Finding Your Center in AFNI and MRIcroGL: Methods for Better Representative Coordinates

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Center of Mass - CM

Traditional and problematic

Average of locations in x, y, z, and can be weighted by a dataset; AKA centroid, center of gravity, etc. Can be outside the ROI/cluster for crescents, rings.

We want these qualities for a center:

- "central" in view
- "representative" of region - reproducible in FMRI
- surrounded by region (deep within the region)

Internal Center - Icent

One of the simplest ways is to find the voxel in a region that is closest to the CM. This method is fast with a center that reverts to the CM if inside the region. Unfortunately, in many cases such as a crescent-shaped ROI, the CM lies, rather unsatisfyingly, on the edge of the region.

Distance Center - Dcent

Rather than measure distance to the CM location, another method starts by finding the distance of every voxel to every other voxel in the region. We find the element with the minimum average distance to all other voxels. Much more computationally expensive, it produces a central voxel, and the idea can be easily applied to the nodes of a surface too. However, this may still lie on the edge of a region. (In the example, it is very close to b, the Icent)

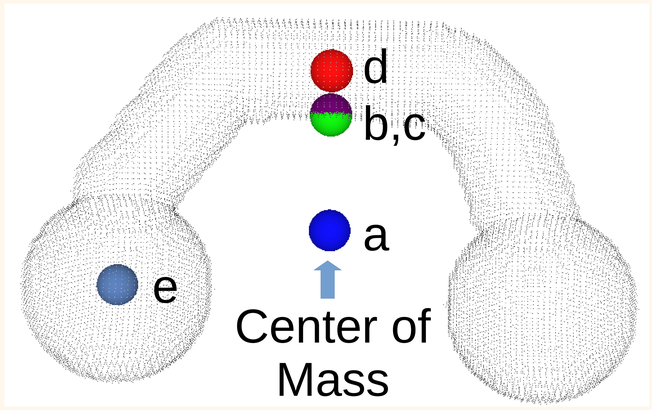
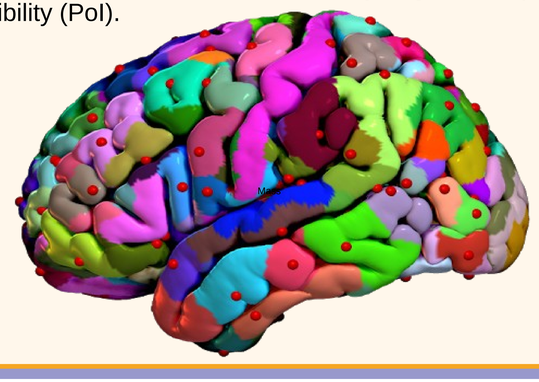


Figure 1. Several centers were computed from a challenging 3D shape that resembles an angled barbell: in this example, it has a bent "bar" of 8mm radius for the middle portion and spheres of 16 mm radius on each end. The actual Center of Mass (CM), 'a', is clearly not in the volume. The closest ROI voxel to the CM, ICent, is shown as b, just on the edge of the volume. The Distance Center, c, is at the same spot. The Deepish Center 'd' is within half the thickness distance of b. The Deepest Center 'e' is one of the deepest voxels and the closest to the CM.

Figure 2. results are shown in Surfice for the central nodes of a surface parcellation by region. Here the central node is determined by finding the node that is farthest from any edge as the poles of inaccessibility (PoI).



Deepish Center

The deepest location near (within half the thickness) of the ICent gives a result both close to the CM and "deep".

Deepest Center / Pole of Isolation (PoI)

A center should be "deep" within the object. We find deeper locations in regions that are close to the CM. By first finding the deepest layers and then finding the voxel closest to the CM from among that set, the resulting central points appear to be both useful and robust (i.e., stable to deformations, such as if thresholds were adjusted).

Distance and Depth

Simple definitions based on erosion or distance fields [Felszenwalb, 2012; Rideout, 2018].

Software - AFNI, SurfIce, MRIcroGL

Depth3D, 3dCM, @measure_erosion_thick, 3dClusterize, @Atlasize

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