

# Training Simulator System of Artillery Radar Azimuth Calibration Based on Scene Simulation

Xianming Shan, Zhaochun Tian and Hongjie Zhou

Electronic Department, Shenyang Artillery Academy, Shenyang, Liaoning, China

**Abstract.** Visual emulation Technology is one of the important parts of VR systems. It takes charge of Vision issue in VR systems, and is the most important fact to affect the immersive of the system. To deal with the difficulties of one type artillery radar, such as limited training field, serious radar loss and expensive training outlay, a training simulator system is realized based on scene simulation technologies. Composition structure, function module and key technologies of the system are discussed first. This system is then developed with tools of Multigen-Creator, Vega, VC++6.0, and a living virtual battlefield environment is created. The emulation pictures are listed, the results show that the emulation system simulates operation process of artillery radar livingly and can meet the requirements of real time emulation.

**Keywords:** simulation system, radar, model

## 1. Introduction

Visual emulation is a new research field of modern emulation technology, the engineering application based mainly on top of 3D development environment develops visual simulation software system<sup>[1]</sup>.

The structure of one type artillery radar is complicated and the price is expensive, especially using calibration training of aiming mirror has very high demand on equipment and ground. In order to save the training funds and improve training efficiency, we consider using the virtual reality technology simulating to aiming mirror vision. This article by "one type of radar simulation training system" for application background, uses MultiGen Vega and OpenGL technology in VC++ platform firstly realizing one type of radar visual simulation of aiming mirror.

## 2. OpenGL and Vega

OpenGL is a very good open 3D graphics interface, it has characteristic of cross-platform-ability, simpleness, efficiency and function perfect, now it has become industrial standards of 3D graphics factory in fact. Microsoft provides three OpenGL function library (glu32.lib, glau.lib, OpenGL32.lib) in VC++, we use them programming expediently and generating beautiful graphics simply and quickly<sup>[2]</sup>. Using directly OpenGL in complex visual simulation system development will spend a lot of time, the development is very difficult. The visual simulation development platform is Vega, it is based on the bottom 3D graphics libraries OpenGL environment, but for some professional visual simulation system development, there are some difficulties, such as drawing function of aiming mirror, Vega does not provide this type of support, in order to solve these problems, it is necessary to introduce OpenGL directly into Vega.

Vega is the industry leading software environment to realize real-time visual and auditory simulation. Vega includes a click type graphical user interface Lynx, a set of complete C application program interface, series of related library and AudioWorks2 real-time multichannel audio systems. It takes the advanced simulation function and easy-to-use tools together, the last generation is ADF files (application definition file).

The simulation flow of OpenGL is shown in Fig.1.

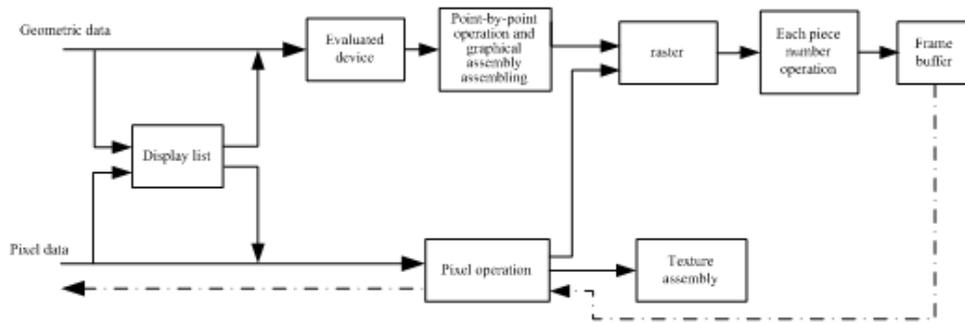


Fig. 1: OpenGL simulation workflow.

### 3. The Function Module of System

It can be seen from Fig.2, the system of simulation is consisted of four function modules, including of creation and showing of two dimension digital map, guiding control, the creation and showing of three scene and the evaluation of training score.

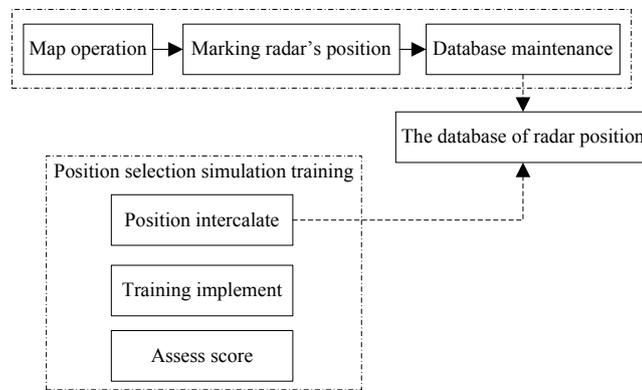


Fig. 2: The constitution of system.

It is an automatic process that creation and showing module of two dimension map mark battlefield situation on map according to basic tactics needs. Radar stationmaster selects the position and spotting on two dimension electronic map in accordance with the battle situation, system can create the scene of three dimension about spotting.

Aiming at the need of training, guiding control module sets the starting state and transmits basic situation to radar stationmaster, and adjusts kinds of state in the process of training.

The module of 3D scene initializes the target and simulates types of objects to show in the virtual scene about battlefield situation, such as vegetation vision, terrain vision etc. On the other side, the module can simulate various of weather conditions and the visual scene of field reconnaissance, according to the scout data set by guiding control module and the location where radar commander is in.

The module of training score evaluation employs the way of multiplicative decision to evaluate the radar position selection in quantitative, referring to the need of position setting, the radar unit's task, spotting area and so on.

## 4. Key Technologies of System

### 4.1. 3D Creating and Showing

Creator Pro is an entity modeling tool which possesses strong function and good alternation, and combining polygon modeling with vector modeling and surface producing. It can create not only spaceflight, surface car and building, but also peculiar field such as airfield, harbor and so on<sup>[3,4]</sup>. There are all function of Creator ,furthermore some other function is added to make creating model convenient , like polygon and vein modeling, vector modeling and editing and surface character creating ,

Terrain Bundle is a database tool for creating large area, which can make simulative terrain closing reality with high fidelity. It makes use of a series of projection arithmetic and earth model to create and transform terrain in the same orientation. By automatic vein mapped, the perfection terrain can be created including of road, river, and town. The path finding arithmetic is better than linearity sexuality arithmetic in that it can create thousands of bridge and crossing in real time three dimension scenes.

Three dimension databases is the basis of whole modeling, which has so many influences on running quality of system. The data format of Open Flight hierarchy structure is adopted by system, which is a logistic visual scene description database used to inform map generator to romance three dimension scene, ensure of controlling of the object and permit geometry layer data to be operate directly.

## 4.2. Simulation Program of Vega

The scene module constructed by Vega can be ran in VC++, after the ADF file is generated<sup>[5]</sup>. It can adopt either standard Win32 Console Application to introduce Vega function to realize the design of emluator, or MFC class libraries to accomplish. The introducing process of API is as following:

```
void main( int argc, char*argv[])
{
vgInitSys();    // initialization
vgInitSym();   // initialization of instrument module
vgInitAudio(); // initialization of sound module
    // using ADF document
    vgDefineSys("radar. adf");
    vgConfigSys();
    {
        vgSynFrame();
        vgFrame();
        // other code
        .....
    }
}
```

The function of controlling radar position in common use is listed below:

```
// acquire the pitching position of radar antenna
vgGetPos( part1, pos1);
// enactment the pitching position of radar antenna
vgSetPos( part1, pos1);
// acquire the pitching azimuth of radar antenna
vgGetPosVec( pospart1, *x1, *y1, *z1, *h1, *p1, *r1);
// enactment the pitching azimuth of radar antenna
vgSetPosVec( pospart1, *x1, *y1, *z1, *h1, *p1, *r1);
```

## 4.3. Coordinate Transformation

Vega coordinate system and OpenGL coordinate system is different, although both are right hand coordinate system, but the z axis in OpenGL coordinate system verticals screen and points out the outside ,but the z axis in Vega coordinate system is vertical and points out the upside.

In callback function, want to use the OpenGL drawings in Vega scene, firstly must to save the current state of the display, then use OpenGL function drawing scene in the Vega coordinate system. In the rendering process to make Vega already available in the 3D scene and with OpenGL painted scenes

completely is an organic whole, must take the OpenGL coordinate system and Vega coordinate system, the complete reunification need through a series of transformations, the transformation process Fig.3 shows.

If redefining its projection transformation, we must obtain Viewing Volume types and the corresponding parameters in Vega channel module, then apply it to the OpenGL projection transformation to ensure that its view volume is exactly the same. when visual areas transforming, we also must get actual visual areas size of Vega, then set up OpenGL visual areas according to gained parameters, and observers must also be set up in the same position, otherwise will not be blended perfectly.

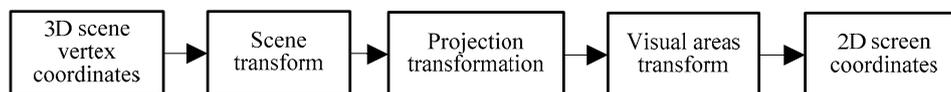


Fig. 3: Coordinate transformation.

## 5. Conclusion

Vega3.7, VC++6.0, Creator2.5 are adopted as instrument, hardware is CPU Pentium4, 2G memory Geforce FX5200(512M display memory) graphics display card, differentiate rate 1024\*768, refresh frequency above 85Hz, software environment Windows XP system. Fig 2 shows simulation training picture, top left of which is aiming mirror scene, top right of which is 3D terrain scene and radar scene; bottom of which realize the pitching and azimuth control by control panel.

The simulation system for artillery radar can train the operator in doors including of field reconnaissance and position selection. At the same time, the training score can be evaluated quantificationally. The system possesses so many merits such as simulation reality, design in reason and function all ready, it can be avail of equipment training and hold large benefits of military and economic.

## 6. References

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