Practical Assignment 1 - Particle Systems

The main objective is to implement a particle system with two different types of emitters: fountain and cascade. Their parameters have to be user-adjustable from the GUI as well as the emission rate (not less than 100 particles per second) and particle life expectancy (not less than a second).

The simulation will have to run inside a box of dimensions [-5, 0, -5] x [5, 10, 5]. The framerate is fixed to 30fps, so each frame should simulate 33.3ms.

1. Use the Euler method as the solver for both fountain and cascade mode. (4pt)
2. Implement collision detection with walls and ground planes. (2pt)
3. Implement collision with some object(s) within the box:
   - A Sphere. Make its position and radius parametrizable. (2pt)
   - A Capsule. Make the position of its points and radius parametrizable. (2pt)

Emmiters

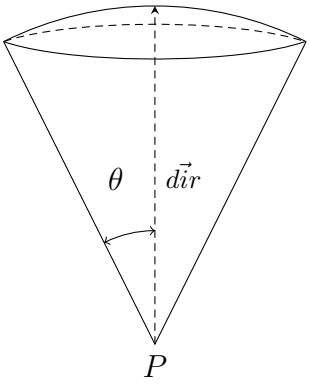
An emmiter generates particles over time. It has an emission rate er, which defines how many particles per second are created (er $[\frac{particles}{time}]$). The emmiter is also responsible of setting the initial velocity and the inital position of the particles, as well as other properties (such the mass) if needed.

Fountain

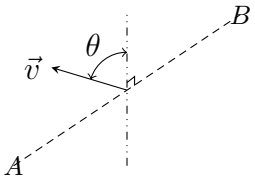
A fountain is an emmiter that generates particles inside a cone. It is defined by the following parameters:

- Direction of the cone $\vec{dir}$
- Cone position P
- Maximum angle θ
- The magnitude of the velocity $||\vec{v}||$

Initially, all the particles start at the same position P, and will have a velocity $\vec{v}$ with a direction defined by a random vector bounded by the cone shape.



(a) A fountain pointing upwards



(b) A cascade defined by two points

Cascade

A cascade is an emmiter that generates particles in a segment. It is defined by the following parameters:

- Starting point A
- Ending point B
- Rotation angle θ
- The magnitude of the velocity $||\vec{v}||$

All the particles will have the same velocity vector $\vec{v}$. The velocity is orthogonal to the segment, and its direction is found by rotating θ a base vector using the segment as the axis. The initial position of each particle will be a random point in the segment.