TP RANGE SCANS TO MESHES

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The goal of this TP was to reconstruct and visualize a 3D model of a bunny from point cloud data using Delaunay triangulation and alpha shapes, and then export the resulting surface mesh to an STL file compatible with MeshLab.

1) Let's explain how we did it.
The code begins by loading a 3D point cloud from the *Bunny.xyz* file. Each line of the file represents a vertex with its X, Y, and Z coordinates. These points are stored in a numpy array of shape Nx3.
Then, using *scipy.spatial.Delaunay*, a volumetric triangulation is computed from the 3D points. This step constructs a mesh of tetrahedra that approximates the volume enclosed by the point cloud. To approximate the surface of the bunny rather than the full volume, an alpha shape approach is used. Thus, for each face of the tetrahedra, the radius of the circumcircle is calculated. Only the triangles with a circumscribed circle with a radius smaller than alpha = 0.008 are kept, as these are assumed to lie on the surface. We found the value of alpha empirically, by trying several and keeping the best one. The retained triangles are written to an STL file using a custom write_stl() function.

2) Results

- The final output is a lightweight surface mesh representing the shape of the bunny, suitable for 3D visualization.
- The STL file can be opened in MeshLab (picture below).
- The choice of alpha = 0.008 offered a good balance between detail and noise removal in the mesh. Smaller alpha values resulted in fewer triangles, the rabbit had holes, while larger alpha could retain too much interior structure, the shape of the rabbit was unrecognizable.