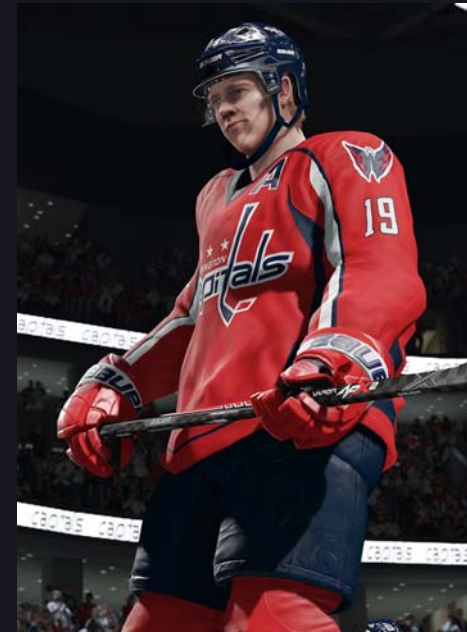
Mip Alpha

Layered Alpha

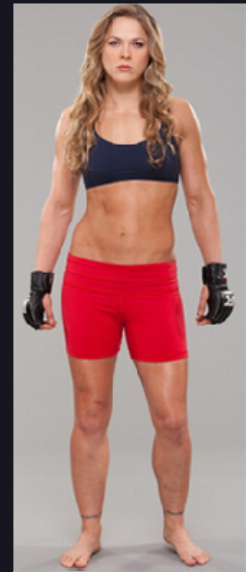
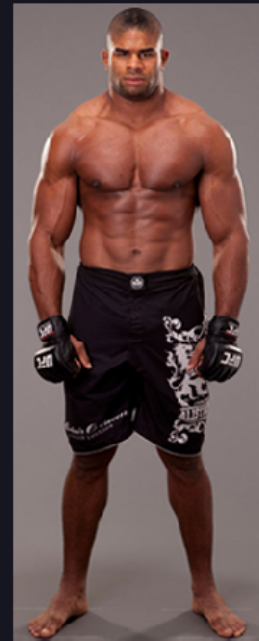
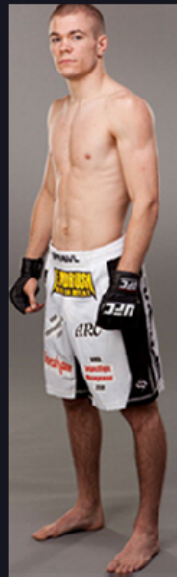
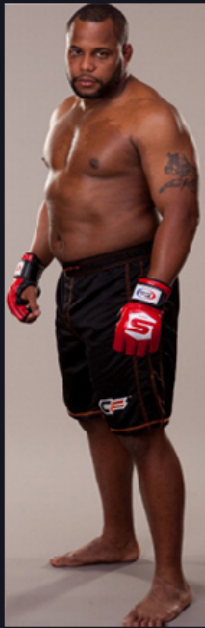
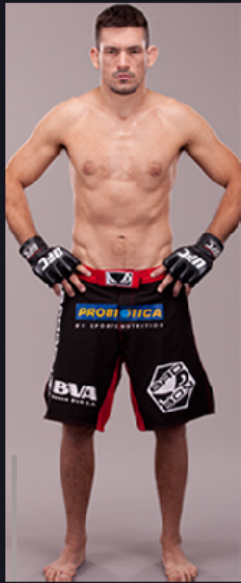


Forward+ Recap

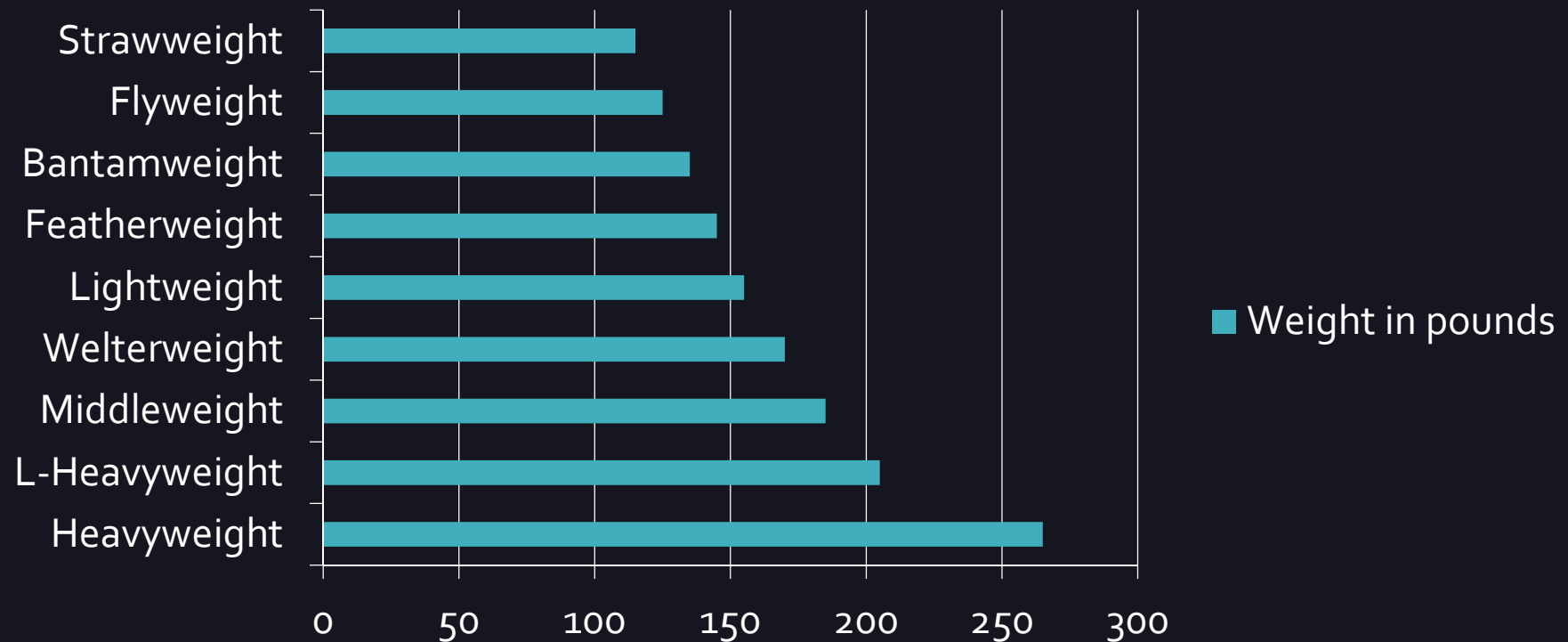
- Forward+ is a viable technique on some hardware with some significant advantages
 - Still a fledgling approach



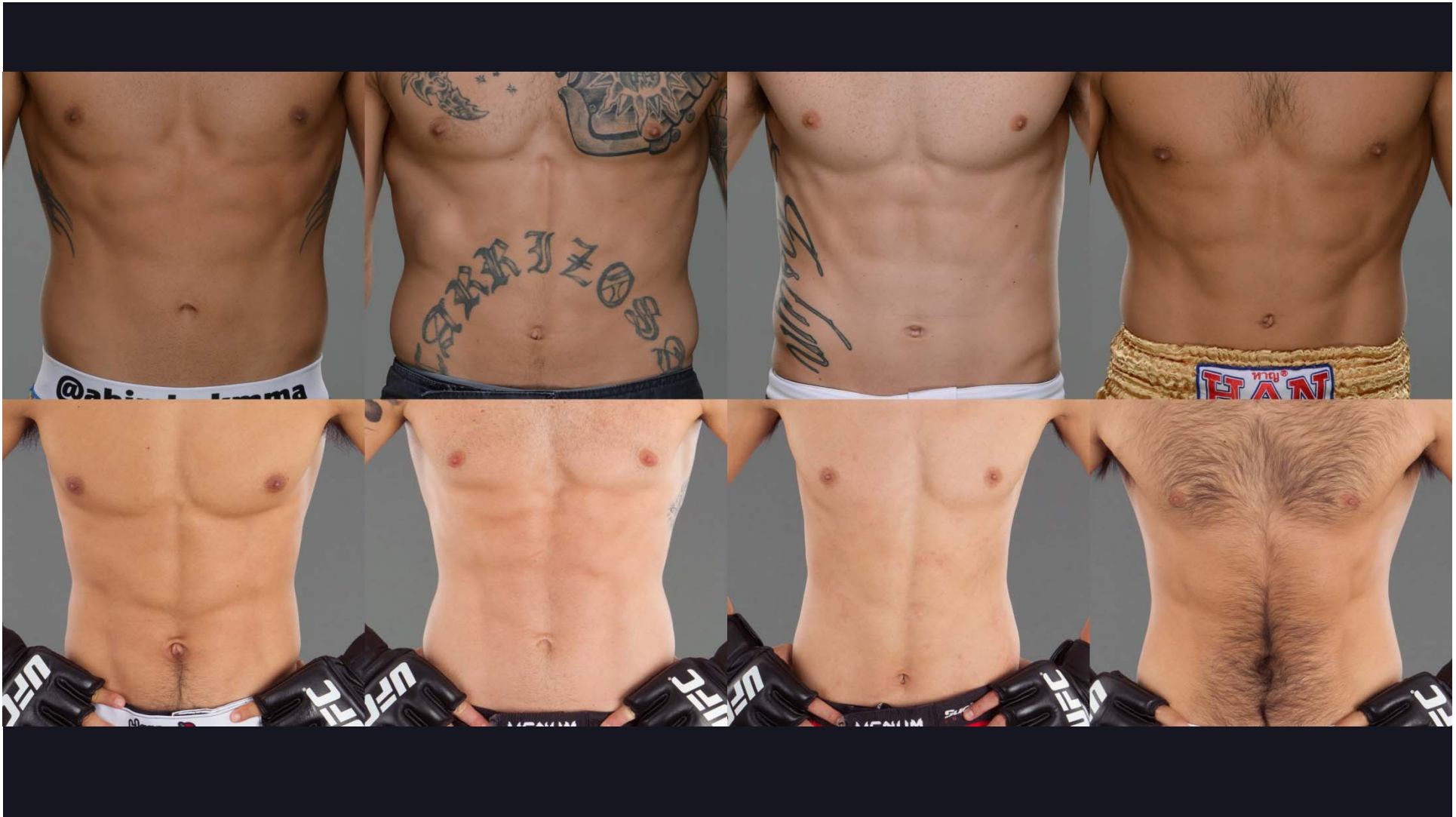
Fighter Creation



Weight classes in the UFC



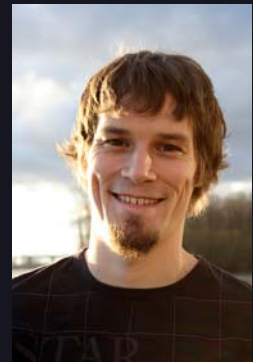


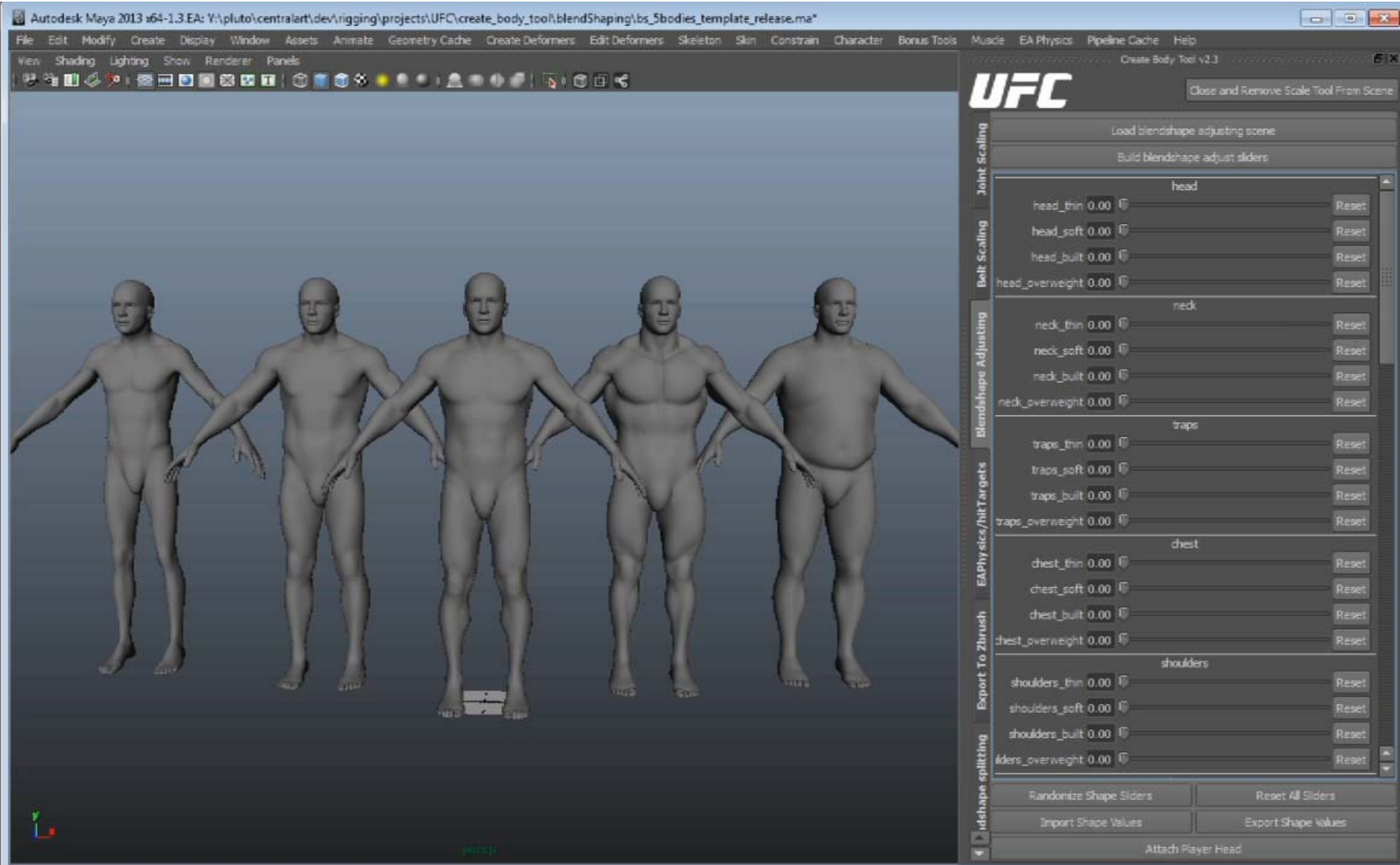


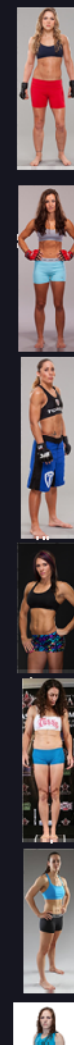
Body Tool



Darren Rudy
Senior Rigger







Likeness and uniqueness



Dan Doluntap,
Lead character artist
EA Canada

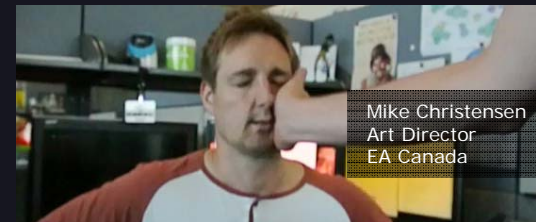


Ian Lloyd,
Art Director
EA Canada



MIKE

Reference gathering



Fighter reference



Fighter reference

