

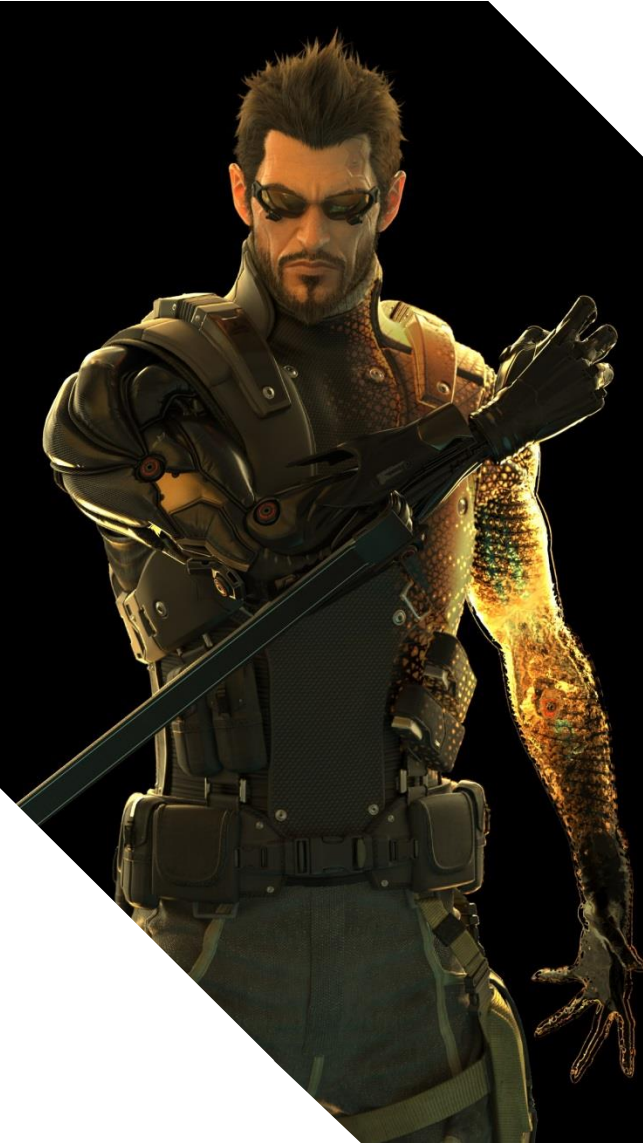


TRESSFX 3.X 

PART OF THE GPUOPEN INITIATIVE
GPUOPEN.COM

HIGH-LEVEL CONTENTS

- ▲ Brief TressFX overview
- ▲ TressFX 3.x library
 - Update to AMD's TressFX example implementation
 - Maya plugin
 - Viewer and runtime library (with full source)
 - Fur support
 - Skinning
 - Future optimizations
 - New memory-friendly OIT method (ShortCut)



A BRIEF HISTORY

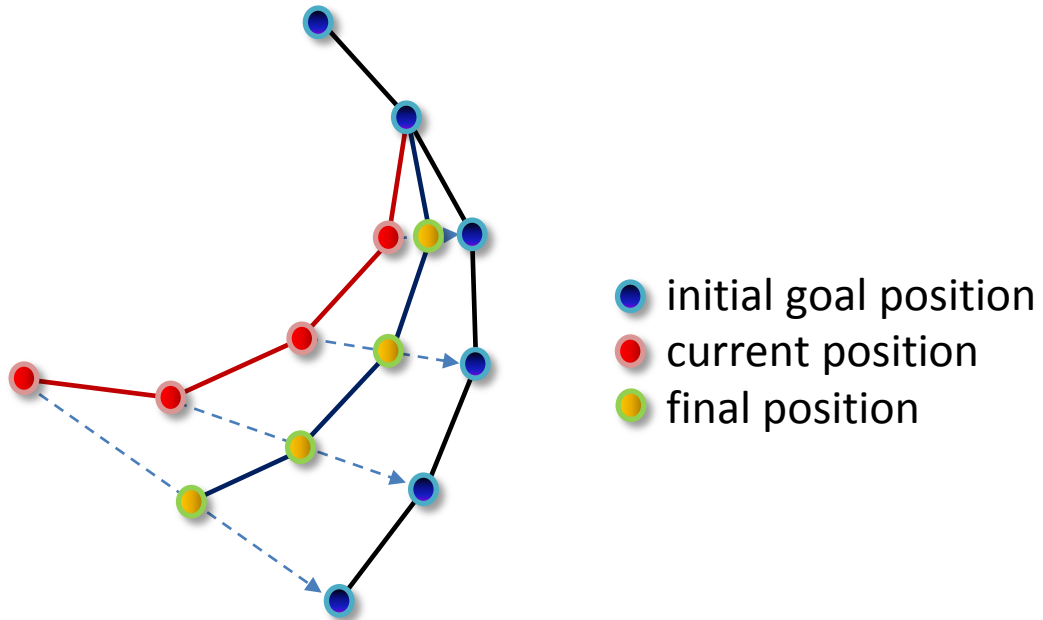
- ▲ TressFX began as a collaboration between AMD and Crystal Dynamics
- ▲ First used in Tomb Raider
 - PC and consoles
 - Set new quality bar for hair in games
- ▲ Optimized for AMD GCN architecture
 - Radeon HD 7000 or later
 - Consoles
- ▲ AMD is now also collaborating with Eidos-Montréal
 - Started with Tomb Raider code
 - Improvements and additions integrated into Dawn Engine™
 - Will be used in future Deus Ex Universe projects

**CRYSTAL
DYNAMICS**
SQUARE ENIX



TRESSFX OVERVIEW

- ▲ Two parts to TressFX
 - Physics simulation on the GPU using compute shaders
 - High-quality rendering
- ▲ Simulates and renders individual hair strands

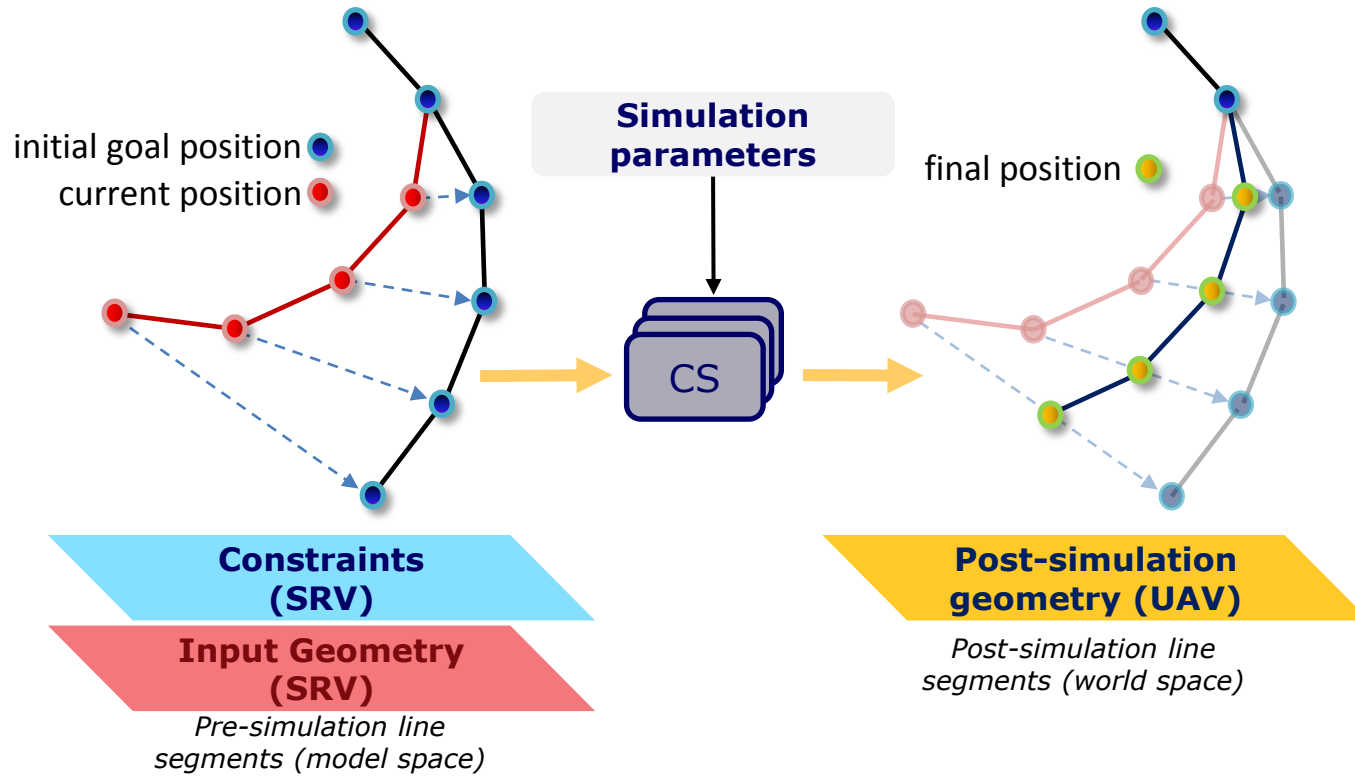


SIMULATION



RENDERING

TRESSFX SIMULATION



- ▲ **SIMULATION COMPUTE SHADERS**
- Edge length constraint
 - Local shape constraint
 - Global shape constraint
 - Model Transform
 - Collision Shape
 - External Forces (wind, gravity, etc.)

TRESSFX RENDERING



Good Lighting + Anti-Aliasing

+ Volume Shadows

+ Transparency



TRESSFX 3.X LIBRARY

TRESSFX SAMPLE HISTORY

▲ TressFX 1.0

- Example implementation (with full source)

▲ TressFX 2.x

- Simulation performance improvements
 - Master and slave strands
 - Compute shader optimizations
 - 1.6 ms → 0.3 ms
- Rendering performance improvements
 - Deferred rendering
 - Distance adaptive LOD
 - Pixel shader optimizations
 - 1.7 ms → 1.2 ms
 - With LOD, 0.3 ms (or lower) at a distance



TRESSFX 3.X

▲ TressFX 3.0

- Maya plugin
 - with full source
- Viewer and runtime library
 - with full source
- Fur support
- Skinning
- Free

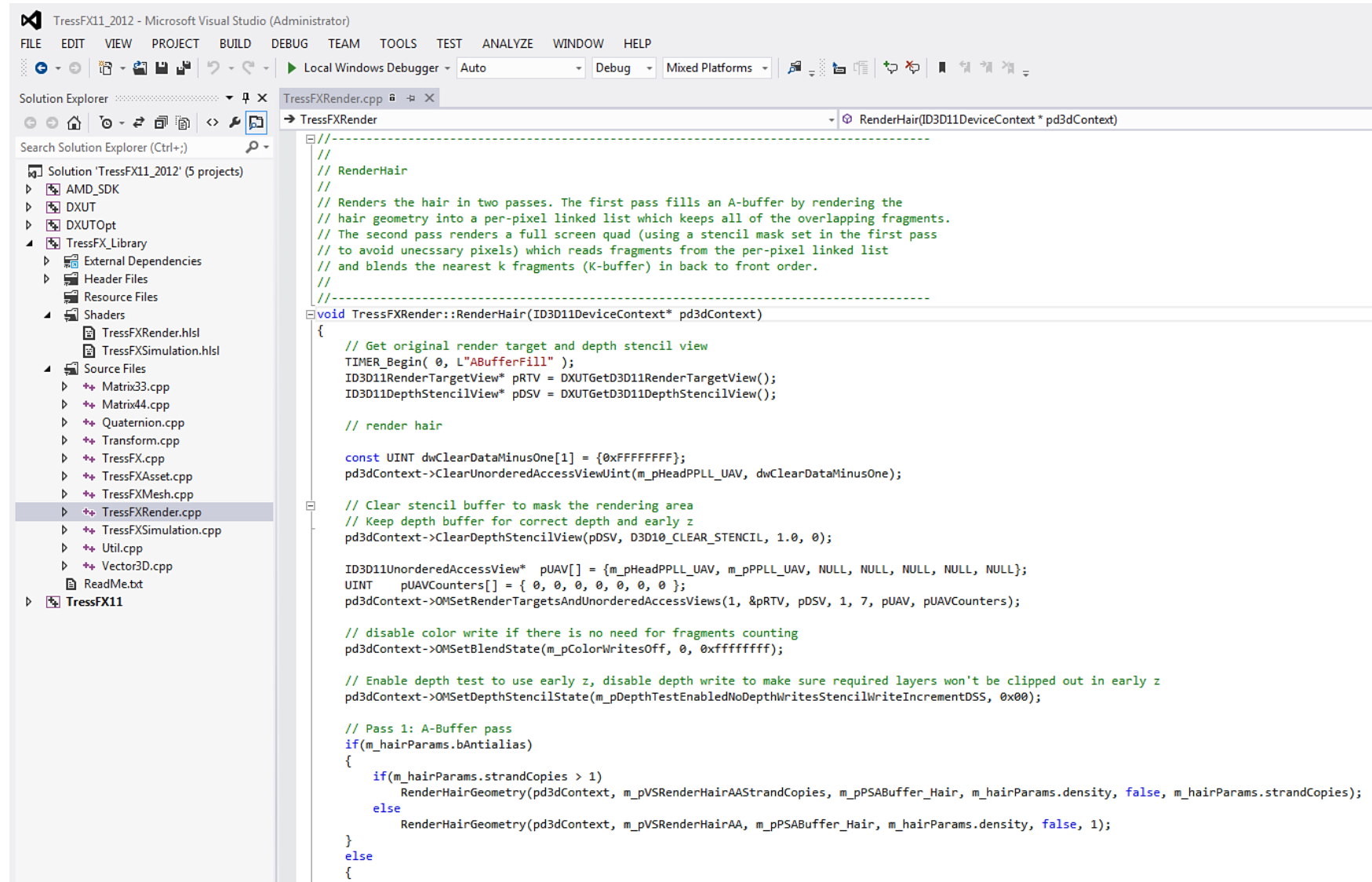
▲ TressFX 3.1

- New ShortCut OIT method
 - Lower memory
 - Potentially better performance
 - But at slightly reduced quality vs. standard PPLL TressFX



TRESSFX 3.X VIEWER AND RUNTIME LIBRARY

- ▲ Viewer provided
 - Preview TressFX assets
- ▲ Runtime reorganized into a library
 - Easier integration
- ▲ Full source
 - Free
 - No black boxes

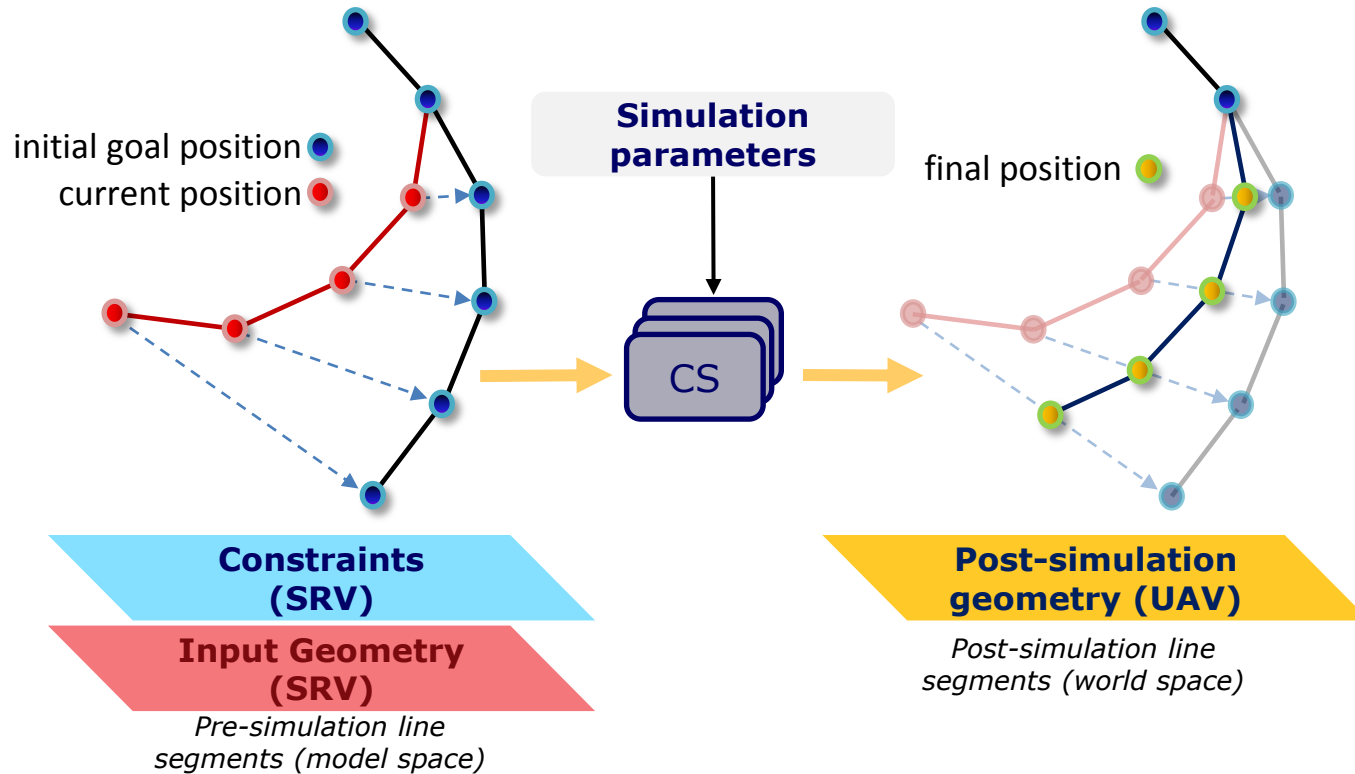


TRESSFX 3.X FUR SUPPORT

- ▲ Core principles are the same
 - Simulation on GPU using compute
 - Good lighting
 - Anti-aliasing
 - Volume shadows
 - Transparency
- ▲ Texture coordinates
 - Allows variation in fur color
- ▲ Skinning
 - A simple head transform was enough for human hair
 - Fur requires skinning support



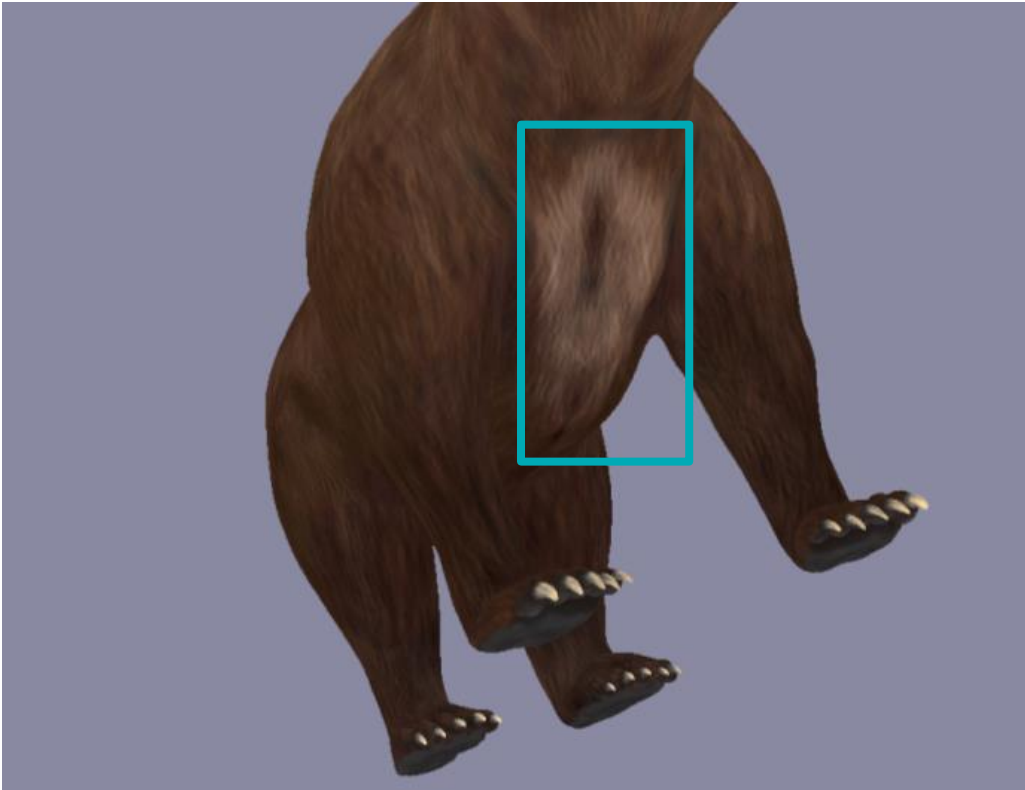
TRESSFX 3.X FUR SIMULATION



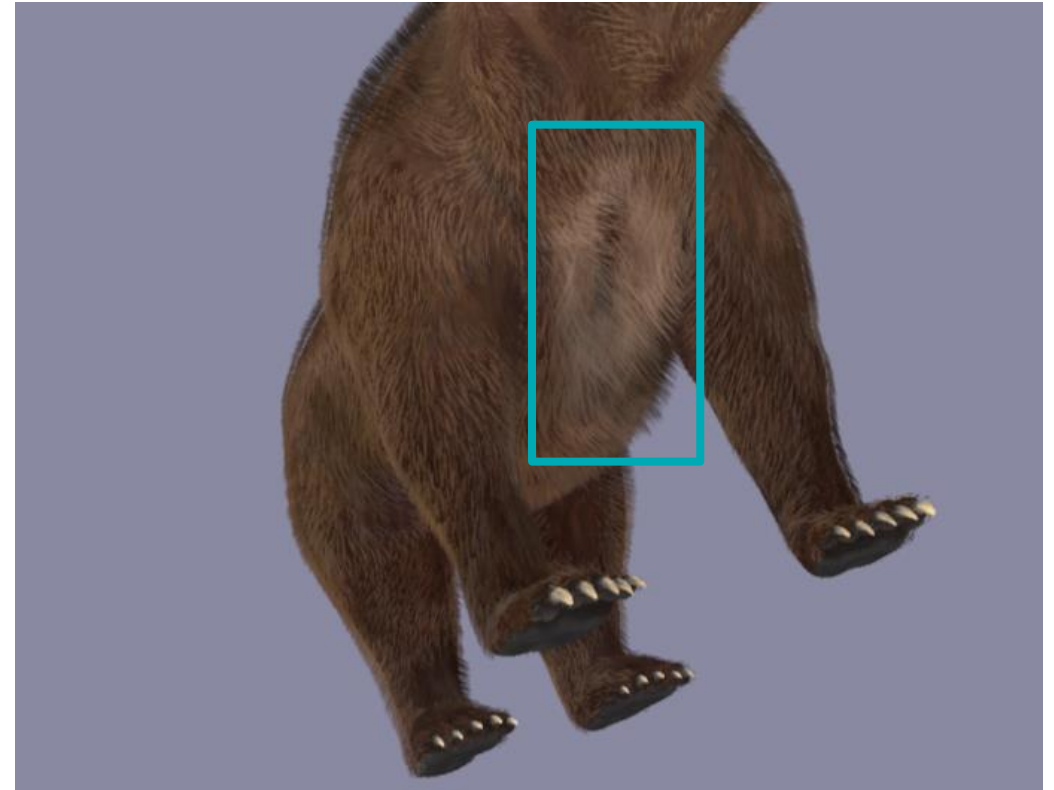
SIMULATION COMPUTE SHADERS

- Edge length constraint
- Local shape constraint
- Global shape constraint
- Model Transform
- Collision Shape
- External Forces (wind, gravity, etc.)

TRESSFX 3.X TEXTURE COORDINATES

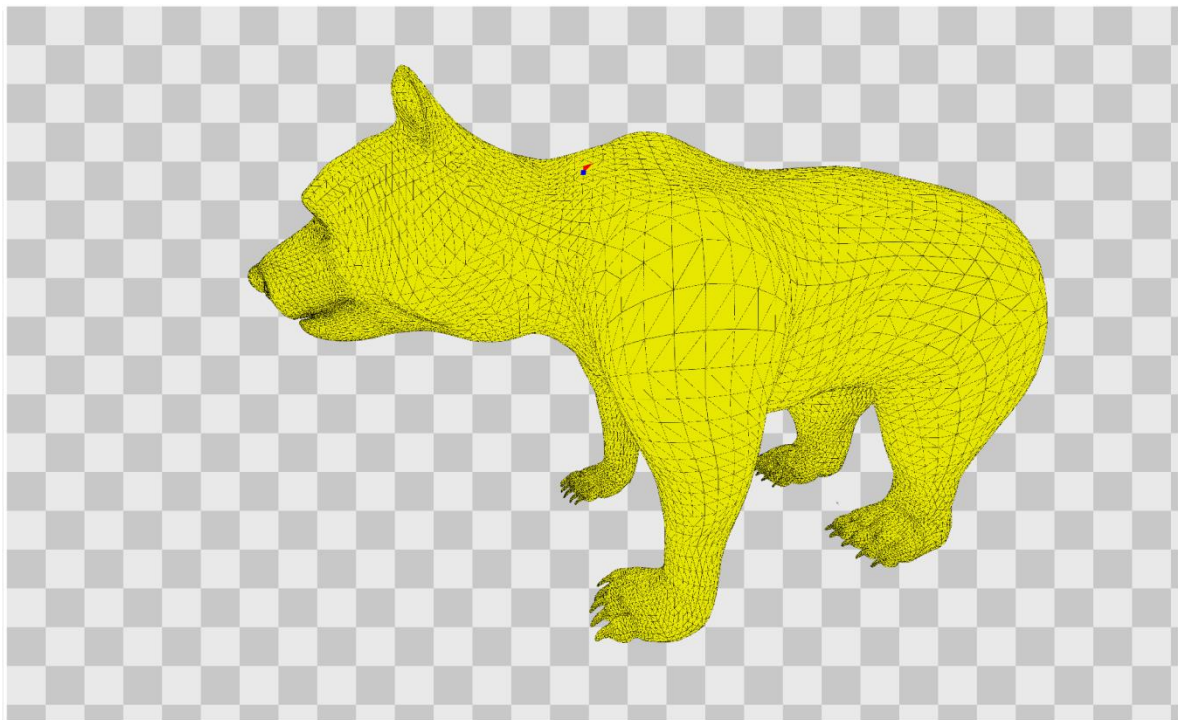


TEXTURED MESH

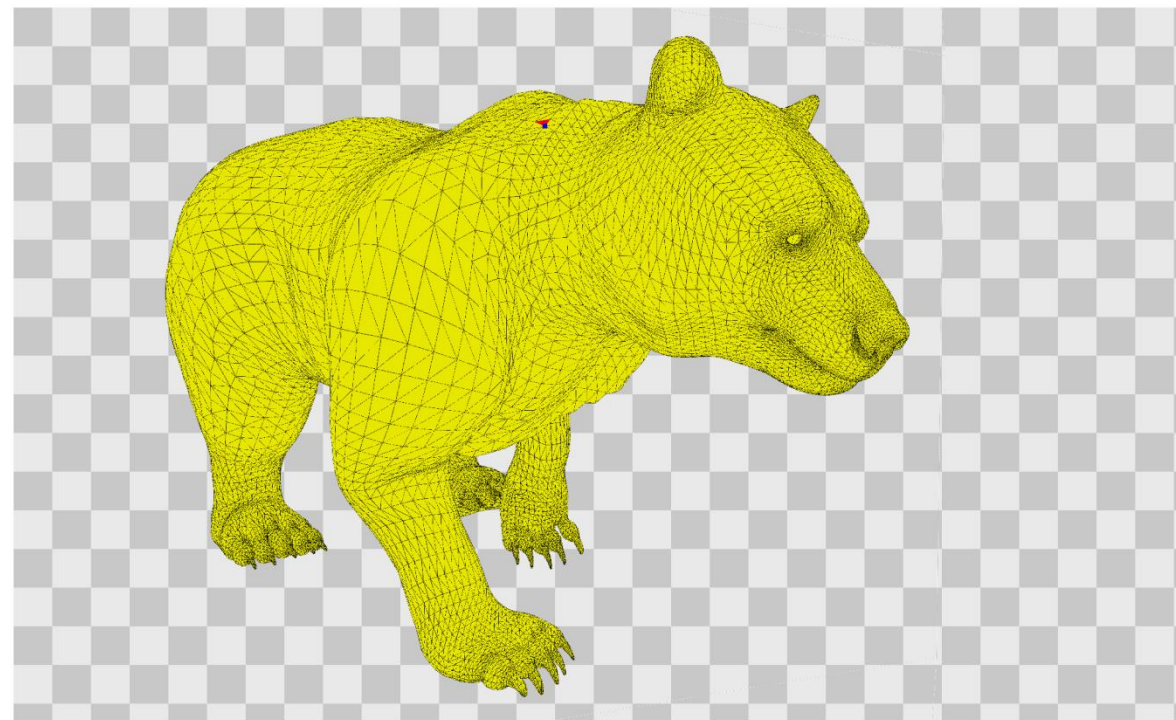


FUR PICKS UP COLOR VARIATION FROM TEXTURE

TRESSFX 3.X SKINNING



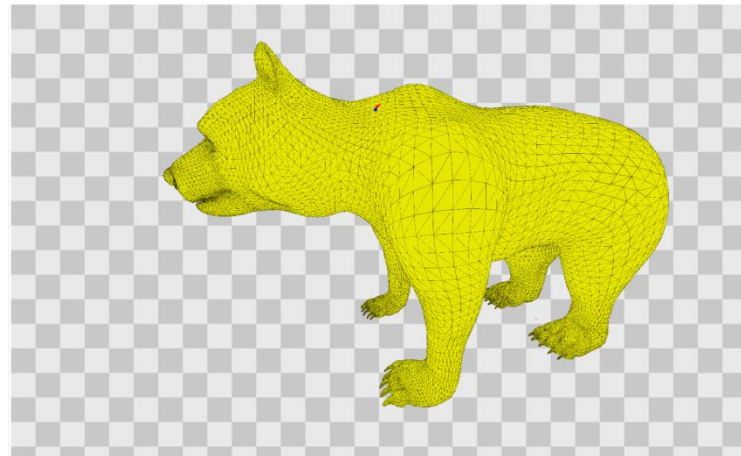
BIND POSE



SKINNED

TRESSFX 3.X SKINNING

- ▲ How to get skinned vertex position data to TressFX library?
- ▲ Up to you
- ▲ TressFX viewer currently uses Stream Out
 - DirectX 11
 - No geometry shader
 - See “Getting Started with the Stream-Output Stage” on MSDN
- ▲ UAVs at vertex shader stage
 - DirectX 11.1
 - DirectX 12

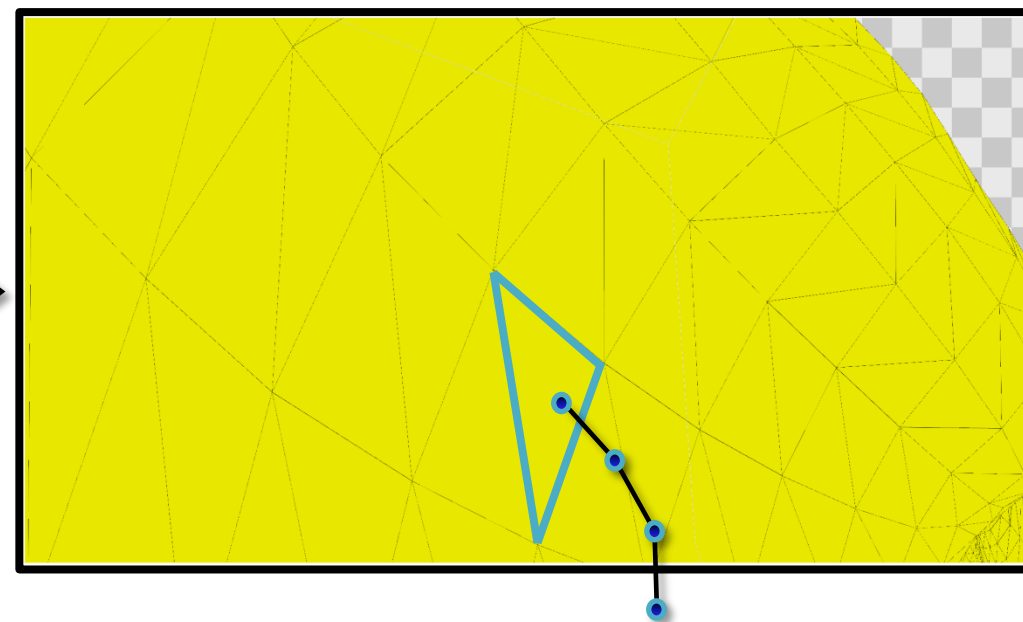
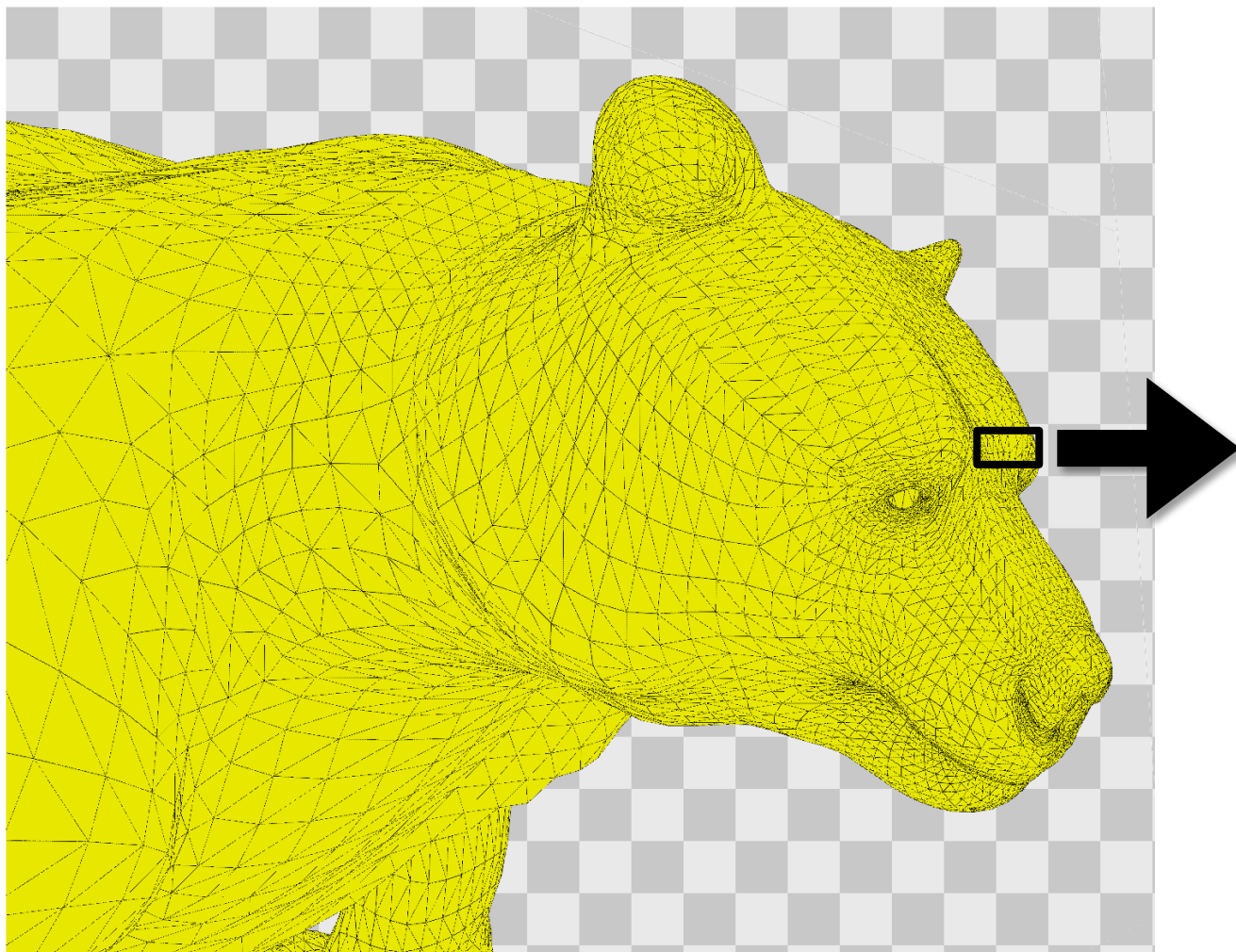


BIND POSE



SKINNED

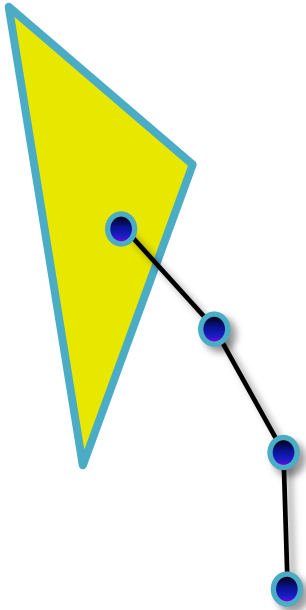
TRESSFX 3.X SKINNING



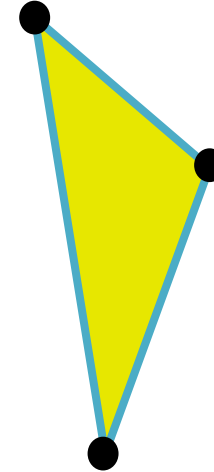
- ▲ Hair-to-mesh mapping
 - Exported from Maya plugin

TRESSFX 3.X SKINNING

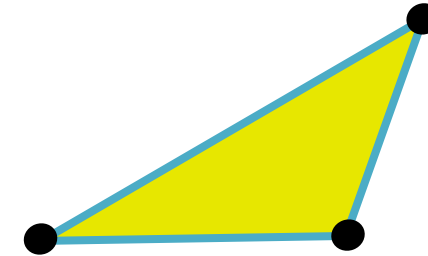
- ▲ Use hair strand index to get triangle index



- ▲ Use triangle index to get bind-pose verts and skinned verts



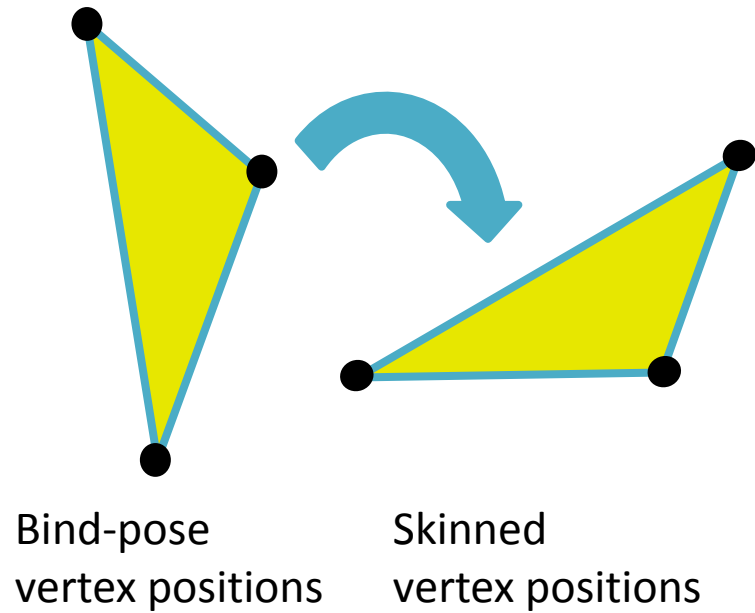
Bind-pose
vertex positions



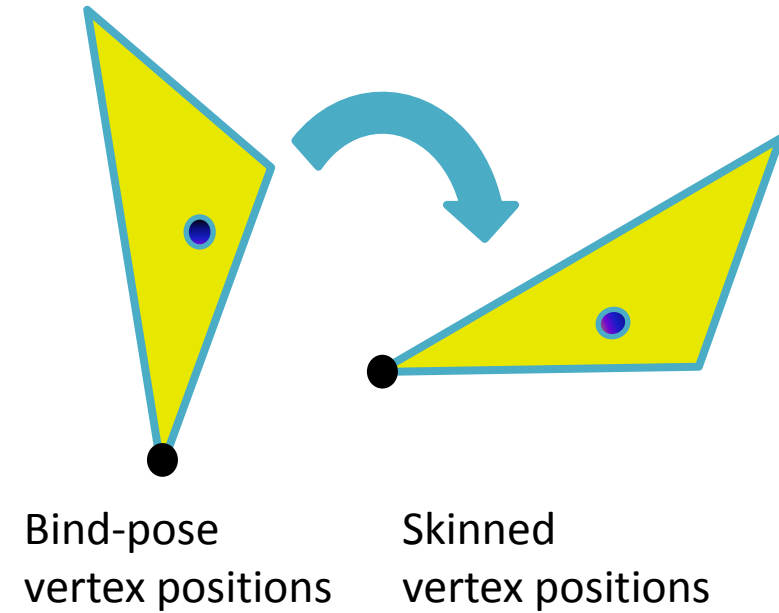
Skinned
vertex positions

TRESSFX 3.X SKINNING

- ▲ Calculate transform from bind-pose to skinned

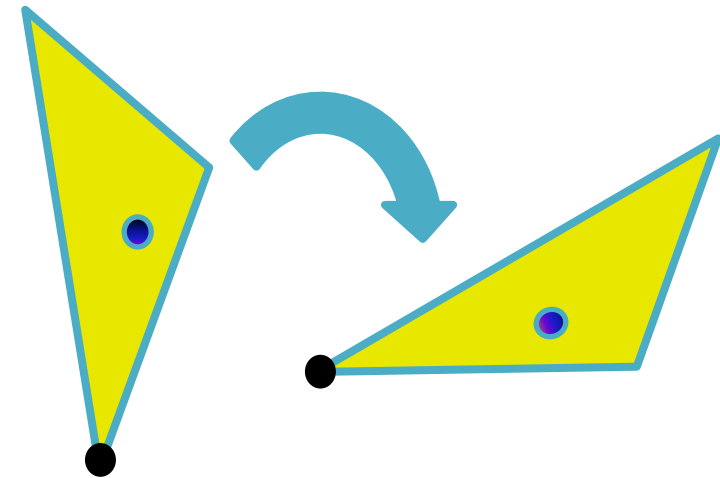


- ▲ Use barycentric coordinates for hair root to calculate final hair transform



TRESSFX 3.X SKINNING

- ▲ Yeah, okay, but why not just skin the hair directly?
- ▲ This way doesn't impose any requirements on how the game engine does the animation update
 - Morph targets/blend shapes
 - Whatever, we just need the updated vertex positions
- ▲ But may code a fast path for ordinary skinning with max 4 bones



TRESSFX 3.X OPTIMIZATIONS

- ▲ Already in TressFX 2.2
 - Master and slave strands
 - Distance adaptive LOD
 - Deferred rendering
 - Lots of shader optimizations
- ▲ Coming in TressFX 3.x
 - Depth pre-pass
 - Adjust K_{overdraw}
 - More shader optimizations



TRESSFX 3.1 *SHORTCUT* RENDERING

- ▲ A second OIT implementation provided with the 3.1 release
 - Inspired by Eidos-Montréal's GDC 2015 talk
 - Enabled in the sample with the ShortCut checkbox
- ▲ Alpha is computed from all hair fragments, while color is based on shading a few front layers
- ▲ Comparison with current PPLL method
 - Memory requirements reduced due to small and fixed number of layers
 - Relative performance depends on depth complexity
 - Requires an extra geometry and screen pass
 - Potential savings from processing fewer layers
 - Result not quite the same quality as PPLL method



DISCLAIMER & ATTRIBUTION

The information presented in this document is for informational purposes only and may contain technical inaccuracies, omissions and typographical errors.

The information contained herein is subject to change and may be rendered inaccurate for many reasons, including but not limited to product and roadmap changes, component and motherboard version changes, new model and/or product releases, product differences between differing manufacturers, software changes, BIOS flashes, firmware upgrades, or the like. AMD assumes no obligation to update or otherwise correct or revise this information. However, AMD reserves the right to revise this information and to make changes from time to time to the content hereof without obligation of AMD to notify any person of such revisions or changes.

AMD MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE CONTENTS HEREOF AND ASSUMES NO RESPONSIBILITY FOR ANY INACCURACIES, ERRORS OR OMISSIONS THAT MAY APPEAR IN THIS INFORMATION.

AMD SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT WILL AMD BE LIABLE TO ANY PERSON FOR ANY DIRECT, INDIRECT, SPECIAL OR OTHER CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF ANY INFORMATION CONTAINED HEREIN, EVEN IF AMD IS EXPRESSLY ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

ATTRIBUTION

© 2016 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, Radeon, and combinations thereof are trademarks of Advanced Micro Devices, Inc. in the United States and/or other jurisdictions. Other names are for informational purposes only and may be trademarks of their respective owners.

DEUS EX, the DEUS EX logo, TOMB RAIDER, CRYSTAL DYNAMICS, the CRYSTAL DYNAMICS logo, EIDOS, the EIDOS logo, the EIDOS-MONTRÉAL logo, and LARA CROFT are registered trademarks or trademarks of Square Enix Ltd. SQUARE ENIX and the SQUARE ENIX logo are registered trademarks or trademarks of Square Enix Holdings Co., Ltd.

