Lab 7: Angular Dynamics in 3D

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GPR-350 Game Physics
Instructor: Daniel S. Buckstein
Lab 7: Angular Dynamics in 3D

Summary:
Carrying on with 3D physics, we revisit angular dynamics and introduce the 3D inertia tensor.

Submission:
Submit a link to your online repository with the completed assignment's branch name and commit ID/index. If you have not created an online repository to keep track of your work, you should do so as part of this assignment; it will be checked. ***Work in pairs***.

Instructions:

Add the following members to your 3D particle class:

- World transformation matrix and its inverse (updated every frame by converting particle's 3D rotation and position into 4D homogeneous matrices)
  - Note: this does not *replace* rotation (quaternion) and position (3D vector); they are needed for integration and converting to above said matrices!
  - Note: inversion should be optimized (i.e. do not call the full 'inverse' function/method)!
- Local and world center of mass (3D vectors; world center is updated every frame by transformation)
- Local and world inertia tensors (3D matrices; world is updated every frame by performing change of basis)
- Torque (applied in world space using cross product)
- Angular acceleration (converted from torque using Newton-2 for rotation)

Implement 3D inertia tensor setters for a variety of shapes including:

- Solid sphere

- Hollow sphere
- Solid box & cube
- Hollow box & cube
- Solid cylinder
- Solid cone

Much like the 2D angular dynamics lab, implement a test scenario to demonstrate 3D angular dynamics on a variety of 3D shapes.

Bonus:
Implement one of the following:

- Custom center of mass and inertia tensor: Instead of hard-setting the local center of mass, implement the general algorithm to calculate it given a set of weighted masses on the rigid body. Also implement a custom inertia tensor given the same set of weighted masses.
- Implement a test scene with a ball rolling down a 3D slope.

Points	8
Submitting	a text entry box

Due	For	Available from	Until
-	Everyone	-	-

+ Rubric