Project title:

Modeling and Simulation of 3D Fireworks Based on Particle System

Resources:

- MODELING AND SIMULATION OF 3D FIREWORKS BASED ON PARTICLE SYSTEM: This can help me to find out the essential components of simulating a firework with particles. The paper outlines the essential steps in generating a frame image using a particle system. Such as the rise, explosion, and disappearance of particles. Also, factors like gravity, air resistance, and wind are considered in modeling particle movement.
  It divides each firework simulation into a first, initialization of particles (number of them, color, …) step. Second, updating them with formulas and algorithms (here, the second paper will help). Third, the disappearance of them. Totally, this can help me learn the subject better theoretically and have some details in my mind.
- FIREWORKS CONTROLLER: This paper presents a novel real-time shape-constrained fireworks animation system. It uses a 3D mesh to depict the shape of fireworks and proposes a fast point sampling method based on the dual depth peeling algorithm to evenly approximate the mesh. It has a lot of details about the formulas and algorithm, and can be my main source because this is the paper written by the authors of the video that I attached in the objective section. It doesn't have any code or implementation, so I aim to implement a part of that.

Objectives:

For a better understanding of the ideal output of this project, here is a sample video. I can summarize the objectives in three sections:

1. The task at hand is to assemble a set of elementary particles. Every particle is a small component of the fireworks. To resemble the motion of them, beginning positions and velocities are assigned to these particles. With time, they look to be an exploding firework because they move, change color, and gradually fade. So, the first task is implementing a simple explosion firework, with a constant number of particles that go up with an explosion and then fall down with gravity and fade. This task mostly needs the first paper.

2. Use the formulas of the second paper, so the particle movements have a specific shape, maybe an animal or a word like “Computer Graphics 2023” shapes by the particles when they go up and then fades when they go down.
3. Rotate the camera around the firework with a proper speed so the user can fill the 3D environment.

Motivations:

- Visual Entertainment: Computer graphics play a crucial role in entertainment, including video games, movies, and virtual reality. Fireworks simulations are a great example of how computer graphics can create captivating and visually pleasing content to entertain people.
- Scientific Visualization: In scientific and engineering contexts, computer graphics are used to depict complex data and simulations. Researchers can gain a better understanding and study of the physics of combustion, explosions, and fluid dynamics by using particle system modeling of fireworks.
- Innovation in Computer Graphics Techniques: It challenges researchers to develop novel methods for handling particle dynamics, lighting, shading, and physics simulation, which can have applications in various other domains of computer graphics.