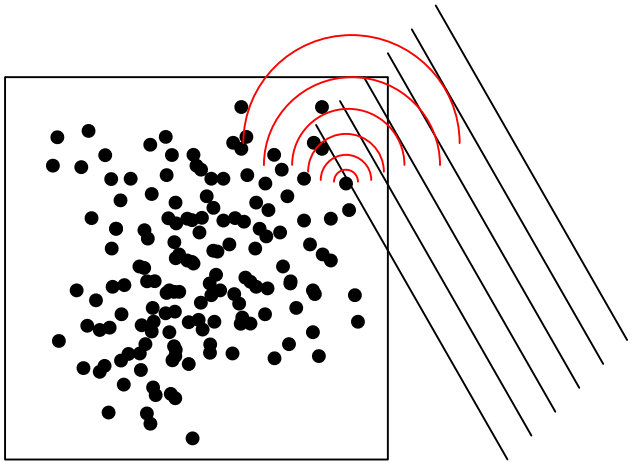
Industrial Liaison: Dr. Derek Kane, DEKA Research and Development

Original question

We have tomographic data in the region surrounding a tumor. Can you extract the volume occupied by the tumor?

Slightly deeper explanation

Many medical imaging systems illuminate a volume of interest and locate the position of scattering elements within the volume.



This system provides samples a space by randomly sampling points that are located within the volume.

1. Given a randomly selected set of points from a volume, how can we determine the surface enclosing the volume assuming that the points are equally likely to occur anywhere within the volume?
2. In most cases the strength of the sampling beam decays as it passes through the volume, typically $S(x) = A \cdot e^{-\alpha x}$, where α is a positive, real number. Does the methodology of determining the surface change when you are more likely to detect elements of the volume which are nearer to the surface?
3. It is often the case that there is not a clear distinction between the volume of interest and the material enclosing it. It is then necessary to distinguish between regions with varying density of scattering sites. Is it possible to create isosurfaces representing the density distribution of the samples?
    a. Is there a straightforward relation between the number of samples required and the density differences that can be resolved?
4. Are there limitations on the types of volumes that can be resolved, i.e., can cusps or voids be determined?