CS 498VR: Virtual Reality Spring 2019
In-class Worksheet

Tracking and Collision Detection

1. Correcting Drift

When tracking orientation, drift correction can be accomplished by a complementary filter:

$$\hat{\theta}_c[k] = \alpha\hat{\theta}_d[k] + (1-\alpha)\hat{\theta}[k]$$

Here, k is the current timestep. The function $\hat{\theta}[k]$ is orientation determined by integrating a gyroscope reading. The function $\hat{\theta}_d[k]$ provides orientation through a lower sampling rate sensor like a camera. The parameter $\alpha \in [0,1]$ is called the *gain*. Approximately where in the interval [0,1] should the gain be set? Provide two reasons supporting your choice for the gain.

2. Orientation Drift in 3D

Suppose the true orientation is given by the quaternion q and the estimated orientation measured by the quaternion $\hat{q}$.

a. Derive a formula for the drift error.

b. If the accelerometer produces a vector **a** in body coordinates, how can it be converted into world coordinates?

3. Using a BVH for Collision Detection

We have two objects **a** and **b,** each with their own BVH as shown below. Each node a bounding volume associated with it. Only the geometry in nodes a3 and b8 are in collision. What is the minimal number of bounding volume intersections that might be needed to determine this? What would be the maximal number?