

Research on a Road Generation and Routing Method

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Abstract. Aiming at the problems of rapid road generation and automatic route finding of equipment in large scene environment, this paper proposes a road generation and route finding method, including environment simulation module, rapid road generation module and automatic route finding module. The corresponding software is realized based on this method, which can be used in 3D modelling, scene construction and other fields.

Keywords- Road generation, automatic routing, environment simulation, modelling and simulation

1 Introduction

In the complex field terrain environment, how to quickly generate an effective road network and support the movement of various vehicles based on the road network is an extensive research topic and a technical difficulty [1,2]. In the background, as the basic work of artificial intelligence and three-dimensional modelling, automatic routing method is widely studied at home and abroad [3]. The existing research is roughly divided into two categories: one is combined with different applications, and the other is combined with advanced computer technology and artificial intelligence technology [4,5]. According to the actual needs of system simulation, this paper aims at the problems of environment simulation, rapid road generation, automatic routing and so on. A road generation and routing method is proposed. The main purposes of the software are: dynamic calculation, processing behaviour, message passing processing, scene colouring and so on.

The software consists of environment simulation module, road rapid generation module and automatic route finding module. As shown in the figure below, they are introduced below.

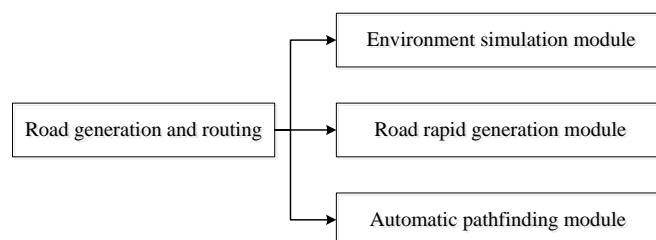


Figure 1. Software composition

1) Environment simulation module

The battlefield environment is simulated through image and elevation data, and the system illumination can be adjusted according to the system time or time axis. At the same time, it can simulate environmental factors such as sky and atmosphere, as well as meteorological factors such as rain, snow, smoke and fog.

2) Road rapid generation module

Provide a rapid road generation module, which can quickly generate three-dimensional roads in the topographic environment by drawing continuous points, including roads, earth roads, railways, etc. It also supports the dynamic generation of road side objects, including guardrails, fences, walls, power lines, tree lines or any other type of geometric path.

3) Automatic pathfinding module

Provide 3D version of a * automatic routing algorithm based on unity3d terrain environment to meet the automatic routing of vehicles, personnel and other action targets.

2 Environment simulation module

Some setting parameters can be changed to simulate the actual 24-hour time change and weather change in a day, including sunny days, cloudy days, rain, snow and fog. [6]

According to the battlefield environment or time axis, the lighting system can simulate and adjust the time axis according to the battlefield environment. At the same time, it can simulate environmental factors such as sky and atmosphere, as well as meteorological factors such as rain, snow, smoke and fog.

2.1 Standard meteorological environment template

Built in a set of standard meteorological environment templates for direct retrieval.

1) Time setting

Press and hold the slider and drag to change the time.

2) Time velocity

Press and hold the slider and drag to change the time and change the time flow rate (range 0-1000).

3) Weather conversion speed

Press and hold the slider and drag to change the weather conversion speed (range 1-100).

4) Weather switching selection

Click the following button to generate the corresponding weather and display the current weather in the current weather.

2.2 Meteorological environment parameters

1) Sunny day

The environmental impact factor is 0, which is composed of grade 0 sunlight.

2) Cloudy

The environmental impact factor is 0, which is composed of level 0 clouds.

3) Mist

The environmental impact factor is 0.1, which is composed of grade 0 fog and grade 0 cloud.

4) Medium fog

The environmental impact factor is 0.15, which is composed of level 1 fog and level 1 cloud.

5) Heavy fog

The environmental impact factor is 0.2, which is composed of level 2 fog and level 2 cloud.

6) Light rain

The environmental impact factor is 0.5, which is composed of grade 0 rain and grade 1 cloud.

7) Moderate rain

The environmental impact factor is 0.6, which is composed of level 2 cloud, level 1 rain and level 0 wind.

8) Heavy rain

The environmental impact factor is 0.7, which is composed of level 2 cloud, level 2 rain and level 1 wind.

3 Road rapid generation module

Provide a rapid road generation tool, which can quickly generate three-dimensional roads in the terrain environment by drawing continuous points, including roads, earth roads, railways, etc. It also supports the dynamic generation of road side objects, including guardrails, fences, walls, power lines, tree lines or any other type of geometric path. [7]

3.1 Road creation

1) Create a base corridor model

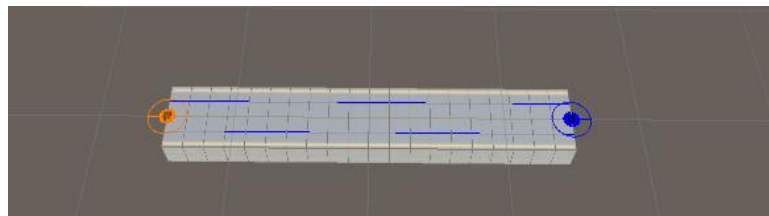


Figure 2. Basic road model

2) Create intersection model

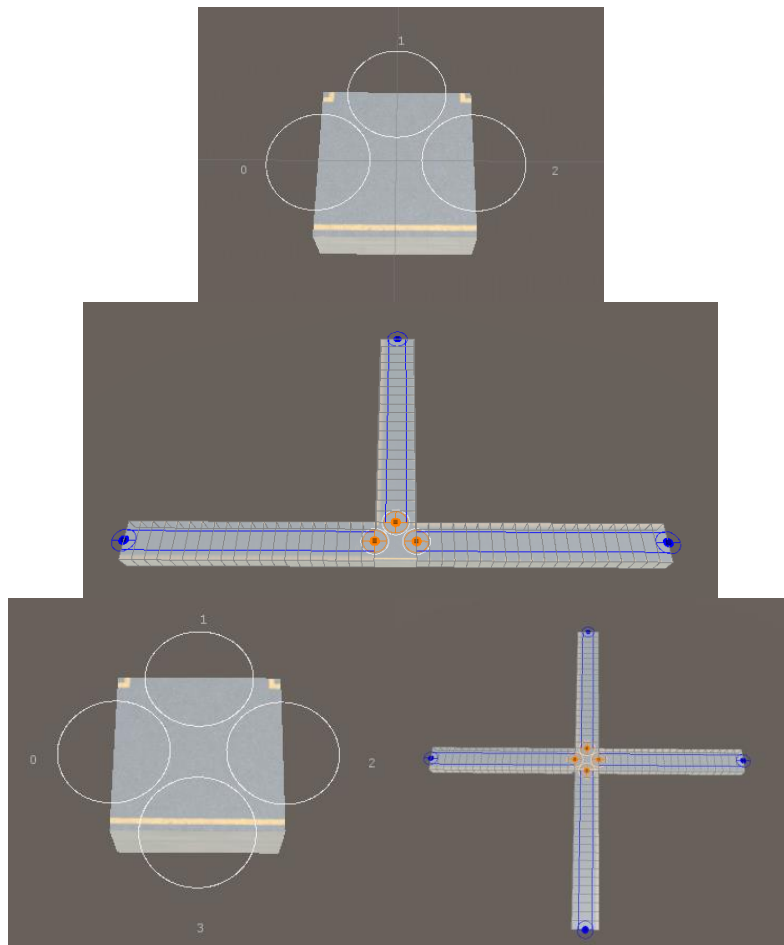


Figure 3. Intersection model

3.2 Road editing

1) Road foundation parameters

Road foundation parameters include: road surface material, road bottom material, curb material, road width, road depth, road bottom width, curb height, curb width, number of road segments, display road contour, roadside buffer space, number of road channels, display channel, fit terrain, distance from terrain, display self-object, etc. The details are as follows:

Note: after modifying the parameters each time, you need to click generate road grid to regenerate the road model.

(1) Road surface material

You can change the road type by replacing materials, and quickly generate earth roads and highways.

(2) Road bottom material

You can change the type of road bottom by replacing materials.

(3) Side material

You can change the shoulder type by replacing the material.

(4) Number of road sections

The number of longitudinal divisions of the road affects the number of objects in the center / both sides of the road.

(5) Show road outline

The modified contour of the road before generating the road mesh.

(6) Roadside buffer space

The distance between the road channel and the edges of both sides.

(7) Number of roads and channels

Number of lanes.

(8) Show channel

Set whether the channel is displayed or not.

(9) Fit terrain / Terrain / distance from terrain

Operation: first click the magnet road to be edited, find the terrain to be fitted, drag it to the place indicated by the arrow, then tick the fitted terrain, set the distance from the terrain, and click to generate the road grid.

(10) Show child objects

The bottom of the road can be split and displayed in hierarchy.

2) Road curve editing

In the scene view, click the yellow square marked by the circle, and a red, green and blue three-way arrow will appear.

(1) Adjust the end point of the road

Drag the yellow square indicated by the red arrow to change the initial and end positions of the road.

(2) Adjust road curvature

Drag the yellow square indicated by the green arrow to change the curvature of the road.

Note 1: after dragging and changing, click generate road grid on the setting panel.

Note 2: after clicking the yellow box, you can also set the coordinates at the bottom of the setting panel.

3) Section addition

Under the grid editing of the settings panel, find the increase or decrease of the road. The blue circle is the negative pole and the orange circle is the positive pole.

(1) Add curve point

You can add new curve points at both ends of the current road.

Note 1: the two ends of the road are not added.

Note 2: the setting parameters of the same panel are used for the whole road.

(2) Remove curve points

You can remove newly added curve points at both ends of the road.

Note 1: the original road cannot be removed.

Note 2: after clicking remove, click generate road grid to regenerate.

(3) Add road

You can add new roads at both ends of the current road, as shown in the following figure:

Note 1: the generated new road has its own two pole endpoints.

Note 2: roads use their own panel setting parameters respectively.

Note 3: the generated road will be displayed in the positive (negative) pole of the connection. Double click to switch to the corresponding panel.

(4) Add three (four) way intersection

New three (four) way junctions can be added at both ends of the current road.

4 Automatic route finding module

Provide 3D version of a * automatic routing algorithm based on 3D terrain environment to meet the automatic routing of operational targets such as combat vehicles and combatants. [8]

4.1 Scene layout

Create a terrain and change its layer to "ground".

4.2 Draw the routing grid

Create an empty object (a *) and add the component astar path. The specific operation is component Pathfinder Pathfinder.

Select "chart" add chart ", you can see that there are five kinds of charts to choose from, namely " grid chart ", " hierarchical grid chart ", " navigation network chart ", " point chart "and" Ray chart "; Select "grid diagram" here.

Click "grid diagram", and some basic settings are required:

"Width (number of nodes)", "depth (number of nodes)" "node size": the number multiplied by the size is the size of the grid in this direction. The size of the grid should adapt to the size of the terrain.

There is a square icon composed of five points on the right. All five points can be clicked to select the alignment of the grid. Note: no matter which alignment is used, the value in the Y direction should be set slightly lower than the ground height to avoid floating-point errors. If The Y coordinate of the ground is 0. To ensure that the y of the wayfinding map is slightly less than that of the plan, it can be set to -0.1.

"Maximum climb" and "maximum slope" can set the maximum height that can be climbed and the maximum angle that can be passed in pathfinding.

Tick "collision test" and set the obstacle layer.

Check "height test" and set the layer that can walk.

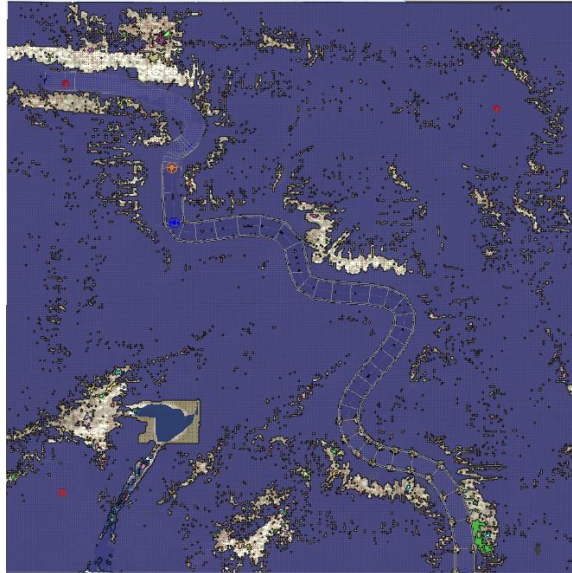


Figure 4. Routing grid

Here we have completed the basic settings. Finally, click the "scan" at the bottom of the component, and we will see that part of the ground will be covered by areas composed of many transparent edges and small red cubes in the middle, which will become unlocked areas. AI will automatically avoid these areas when walking.

4.3 Creating movable objects

Create a three-dimensional object as a pathfinding object and create an empty object (AI). Select "ignore raycast" for the layer name (layer) as the parent object of the pathfinding object, and add the AI path component. At this time, the seeker component will be added automatically.

You can set the "maximum speed" and "rotation speed" of the moving speed of the pathfinding object.

Add the character controller component to control the character of the pathfinding object.

You can set the slope limit, step height, skin thickness and other parameters to correspond to the moving effect of the wayfinding object.

Add AI destination setter component to set "wayfinding target".

4.4 Create wayfinding target

1. Then create a 3D object as the target object of pathfinding
2. Remove the built-in Collider to avoid unnecessary errors.
3. Drag the created target object to the "pathfinding target" under the AI destination setter component of the moving object AI.
4. During the test, you can also add the target mover component, drag the pathfinding target to the "moving target", and select "everything" for the movable layer. In this way, the target object will follow the mouse movement, which can better observe the pathfinding effect.

5 Conclusion

Aiming at the problems of rapid road generation and automatic route finding of equipment in large scene environment, this paper proposes a road generation and route finding method, including environment simulation module, rapid road generation module and automatic route finding module. The corresponding software is realized based on this method, which can be used in 3D modelling, scene construction and other fields.

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