实验报告 8

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1、实现

1.1. Rope()
(1)位置：Rope.cpp
(2)实现：

```
Rope::Rope(Vector2D start, Vector2D end, int num_nodes, float node_mass, float k, vector<int> pinned_nodes)
  {
      // TODO (Part 1): Create a rope starting at `start`, ending at `end`, and containing `num_nodes` nodes.
      // Comment-in this part when you implement the constructor
      // for (auto &i : pinned_nodes) {
      //     masses[i]->pinned = true;
      // }


      // TODO Traverse the BVH to find intersection
      ////////////////Solution//////////////////
      ////Name:JiangZhuoyang
      ////StudentID:58119125
      ////FinishDate:21/11/19
      for (int i = 0; i < num_nodes; i++)
      {
          Vector2D current = start + i * (end - start) / (num_nodes - 1);
          Mass* tmp = new Mass(current, node_mass, false);
          masses.push_back(tmp);
      }
      for (int i = 0; i < num_nodes - 1; i++)
      {
          Spring* tmp = new  Spring(masses[i], masses[i + 1], k);
          springs.push_back(tmp);
      }

      for (auto& i : pinned_nodes) {
          masses[i]->pinned = true;
```

```
    }
    //////////////////////////////////////////////

}
```

1. 2. simulateEuler()

(1)位置：Rope. cpp

(2)实现：

```
void Rope::simulateEuler(float delta_t, Vector2D gravity)
  {
    /////////////////Solution////////////////////
    ////Name:JiangZhuoyang
    ////StudentID:58119125
    ////FinishDate:21/11/19

    for (auto &s : springs)
    {
      // TODO (Part 2): Use Hooke's law to calculate the force on a node
      Vector2D ab = s->m2->position - s->m1->position;
      Vector2D f = s->k * (ab.unit()) * (ab.norm() - s->rest_length);
      s->m1->forces += f;
      s->m2->forces -= f;

    }

    for (auto &m : masses)
    {
      float k_d = 0.1;
      if (!m->pinned)
      {
          // TODO (Part 2): Add the force due to gravity, then compute the new velocity and position
        m->forces += gravity * m->mass;
        // TODO (Part 2): Add global damping
        m->forces += -k_d * m->velocity;
        Vector2D a = m->forces / m->mass;
        //implicit Euler
        m->velocity += a * delta_t;
        m->position += m->velocity * delta_t;
      }

```

```
        // Reset all forces on each mass
        m->forces = Vector2D(0, 0);
    }

    ///////////////////////////////////////////
}
```

1.3. castRay()

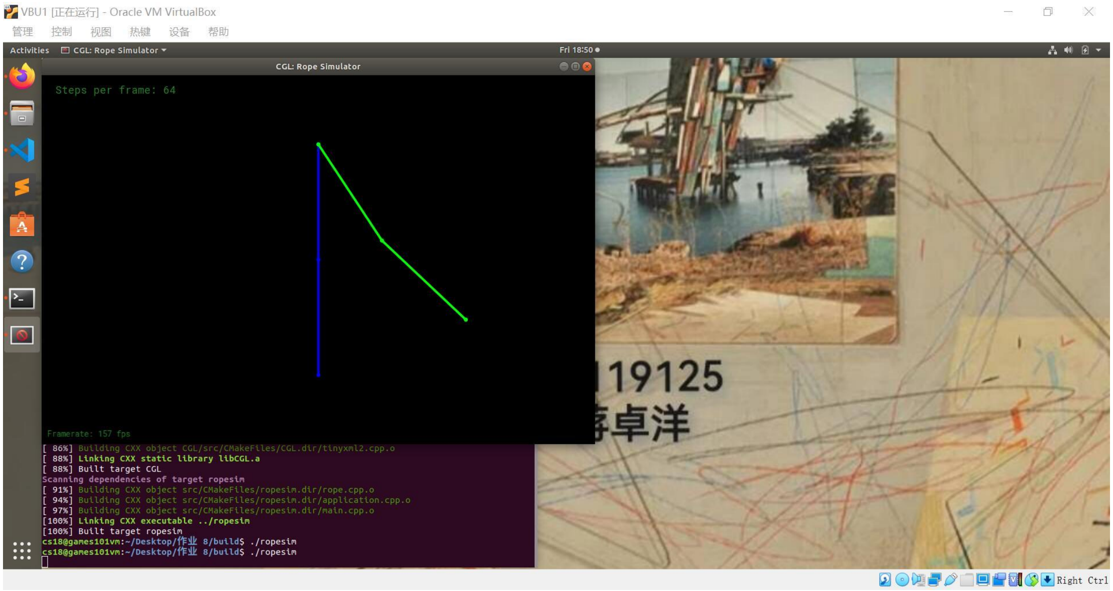
(1)位置：Rope. cpp

(2)实现：

```
void Rope::simulateVerlet(float delta_t, Vector2D gravity)
{
    ////////////////Solution//////////////////
    ////Name:JiangZhuoyang
    ////StudentID:58119125
    ////FinishDate:21/11/19
    for (auto &s : springs)
    {
        // TODO (Part 3): Simulate one timestep of the rope using explicit Verlet（solving constraints)
        Vector2D ab = s->m2->position - s->m1->position;
        Vector2D f = s->k * (ab.unit()) * (ab.norm() - s->rest_length);
        s->m1->forces += f;
        s->m2->forces -= f;
    }

    for (auto &m : masses)
    {
        if (!m->pinned)
        {

            // TODO (Part 3.1): Set the new position of the rope mass
            m->forces += gravity * m->mass;
            Vector2D a = m->forces / m->mass;
            Vector2D temp = m->position;
            // TODO (Part 4): Add global Verlet damping
            double  damping_factor = 0.00005;
            //To do calculation
             m->position = m->position + (1 - damping_factor) * (m->position - m->last_position) + a * delta_t * delta_t;
            m->last_position = temp;
            }
            m->forces = Vector2D(0, 0);
        }

        /////////////////////////////////////////////
    }
}
```

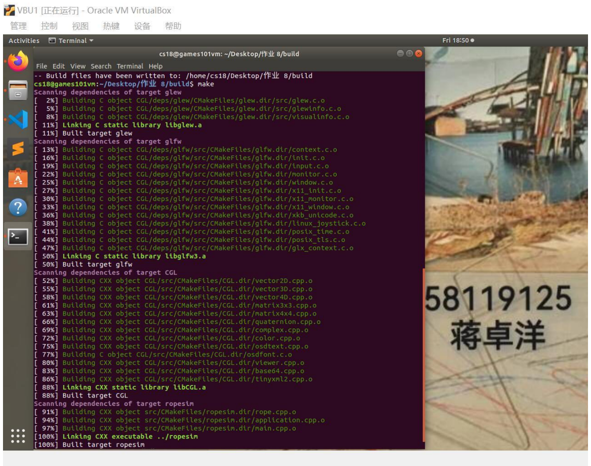
2、结果

- **实验结果如下：**



```
[ 86%] Building CXX object CGL/src/CMakeFiles/CGL.dir/tinyxml2.cpp.o
[ 88%] Linking CXX static library libCGL.a
[ 88%] Built target CGL
Scanning dependencies of target ropesim
[ 91%] Building CXX object src/CMakeFiles/ropesim.dir/rope.cpp.o
[ 94%] Building CXX object src/CMakeFiles/ropesim.dir/application.cpp.o
[ 97%] Building CXX object src/CMakeFiles/ropesim.dir/main.cpp.o
[100%] Linking CXX executable ../ropesim
[100%] Built target ropesim
cs18@games101vm:~/Desktop/作业 8/build$ ./ropesim
cs18@games101vm:~/Desktop/作业 8/build$ ./ropesim
```

图 1. 实验结果


VBU1 [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Activities
Terminal
Fri 18:50
cs18@games101vm: ~/Desktop/作业 8/build
File Edit View Search Terminal Help
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```
-- Build files have been written to: /home/cs18/Desktop/作业 8/build
cs18@games101vm:~/Desktop/作业 8/build$ make
Scanning dependencies of target glew
[  2%] Building C object CGL/deps/glew/CMakeFiles/glew.dir/src/glew.c.o
[  5%] Building C object CGL/deps/glew/CMakeFiles/glew.dir/src/glewinfo.c.o
[  8%] Building C object CGL/deps/glew/CMakeFiles/glew.dir/src/visualinfo.c.o
[ 11%] Linking C static library libglew.a
[ 11%] Built target glew
Scanning dependencies of target glfw
[ 13%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/context.c.o
[ 16%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/init.c.o
[ 19%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/input.c.o
[ 22%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/monitor.c.o
[ 25%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/window.c.o
[ 27%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/x11_init.c.o
[ 30%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/x11_monitor.c.o
[ 33%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/x11_window.c.o
[ 36%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/xkb_unicode.c.o
[ 38%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/linux_joystick.c.o
[ 41%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/posix_time.c.o
[ 44%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/posix_tls.c.o
[ 47%] Building C object CGL/deps/glfw/src/CMakeFiles/glfw.dir/glx_context.c.o
[ 50%] Linking C static library libglfw3.a
[ 50%] Built target glfw
Scanning dependencies of target CGL
[ 52%] Building CXX object CGL/src/CMakeFiles/CGL.dir/vector2D.cpp.o
[ 55%] Building CXX object CGL/src/CMakeFiles/CGL.dir/vector3D.cpp.o
[ 58%] Building CXX object CGL/src/CMakeFiles/CGL.dir/vector4D.cpp.o
[ 61%] Building CXX object CGL/src/CMakeFiles/CGL.dir/matrix3x3.cpp.o
[ 63%] Building CXX object CGL/src/CMakeFiles/CGL.dir/matrix4x4.cpp.o
[ 66%] Building CXX object CGL/src/CMakeFiles/CGL.dir/quaternion.cpp.o
[ 69%] Building CXX object CGL/src/CMakeFiles/CGL.dir/complex.cpp.o
[ 72%] Building CXX object CGL/src/CMakeFiles/CGL.dir/color.cpp.o
[ 75%] Building CXX object CGL/src/CMakeFiles/CGL.dir/osdtext.cpp.o
[ 77%] Building C object CGL/src/CMakeFiles/CGL.dir/osdfont.c.o
[ 80%] Building CXX object CGL/src/CMakeFiles/CGL.dir/viewer.cpp.o
[ 83%] Building CXX object CGL/src/CMakeFiles/CGL.dir/base64.cpp.o
[ 86%] Building CXX object CGL/src/CMakeFiles/CGL.dir/tinyxml2.cpp.o
[ 88%] Linking CXX static library libCGL.a
[ 88%] Built target CGL
Scanning dependencies of target ropesim
[ 91%] Building CXX object src/CMakeFiles/ropesim.dir/rope.cpp.o
[ 94%] Building CXX object src/CMakeFiles/ropesim.dir/application.cpp.o
[ 97%] Building CXX object src/CMakeFiles/ropesim.dir/main.cpp.o
[100%] Linking CXX executable ../ropesim
[100%] Built target ropesim
```

图 2. 结果编译过程