NVIDIA APEX: High-Definition Physics with Clothing and Vegetation

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Outline

- **Introduction**
  - APEX: A Scalable Dynamics Framework

- **APEX Clothing Module**
  - In-Depth Demonstration

- **APEX Vegetation Module**
  - SpeedTree v5.0
  - APEX run-time
Scalable Dynamics Content

APEX Destruction

APEX Vegetation

APEX Clothing

APEX Turbulence
APEX Destruction
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 Architecture

- **Authoring**
  - DCC Plug-In
  - Standalone APEX Tools
    - Destruction
    - Clothing
    - Vegetation
    - ...

- **Run-time**
  - APEX Core
  - Renderer
  - PhysX SDK
  - Consoles
  - PC
  - PC +GPU
APEX is Artist Focused

- Artist level abstractions of dynamic systems
  - “Destructible bunker” vs. “collection of bricks”
- Intuitive and easy to use
APEX is Easy to Integrate

- Already integrated into leading game engines
  - UE3, Gamebryo, HeroEngine, ...

- APEX modules are plug & play
  - Clothing, Vegetation, Destruction
  - More modules in development

- APEX is already used for AAA content
  - Licensed by major publishers
  - NVIDIA developed APEX modules are free for PhysX developers
APEX Clothing Module
Outline

- Authoring pipeline
- Runtime pipeline
- Maya authoring example
- Clothing parameter overview
- HeroEngine integration
Authoring Pipeline

- MB
- OBJ
- FBX
- Mesh data & Animation
- ACA
- APEX Clothing Tool
- APEX Core
- Renderer
- PhysX SDK
- APEX Clothing Asset File
Runtime Pipeline

Game Engine

APEX Core

Renderer

PhysX SDK

ACA
APEX Clothing Asset File

FBX
Graphics mesh, animation, textures
APEX Clothing Plug-in (Maya)
Coat - Example
Motion Radius

- Allows the artist to constrain the simulation
Collision Shapes

- Semi-automatic or manual generation
  - Convex collision volumes
  - Primitive collision volumes
  - Mix of primitives and convexes
A – Collision

- Use animation mesh as a collision mesh
Scalability

- Number of physically simulated characters
High Fidelity Clothing
HeroEngine by SIMUTRONICS

- MMOG engine licensed by:
  - Bioware Corp, Trianit Virgin Games, Mindfuse, Stray Bullet Games, Awomo, HSC Labs, ..

APEX Clothing integration

- Completed within 1.5 man month
- LoD support
- Effects system (Wind)
- APEX Clothing debug render functionality
HeroEngine – Clothing Visualization
Upcoming Features

- Integration with Morpheme 2.0
SpeedTree v5.0
and
APEX Vegetation Module

GDC 2009, San Francisco, CA
Outline

- SpeedTree 5.0 preview
- SpeedTree and APEX
- Modeling pipeline
- Compilation pipeline
- Run-time pipeline
- Modeler demonstration
- APEX sample application
SpeedTree v5.0

- Complete redesign of toolset
- Tree centric modeling
- Improved SDK
- Fully integrated with APEX

Tools cover three areas:
  - Modeling
  - Compiling
  - SDK
SpeedTree and APEX

- Dynamics directly integrated into modeling tool
- Compiler tool creates all required APEX assets
- SpeedTree runtime is integrated into APEX Vegetation
- Reference application

Seamless, comprehensive path to dynamic trees
Modeling Pipeline

- Library trees are APEX ready
  - Plug & Play
- Create your own physical trees
  - Bones, Joints, Branch Density,..
- Full preview capabilities
  - Destruction
  - Deformation
  - Leaf Particles

Images, meshes

SPM

Procedural files

All physics related data resides in here until compile for real-time use

The Modeler interacts with APEX and PhysX to provide an exact preview of in-game behavior.
Compilation Pipeline

Users compile single or multiple tree models for use in real-time rendering.

These are the files that house the artist tuned physics data.

These assets are ready to be loaded by the game engine.

SpeedTree v5.0 Compiler

Images, meshes

Procedural files

Run-time tree files

Texture atlases, billboard atlases

APEX vegetation assets

VSA

SPM

TGA

DDS

PNG

OBJ

STM

ATA

SRT

VSA
Run-Time Pipeline

These are the assets created by the SpeedTree Compiler

- SRT: Run-time tree files
- DDS, TGA: Texture atlases, billboard atlases
- ATA, VSA: APEX vegetation assets

APEX uses the SpeedTree SDK to manage large groups of trees and abstracts which are physical and which are not. APEX acts as the common render interface.

APEX / PhysX

Game Engine
APEX Vegetation – Sample App.
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Summary

- APEX is provides lots of different modules
- APEX is artist focused and easy to use
- APEX is modular and easy to integrate
- APEX is being integrated into UE3 and Gamebryo
- APEX is a scalable dynamics framework
- APEX has been licensed by major publishers
- APEX is already used to create AAA content
- APEX is free for PhysX developers
How To Reach Us

- **During GDC**
  - Expo Suite 656, West Hall
  - Developer Tool Open Chat, 1:30 to 2:30 pm (25th-27th)

- **Online**
  - Twitter: nvidiadeveloper
  - Website: [http://developer.nvidia.com](http://developer.nvidia.com)

- **IDV (Speedtree)**
  - Website: [www.speedtree.com](http://www.speedtree.com)