Bullet 2.82 Quickstart Guide

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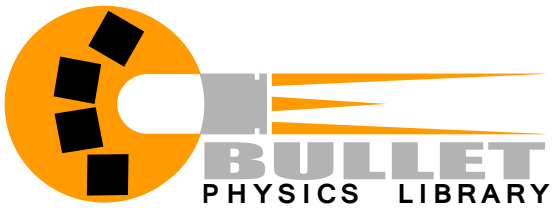

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Chapter 1

Introduction to Bullet

Bullet Physics is a professional open source collision detection, rigid body and soft body dynamics library. The library is free for commercial use under the zlib license.

1.1 Main Features

- Open source C++ code under zlib license and free for any commercial use on all platforms including PLAYSTATION 3, XBox 360, Wii, PC, Linux, Mac OSX, Android and iPhone
- Discrete and continuous collision detection including ray and convex sweep test. Collision shapes include concave and convex meshes and all basic primitives
- Fast and stable rigid body dynamics constraint solver, vehicle dynamics, character controller and slider, hinge, generic 6DOF and cone twist constraint for ragdolls
- Soft Body dynamics for cloth, rope and deformable volumes with two-way interaction with rigid bodies, including constraint support
- Maya Dynamica plugin, Blender integration, COLLADA physics import/export support

1.2 Contact and Support

- Public forum for support and feedback is available at `http://bulletphysics.org`

1.3 What's new

1.3.1 Preparing for Bullet 3.0 alpha

- The new Bullet 3.x version is making good progress, and the performance on high-end GPUs such as AMD 7970 and NVIDIA 680 is good. See the github repository at `https://github.com/erwincoumans/bullet3`

1.3.2 New in Bullet 2.82

- Featherstone articulated body algorithm implementation with integration in the Bullet constraint solver. See See `Demos/FeatherstoneMultiBodyDemo`
- New MLCP constraint solver interface for higher quality direct solvers. Dantzig (OpenDE), PATH and Projected Gauss Seidel MLCP solvers, with fallback to the original Bullet sequential impulse solver. See `src/BulletDynamics/MLCPSolvers`
- New btFixedConstraint as alternative to a btGeneric6DofConstraint with all DOFs locked. See `Demos/VoronoiFractureDemo`

- Various bug fixes, related to force feedback and friction. Improved performance between btCompoundShape using the new btCompoundCompoundCollisionAlgorithm. See the commit log at https://code.google.com/p/bullet/source/list

1.3.3 New in Bullet 2.81

- SIMD and Neon optimizations for iOS and Mac OSX, thanks to a contribution from Apple
- Rolling Friction using a constraint, thanks to Erin Catto for the idea. See Demos/RollingFrictionDemo/RollingFrictionDemo.cpp
- XML serialization. See Bullet/Demos/BulletXmlImportDemo and Bullet/Demos/SerializeDemo
- Gear constraint. See Bullet/Demos/ConstraintDemo.
- Improved continuous collision response, feeding speculative contacts to the constraint solver. See Bullet/Demos/CcdPhysicsDemo
- Improved premake4 build system including support for Mac OSX, Linux and iOS
- Refactoring of collision detection pipeline using stack allocation instead of modifying the collision object. This will allow better future multithreading optimizations.

Chapter 2

Building the Bullet SDK and demos

Windows developers can download the zipped sources of Bullet from http://bullet.googlecode.com. Mac OS X, Linux and other developers should download the gzipped tar archive. Bullet provides several build systems.

2.1 Microsoft Visual Studio

After unzipping the source code you can open the Bullet/build/vs2010/0BulletSolution.sln, hit F5 and your first Bullet demo will run. Note that by default Visual Studio uses an unoptimized Debug configuration that is very slow. It is best to enable the Release configuration.

2.2 Using Premake

Premake is a meta build system based on the Lua scripting language that can generate project files for Microsoft Visual Studio, Apple Xcode as well as Makefiles for GNU make and other build systems. Bullet comes with Premake executables for Windows, Mac OSX and Linux.

2.2.1 Premake Visual Studio project generation

You can double-click on Bullet/build/vs2010.bat to generate Visual Studio 2010 project files and solution. This batch file calls Premake. Just open Bullet/build/vs2010/0BulletSolution.sln

2.2.2 Premake Mac OSX Xcode project generation

On Mac OSX it is easiest to open a Terminal window and switch current directory to Bullet/build and use the following command to generate XCode projects:

Source Code 2.1: Premake for Mac OSX

```
1 cd Bullet/build
2 ./premake_osx xcode4
3 open xcode4/0BulletSolution.xcworkspace
```

2.2.3 Premake iOS Xcode project generation

XCode project generation for iOS, such as iPhone and iPad, is similar to Mac OSX. Just provide the –ios option to premake and premake will automatically customize the project and append ios to the directory:

Source Code 2.2: Premake for iOS

```
1 cd Bullet/build
2 ./premake_osx --ios xcode4
3 open xcode4ios/0BulletSolution.xcworkspace
```

Note that Bullet comes with a modified version of `premake_osx` that enables the iOS specific customizations that are required by XCode.

2.2.4 Premake GNU Makefile generation

You can also generate GNU Makefiles for Mac OSX or Linux using premake:

Source Code 2.3: Premake to GNU Makefile

```
cd Bullet/build
./premake_osx gmake
cd gmake
make config=release64
```

2.3 Using cmake

Similar to premake, CMake adds support for many other build environments and platforms, including Microsoft Visual Studio, XCode for Mac OSX, KDevelop for Linux and Unix Makefiles. Download and install CMake from http://cmake.org and use the CMake cmake-gui tool.

2.4 Using autotools

Open a shell terminal and go to the Bullet root directory. Then execute

Source Code 2.4: autotools to Makefile

```
./autogen.sh
./configure
make
```

The `autogen.sh` step is optional and not needed for downloaded packages.

Chapter 3

Hello World

3.1 C++ console program

Let's discuss the creation of a basic Bullet simulation from the beginning to the end. For simplicity we print the state of the simulation to console using printf, instead of using 3D graphics to display the objects. The source code of this tutorial is located in `Demos/HelloWorld/HelloWorld.cpp`.

It is a good idea to try to compile, link and run this HelloWorld.cpp program first.

As you can see in **??** you can include a convenience header file `btBulletDynamicsCommon.h`.

Source Code 3.1: HelloWorld.cpp include header

```
16 #include "btBulletDynamicsCommon.h"
17 #include <stdio.h>
18
19 /// This is a Hello World program for running a basic Bullet physics simulation
20
21 int main(int argc, char** argv)
22 {
```

Now we create the dynamics world:

Source Code 3.2: HelloWorld.cpp initialize world

```
27
28   ///collision configuration contains default setup for memory, collision setup. Advanced
         users can create their own configuration.
29   btDefaultCollisionConfiguration* collisionConfiguration = new
         btDefaultCollisionConfiguration();
30
31   ///use the default collision dispatcher. For parallel processing you can use a diffent
         dispatcher (see Extras/BulletMultiThreaded)
32   btCollisionDispatcher* dispatcher = new btCollisionDispatcher(collisionConfiguration);
33
34   ///btDbvtBroadphase is a good general purpose broadphase. You can also try out
         btAxis3Sweep.
35   btBroadphaseInterface* overlappingPairCache = new btDbvtBroadphase();
36
37   ///the default constraint solver. For parallel processing you can use a different solver
          (see Extras/BulletMultiThreaded)
38   btSequentialImpulseConstraintSolver* solver = new btSequentialImpulseConstraintSolver;
39
40   btDiscreteDynamicsWorld* dynamicsWorld = new btDiscreteDynamicsWorld(dispatcher,
         overlappingPairCache,solver,collisionConfiguration);
41
42   dynamicsWorld->setGravity(btVector3(0,-10,0));
```

Once the world is created you can step the simulation as follows:

Source Code 3.3: HelloWorld.cpp step simulation

```
115   for (i=0;i<100;i++)
116   {
117     dynamicsWorld->stepSimulation(1.f/60.f,10);
118
119     //print positions of all objects
120     for (int j=dynamicsWorld->getNumCollisionObjects()-1; j>=0 ;j--)
121     {
122       btCollisionObject* obj = dynamicsWorld->getCollisionObjectArray()[j];
123       btRigidBody* body = btRigidBody::upcast(obj);
124       if (body && body->getMotionState())
125       {
126         btTransform trans;
127         body->getMotionState()->getWorldTransform(trans);
128         printf("world␣pos␣=␣%f,%f,%f\n",float(trans.getOrigin().getX()),float(trans.
              getOrigin().getY()),float(trans.getOrigin().getZ()));
129       }
130     }
131   }
```

At the end of the program you delete all objects in the reverse order of creation. Here is the cleanup listing of our HelloWorld.cpp program.

Source Code 3.4: HelloWorld.cpp cleanup

```
138
139   //remove the rigidbodies from the dynamics world and delete them
140   for (i=dynamicsWorld->getNumCollisionObjects()-1; i>=0 ;i--)
141   {
142     btCollisionObject* obj = dynamicsWorld->getCollisionObjectArray()[i];
143     btRigidBody* body = btRigidBody::upcast(obj);
144     if (body && body->getMotionState())
145     {
146       delete body->getMotionState();
147     }
148     dynamicsWorld->removeCollisionObject( obj );
149     delete obj;
150   }
151
152   //delete collision shapes
153   for (int j=0;j<collisionShapes.size();j++)
154   {
155     btCollisionShape* shape = collisionShapes[j];
156     collisionShapes[j] = 0;
157     delete shape;
158   }
159
160   //delete dynamics world
161   delete dynamicsWorld;
162
163   //delete solver
164   delete solver;
165
166   //delete broadphase
167   delete overlappingPairCache;
168
169   //delete dispatcher
170   delete dispatcher;
171
172   delete collisionConfiguration;
173
174   //next line is optional: it will be cleared by the destructor when the array goes out of
        scope
```

```
175   collisionShapes.clear();
```

Chapter 4

Frequently asked questions

Here is a placeholder for a future FAQ. For more information it is best to visit the Bullet Physics forums and wiki at http://bulletphysics.org.

Source Code Listings