Test task

Given a 3-dimensional Euclidean point cloud aligned on the principal axes (x, y, z) and with a constant grid of distances (Figure 1), starting from a given reference point (the point with indices 0, 0, 0 is located at the reference point with indices 0, 0, 0, 0) is intersected by moving the sphere (Figure 2), where the trajectory of the center of the sphere is determined by the user-defined formula $\vec{x} = f(t)$, where t is in the interval from t0 to t1 . The function f (t) can be processed as a discrete function with a user-defined Δt.

Points that intersect with the motion of the sphere are considered deleted (Fig. 3, middle). Only the first layer of points (which remains visible/not deleted) from the top view should be written to the data file (Figure 3 right). The file format is defined as follows:

- Each line contains one point.
- The point description contains x, y and z coordinates separated by spaces.
- Each line ends with a newline character.
- Create a small documentation (1 page with 2 figures) to present
  the mathematical approach to intersecting the points of motion of the sphere. It should clearly explain
  the mathematical approach and how the mathematical code is generated on its basis.
- Briefly, in 4-5 sentences, please discuss what problems may arise
  when using a discrete step Δt.
  Hints
- It is strongly recommended to use vector algebra (products of points,
  cross products, etc.). The use of sin and cos functions is not desirable.
- The motion of the sphere between f(t) and f(t + Δt) can be considered as a linear motion of the center of the
  of the sphere

Illustrations

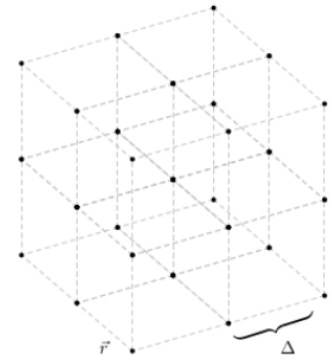

Figure 1: 3d point cloud defined by reference point $\vec{r}$ and point grid distance Δ.

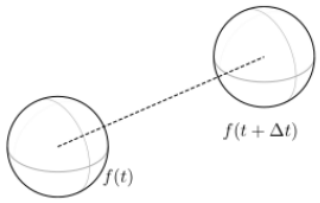

Figure 2: Linear move of a sphere with start point $f(t)$ and end point $f(t + \Delta t)$.

Figure 3: Left to right: complete point cloud, without deleted points, top skin of the point cloud.