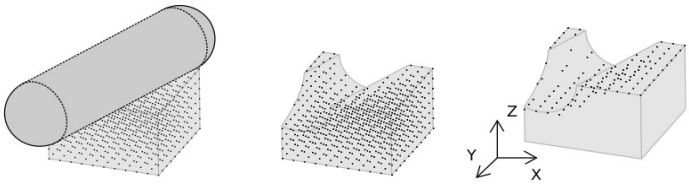
3D Point Cloud & a Moving Sphere – Brief Documentation

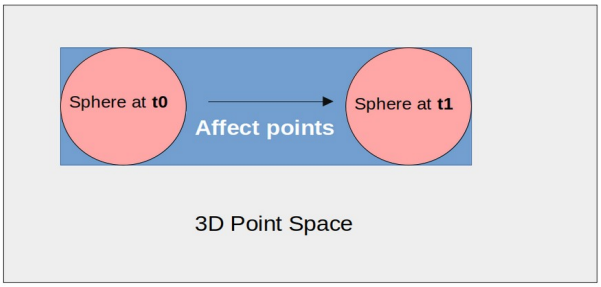
Problem Statement:

“Sphere Moves in straight path in 3D Point Cloud and intersecting points are considered removed”

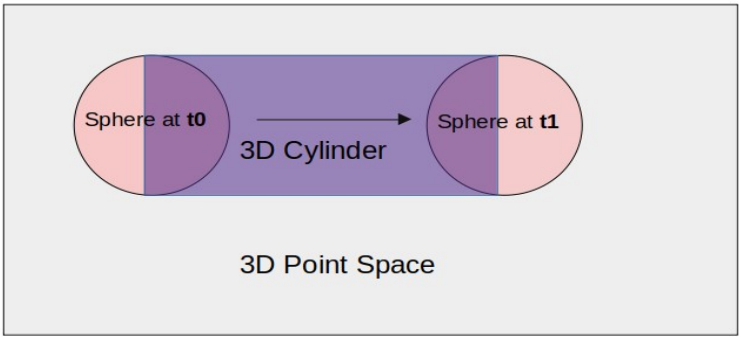


Solution:

1. Narrow down the points affected by the move of sphere, hence check only them if they lie in path:



2. Define path by sphere’s initial and final position as “**Initial Sphere**”, “**Final Sphere**” and “**3D Cylinder”** between the initial and final position:



3. Now check each point of “**Narrowed Down Range of Points**” whether they lie in:

Given:-

q = Position Vector of Point (x,y,z)

p1 = Position Vector of Center of Sphere at t0

p2 = Position Vector of Center of Sphere at t1

a) 3D cylinder

An `o(1)` method would be:

- Given a test point `q`, check that:

  $(\vec{q} - \vec{p_1}) \cdot (\vec{p_2} - \vec{p_1}) \geq 0$

  $(\vec{q} - \vec{p_2}) \cdot (\vec{p_2} - \vec{p_1}) \leq 0$

  This will confirm that `q` lies between the planes of the two circular facets of the cylinder.

- Next check that:

  $$\frac{|(\vec{q} - \vec{p_1}) \times (\vec{p_2} - \vec{p_1})|}{|\vec{p_2} - \vec{p_1}|} \leq r$$

  This will confirm that `q` lies inside the curved surface of the cylinder.

Where:-

i. Conditional Equation involving Dot Products are used to check whether point lies within circular facets

ii. Conditional Equation involving Cross Product checks perpendicular distance from Axis of Cylinder

b) Sphere at t0

|q-p1| <= r

c) Sphere at t1

|q-p2| <= r

4. Consider Detected Points as removed:

- Set 3D Point Cloud represented by 3D Vector value at (x,y,z) equal to 1

5. Write to **test.asc** by writing the points index (x,y,z) for each Z level starting from top-z that are not equal to 1. Keep doing until all (x,y) are covered. Final output by **test.asc** is something like this: