PHYSICALLY SIMULATED CLOTHING
BY CCP (EVE Online)
USING NVIDIA APEX

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Outline

- APEX Overview
- APEX Clothing used by CCP
  - Clothing considerations
  - Maya DCC plug-in overview
  - APEX Integration
  - Demos
- APEX Modules
  - APEX Destruction
  - APEX Particles
  - APEX Vegetation
  - APEX Turbulence
What is APEX?

APEX is a “Scalable Dynamics Framework”
- **Scalable**: Content adapts to different hardware capabilities
- **Dynamics**: The way things move and interact
- **Framework**: A structured environment

APEX consists of two major components:
- **Authoring**:
  - High-level authoring of dynamic systems
  - DCC plugins, standalone tools, and game engine plugins
- **Runtime**:
  - A modular SDK – minimal integration into game engine
  - Leverages PhysX for simulations
APEX is Artist Focused

- Artist level abstractions of dynamic systems
  - “Destructible bunker” vs. “collection of bricks”
- Intuitive and easy to use
Why Cloth Simulation?

- Adds variety and secondary motion to animation
- Can increase plausibility in realistic scenes a lot
- The same toolset can also be used to create soft body simulation
Things to be aware of

- Like any other simulation, cloth requires boundaries and “taming”
- Sometimes non-realistic cloth simulation looks better
- Elaborate cloth assets can be quite complex to keep nice at all times
- Iteration and testing are the key
Pipeline Integration

- APEX export was easily integrated into CCP export pipeline
- Use of cloth templates speeds up clothing creation
  - Create once, use often

APEX Cloth Data
Other Model Data
CCP Export
ACA
GR2
RED
Challenges

- Numbers of characters on-screen can’t be controlled in an MMO
  - LODs are a must
- High visual fidelity requires lots of consideration for collision meshes
  - Sitting on furniture – how do you handle that?
  - Characters must affect each other too
APEX integration
Implement a few classes

- **NxResourceCallback**
  - Manage shared objects
- **NxUserRenderResourceManager**
  - Manage vertex and index buffers
- **NxUserRenderer**
  - Perform the rendering
Actors

- Load clothing assets from .aca files
- Create clothing actor from asset
- APEX renders actors through your engine
Debugging aids

- Lots of debugging info to be rendered
  - Useful for the programmers
  - But even more so for cloth authoring
  - Worth spending time to support it all
More debugging aids

- Visual debugger
  - Allows recording of data
  - Analyze simulation without game engine
Maximizing performance

- Cloth simulation is heavy
- GPU can do heavy lifting
- Maximizing parallelism maximizes performance
  - Delay skinning to match up with simulation
  - Rendering lags further behind
  - Syncing audio and other effects with animation may become a bigger issue
Benefits of APEX

- Fast, easily iterated authoring
- Artist friendly
- Tweakable data easily exposed in engine for final tweaking
- Debug preview in engine available
- Easily integrated into game engine
Live Demo
APEX Modules
APEX Destruction

- Fully and partial destructible environments
- PhysXLab tool with preview functionality
- Fully integrated with APEX Particles
- Fracture with noise
- Hierarchical destruction
- Plastic deformation
- Level of Detail
- Scalability
APEX Particles

- Full Collision with PhysX environment
- Force fields (wind, explosions)
- Authorable behavior and effect modifiers
- Renderable as sprites or meshes (with orientation)
- Generic emitter
- Special purpose emitters
  - Air/Ground emitter
  - Weapon emitter
APEX Vegetation / SpeedTree

- Full and partial tree destruction/deformation
- State transition between physical and static trees
- Tight integration with APEX Particles
- Level of Detail
- Fully integrated into SpeedTree® Modeler
  - Automatic generation of tree skeleton
  - Configurable bone and joint system
  - Support for multiple APEX Particle Emitters
APEX Vegetation / SpeedTree
Authoring Pipeline

TGA, PNG, OBJ, STM
Images, meshes

SPM
Procedural Files
Where To Find Us

- NVIDIA - Main Expo Area, Booth 1702
- CCP – Career Pavilion, Booth 2502
- March 11\textsuperscript{th} Sponsored Sessions

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<td>0900-1000</td>
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<td>Tegra - Developing Killer Content for Advanced Mobile Platforms</td>
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<tr>
<td>1330-1430</td>
<td>Room 310, South Hall</td>
<td>Physically Simulated Clothing by CCP (EVE Online) Using NVIDIA APEX</td>
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<td>1500-1600</td>
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<tr>
<td>0900-1000</td>
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<td>Taking Fluid Simulation Out of the Box: Particle Effects in Dark Void, Sarah Tariq (NVIDIA), Joe Cruz (VFX)</td>
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- Twitter: nvidiadeveloper, Website: http://developer.nvidia.com