Mathematics

ZhangXiang
13211144
ZSD university

Abstract

The mathematical game will have access to are: trigonometry, calculus, physics, algebra, statistics.

At the time of learning 3 d game programming, for the basis of the mathematical knowledge needed to have:

Vector, matrix, quaternion, ray, plane, polygons, simple physics.

1.Introduction

1, the vector

Vector is the most basic object involved in the game development, vector has a variety of forms, can be 2 d, 3 d or 4 d, etc. 3 d vector is a structure containing three floating point Numbers, and the value of the each member represents different axis vector, x, y, z axis, is used to describe the three dimensional space. Vector can also be used to describe the direction in 3 d space, it is probably the most commonly used mathematical objects in 3 d programming.

2, matrix

Matrix is the second most commonly used mathematical objects in the game development. Matrix is mainly used for transfer vector from one coordinate system to another coordinate system, can also be used for rotation and translation, etc. Matrix is composed of a 2 d array of floating-point Numbers. 3 x3 matrix with three rows 3 columns, a total of nine elements, 4 x4 matrix is

composed of four row 4 column, a total of 16 floating element of a 2 d array. The most commonly used have 3 x3, 3 x4, 4 x4 matrix.

3, quad

Quad is used to describe rotation. Quad oil four floating-point w, x, y, z structure, like a 4 d vector. Although the matrix can also be used to spin, but using quad is better, because only four quad floating point Numbers, and the matrix has 16 floating-point Numbers (for 4 x4 matrix). This means that the storage memory space needed for the quad less than the required memory space to store matrix, quad mathematical operation also less, which makes the quad calculations faster. In dealing with a rotating, quad also more smooth than matrix.

4, ray

Ray is used to describe the position and direction. Ray has the origin, that is ray's starting position, direction is where ray point. Ray contains two vectors, a representative position, the direction of a representative. Usually, ray is used for collision detection.

5, plane

Plane is on the regional unlimited extension of the grid. Can be flat as along the ground surface of unlimited extension. Infinite plane narrow, and there is no boundary.

6, polygons,

Polygon is a closed area, it has a boundary, and the size is limited. At various points such as 3 connected constitute 3 jumpers, and 3 points 3 lines form a three angular. This is a computer image of the most basic polygon.

7, physics

In the game is the most basic of gravity and collisions. But this is only the tip of the iceberg of physics.

2.Vector and its operation

Vector can also be called Vector, Vector, English name can be expressed in the 3 d coordinates of the position or direction. Vector is different from scalar, scalar only said size, while vector that has magnitude and direction. Detailed in 3 d graphics, vector can represent the velocity and acceleration of the particles and the direction of both size and direction of light.

Vector math:

1, the length of the vector and normalized

Often encounter a problem when using vector is calculated the length of a vector. The length of the vector is also known as Norm Norm in math. Said from the geometry, the length of the vector from the origin of the vector to the vector at the end of the distance. To compute the a vector of length, application of the formulas:

I.e., vector V mode (the length of the vector V) | V | = SQRT (v.x ^ 2 + v.y ^ 2 + v.z ^ 2)

After know the length of the vector, can on the normalized (normalize) processing, normalization of both vector to zoom in, make its length is 1.0, and the direction remains the same. On a vector normalization, can use the following formula:

Both: v = v/v | |

2, the vector dot product

If learned linear algebra, heard of the concept of vector dot product and cross products, called the dot product and cross product here. Two vector dot product to get a number, get a vector cross product of two vectors.

The dot product is very useful, such as light is used in the calculation of the operation, the algorithm can be expressed in the following formula:

U, v = u.x, v.x + u.y 路 v.y + u.z v.z

Can be seen from the formula, the dot product is a vector of each component of the multiplication and addition, get a scalar. It can also be expressed in the following formula:

U, v = | u |, | | v, cos (theta)

Theta as the Angle between two vectors, it shows that the dot product also means that it is not only related to the length of the vector, is associated with the Angle of two vectors. If two vectors are perpendicular, their dot product must be 0. You can use the dot product whether two vectors are perpendicular (this is very important, especially in game programming is often used!)

Combination of two formulas can be found on any given two vector, can easily calculate the Angle between them, and the Angle formula is:

This is a very powerful tool, is also the basis of a lot of 3 d graphics algorithm. Here are the vector dot product with the Angle between the qualitative regularity, these laws are very useful:

If the Angle between the vectors u and v = 90 degrees (perpendicular), u, v = 0.

If the Angle between the vectors u and v > 90 degrees (obtuse Angle), the u, v < 0.

If the Angle between the vectors u and v < 90 degrees (sharp Angle), u, v > 0.

If the Angle between the vectors u and v (parallel) = 90 degrees, is u, v = | u | | v |.

The dot product can also be used for many other operations. In computer graphics and game programming, often should calculate a vector projection on another vector component size. Suppose you have a vector v, he represents a certain role in the game, the movement track, there is another vector u, he represents another role movement track. In many cases, it is necessary to know u in v directions component (Projv (u)), then you can use the dot product to complete this operation.

In general, the calculation on u v projection vector formula is as follows:

In particular, if v is a unit vector, the formula can be simplified as:

The dot product meet the commutative law, both:

U, v = v, u

3. The cross product vector

Another vector multiplication is the cross product. Cross product of two vectors is the third vector, the vector with the original two vector angles, their size are defined as follows (cross-product symbols defined as x) :

| | = | u * v u | v | | * * sin (theta)

The sin (theta) into two sine value of vector Angle. To calculate the size of the cross product of two vector, can establish the matrix:

Where n = (v, u so:

N.x = v.y v.z - u.z u.y * *

N.y. = - (v.z - u.z u.x * * v.x)

N.z = v.x v.y - u.y u.x * *

Have said before, in front of the cross product of two vectors to get the vector with the original vector are vertical, it is very useful when calculating the surface normal vector.

Note that the cross product does not meet the commutative law, but the result of the switching sequence is just change the symbol of the cross product results, namely:

U * u v = v

4.Conclusion

3 d game mathematics is an art. He is an important part of the game.

Acknowledgements

Thanks to my classmates helped me.

References

· http://blog.csdn.net/asd237241291/article/details/8515713