Computational topology - group project

Sensors

You are given a number of points on the sphere of radius 1. You should view them as sensors on the surface of the Earth. The sensors are used to gather data and form a sensor network with parameters r and R:

- each sensor gathers data from the surrounding area in the shape of a circle of radius R,
- each sensor can communicate with other sensors which are at most r away.

Project goal: Determine r and R, so that

- 1. numbers r and R are as small as possible (that would decrease the cost of sensors),
- 2. the sensor network is connected (i.e. the Vietoris-Rips graph is connected),
- 3. the sensor network covers the whole sphere (the Čech complex should be homotopy equivalent to the sphere, i.e. the Euler characteristic of the Čech complex should be that of a sphere).

Furthermore, once the parameters r and R are established, the program should return a list of obsolete sensors, i.e. sensors, whose removal would not change the desired properties 2. and 3. of the sensor network.

Data: The input data is a set of points on the sphere of radius 1.

Results: The result should be required parameter values r and R. Start with an estimate for r and R and keep optimizing the values. To generate the Čech complex you can use the MiniBall algorithm.

Data generator: You should also produce a distribution of 50 points on the sphere with parameters r and R as small as possible.