Christian Lascsak

Task2

There are three types of Orientation. The combination of orientation and location describe the position of an object in space.

Euler angles

One axis is fixed, while the other two are being changed. This means, that the fixed axis is the one the object rotates around.

Two rotations can also be summed up by one rotation. To do this, a rotation vector has to be calculated, which represents the axis around which the object rotates.

This is a complicated calculation when not using matrices.

It is very easy for humans to read and understand and every rotation can be described as a sequence of euler-angle rotations.

Problem: Gimbal Lock.

Axis Angle

Rotation around a vector, which defines the axis of a rotation, and a scalar which is the angle of the rotation. The vector has to be normalized, so its length is 1.

Because the point gets rotated around a vector, gimbal lock is avoided.

Problem is, that it is not readable by humans and needs lots of storage.

Quaternions

A concept which comes from complex numbers. When displaying complex numbers in polar coordinates, the exponent of “e” is actually the degree of a rotation, so we can use this to describe the orientation of an object.

Quaternions solves the issue of Euler’s angles, where an axis is locked during a rotation (gimbal lock problem). Therefor it is possible to rotate an Object around every axis at once, without fixing one in position.

It is rotating the point in the fourth dimension with the real part w of a complex number n = (w,x,y,z). The rotation is being made twice, because w has to be calculated back and forth, so it is in the end in the same state as before the rotation.

Its advantage, besides solving the gimbal lock, is that it does not use as much storage as the axis angle-pair method.