A mathematical approach is used to realize the intersection of a point by moving the sphere

At each step of the center point of the sphere, all points of the cloud are checked for intersection with the sphere. The specified ReferencePoint passes through each point of the cloud. The length between the center of the sphere and the current location of the ReferencePoint is calculated (according to formula 1), this length is compared with the value of the radius of the sphere, if the length is less, then the point is marked as deleted.

$$\text{length(vector)} = \sqrt{x^2 + y^2 + z^2} \quad (1)$$

The scalar product (according to formula 1) between the direction vector of the movement of the center of the sphere and the vector from the center of the sphere to the studied point is calculated before calculating the length to the point (Figure 1). This is implemented to reduce the number of calculations and checks.

$$\text{dot(A, B)} = A_X B_X + A_Y B_Y + A_Z B_Z (2)$$

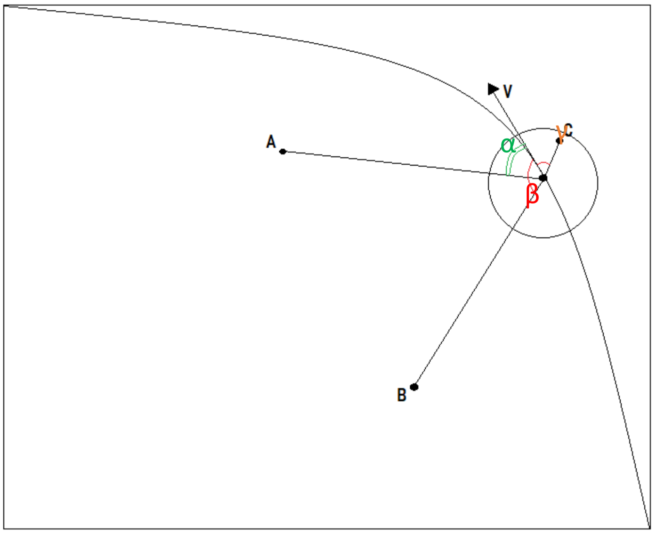

Figure 1. The position of the sphere at a certain time t, and the study of cloud points.

If the scalar product has a positive value (the angle has a value from 0° to 90°), then this point is considered a potential sphere for intersection. Such logic proceeds from the idea that a sphere cannot cross a point behind itself.

V – is the vector of movement of the center of the sphere at a certain moment t;

A, B, C – examples of researched cloud points;

α, β, γ – the angles between V and the vectors connecting the center of the sphere and A, B, C.

Overloaded operators of the class that describes a point3D are used to calculate the length of a vector and find the scalar product of vectors.

The function used to describe the movement of the center of the sphere

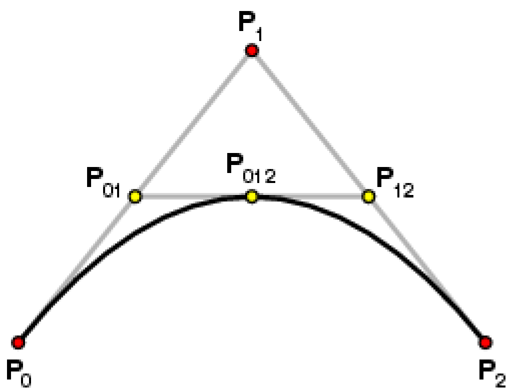

Figure 2. The process of finding the point of the Bezier curve

The quadratic form of the Bezier curve was used to specify the function of moving the center of the sphere. This method relies on the use of interpolation.

Three points P_0, P_1, P_2 are used in Figure 2. Vertices P_0, P_1 are gradually interpolated. As a result of vector interpolation between the received points, a curve point is obtained.

***Problems that may arise by using a discrete step* Δt**

In the proposed solution, the number of steps and, accordingly, the number of recalculations of the coordinates of the center of the sphere depend on the value of the Δt parameter. When the Δt parameter increases, the number of steps decreases, while the accuracy and smoothness of the object's movement are noticeably lost. The analysis of the intersection of cloud points with a sphere also deteriorates. But the decrease of the parameter Δt also leads to negative consequences, namely, an increase in iterations and, accordingly, the time of execution of the task by the program. This value should be selected depending on the parameters of the objects and the desired accuracy of solving the task.