



COLLADA™

COLLADA Physics

Erwin Coumans
Simulation Lead, SCEA

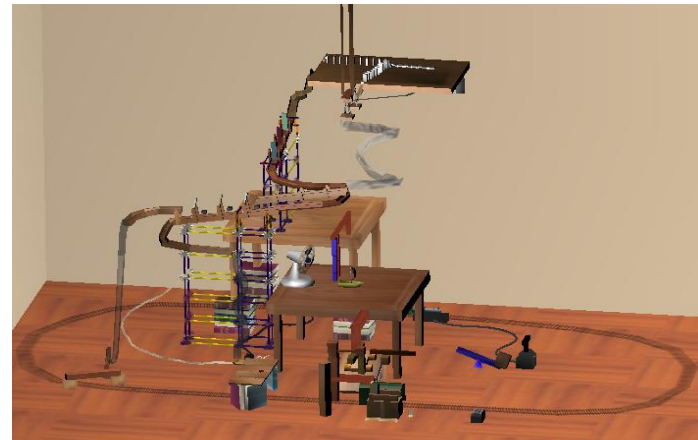
Overview

- Intro with 'Rube Goldberg' Physics Demo
- Why COLLADA Physics
- Features and some XML snippets
- Available COLLADA Physics supporting Tools and SDK's
- Future directions



'Rube Goldberg' Physics Demo

- Demo entries from a Bullet Physics Contest 2007
- Converted to COLLADA Physics
- Difference in physics behavior is a challenge for a standard
- COLLADA Physics baked into COLLADA animation
- COLLADA RT Viewer with physics



Images courtesy of moobins.com and Samuel Muse

Why COLLADA Physics

- Standard physics representation with industry support
- Make use of growing number of available tools and assets
- Open standard allows your own extensions
- Improve compatibility between physics tools
- Researchers can start using it
 - Stanford bunny with physics properties
- Collaboration and Benchmarking

Features

- **Collision volumes**
 - Box, sphere, capsule, cylinder, convex mesh, concave triangle mesh, composite etc.
- **Rigid-bodies**
 - Mass, inertia, dynamic (movable) or static (inactive), collision shape
- **Constraints**
 - Generic representation with motors, springs and limits, for ragdolls etc.
- **Physics materials**
 - Friction, restitution



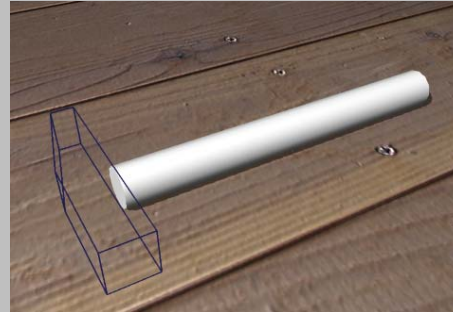
Features continued

- **Complex physics models**
 - Grouping of multiple rigid bodies and constraints
- **Instancing**
 - Re-use of collision shapes, rigid bodies, physics materials, constraints and physics models
- **Force-fields**
 - Gravity, wind etc.
- **Multiple simulation environments**
 - Multiple physics scenes
- **Extensible for custom properties**
 - Attach your own data to elements

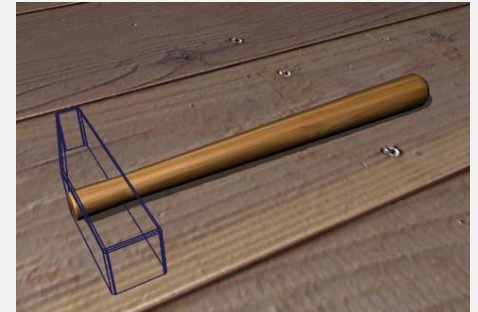


Rigid Body Example

```
<library type="PHYSICS">
  <rigid_body id="hammerHandleRigidBody">
    <shape>
      <mass> 0.25 </mass>
      <inertia> ... </inertia>
      <cylinder>
        <height> 8.0 </height>
        <radius> 0.5 0.5 </radius>
      </cylinder>
      <physics_material url="#WoodPhysMtl"/>
    </shape>
  </rigid_body>
</library>
```



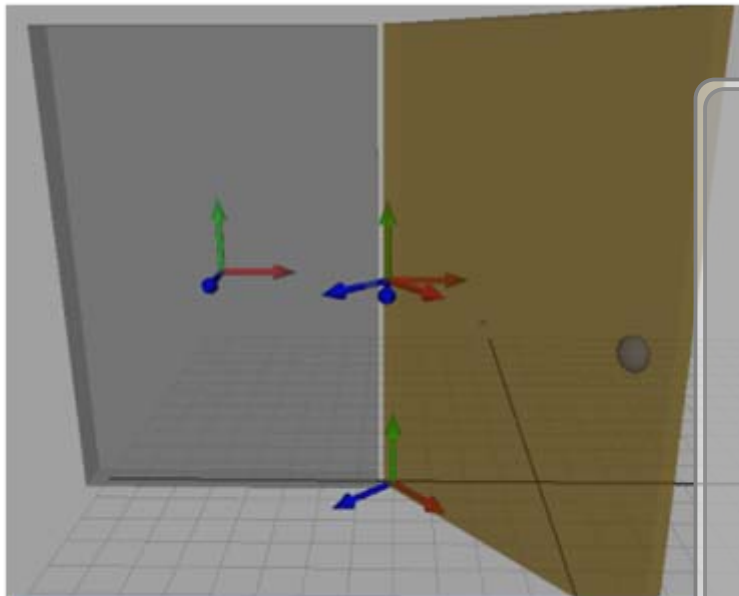
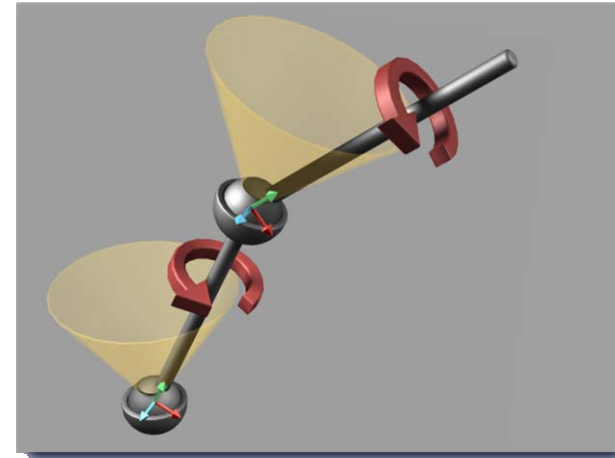
```
<library type="GEOMETRY">
  <geometry id="hammerHandleToRender">
    <mesh>
      ...
    </mesh>
  </geometry>
</library>
```



Constraint Example

- Generic representation

- X & Y min/max angles: elliptical "swing cone"
- Z min/max angles: "twist" range



```
<rigid_constraint id="rigidHingeConstraint">
  <ref_attachment body="#wallRigidBody">
    <translate sid="translate">5 0 0</translate>
  </ref_attachment>
  <attachment body="#doorRigidBody">
    <translate sid="translate">0 8 0</translate>
    <rotate sid="rotateX">0 1 0 -45.0</rotate>
  </attachment>
  <technique_common>
    <limits>
      <swing_cone_and_twist>
        <min> 0 90 0 </min>
        <max> 0 -90 0 </max>
      </swing_cone_and_twist>
    </limits>
  </technique_common>
</rigid_constraint>
```

COLLADA Physics tools

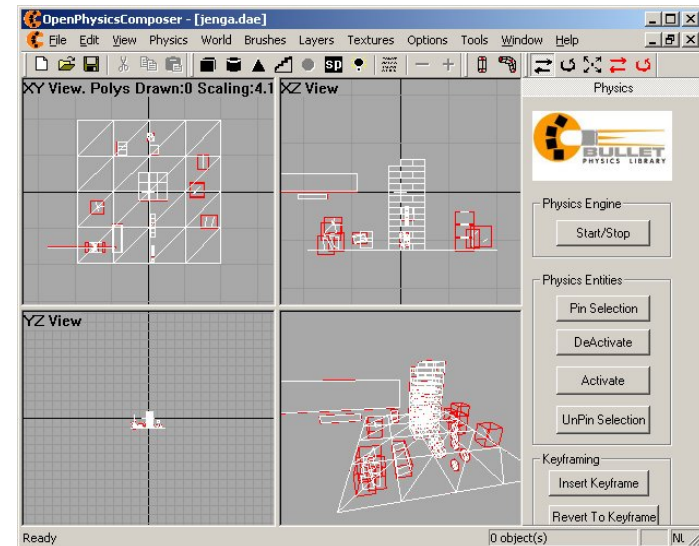
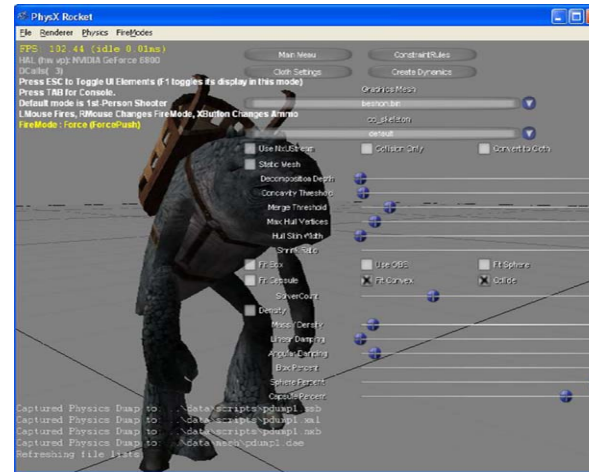
- **Feeling Software and Ageia**
 - 3ds Max plugin with COLLADA Physics export
 - Maya ColladaMaya plugin exporting Maya dynamics and PhysX
 - Maya Nima plugin
 - Feeling Viewer has physics simulation
- **XSI**
 - Physics export planned
- **Blender 2.43**
 - COLLADA Physics export and import



Images courtesy of Feeling Software (www.feelingsoftware.com), and AGEIA (www.ageia.com)

Other standalone physics tools

- **Create Dynamics**
 - Convex decomposition
 - Cloth and deformable skinning authoring
- **Open Physics Composer**
 - Early prototype, steered by feedback
 - Similar idea to FX Composer, but for physics
- **Scythe Physics Editor**
 - Multiple physics engine support
- Several in-house, command-line or stand-alone physics tools



SDK support for COLLADA Physics

- **Ageia PhysX SDK**
 - Provides NxuStream library with COLLADA Physics support
- **Bullet Physics SDK**
 - Open source with COLLADA Physics import and export samples
- **COLLADA DOM**
 - Open source lossless COLLADA import and export based on libxml
 - Autogenerated from the COLLADA XML Schema
- **FCollada**
 - Open source import/export library by Feeling Software
 - Used in ColladaMaya, ColladaMax plugins and various other tools



Future Directions

- **Conformance testing for better compatibility**
 - Khronos is actively working on this
- **Improved tools**
 - 3ds Max, Maya, XSI (planned), Blender, stand-alone physics tools
- **Character behavior and blending of animation and physics**
 - See Natural Motion and Havok behavior with 'smart balancing ragdolls'
- **Deformable Objects, Fracture, Cloth and Fluids**
 - See Pixelux DMM deformable physics technology for Lucas Arts
 - Ageia is supporting cloth, fluids and deformable objects in their SDK
 - Havok showing fracture in their Motorstorm demo

Links

- Khronos <http://www.kronos.org/collada>
- Collada <http://www.collada.org>
- Ageia <http://www.ageia.com>
- Havok <http://www.havok.com>
- Pixelux <http://www.pixeluxentertainment.com>
- NaturalMotion <http://www.naturalmotion.com>
- Bullet Physics <http://bulletphysics.com>
- Scythe Physics editor <http://www.physicseditor.com>
- Feeling Software <http://www.feelingsoftware.com>



Thanks !

Questions?

erwin_coumans@playstation.sony.com