Draft version March 8, 2019

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Typeset using LaTeX **preprint** style in AASTeX62

Weekly Activity Report
Week 4
Tagging voids using the Random Point Algorithm and the 1-Skeleton

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ABSTRACT

A kind of "Volume Function" is plotted. Installing libraries on the Uniandes HPC.

1. A KIND OF VOLUME FUNCTION

The algorithm ran again over the 3N:N dataset, (by mistake it has run over the 2N:N dataset) (fig **??**). A huge void is detected in the 2N:N dataset, this void is a big patch over the sphere's surface. It was suposed to be related to a percolation phenomenom in the 1-Skeleton formation, due the higher density, random-random point conections on the surface, where voids are trunked.

It was proposed to run the algorithm again, but having a slightly diminished radius for the Random Points Catalog ($R_{\rm rnd} = 0.95 R_{\rm obs}$).

For the record, running times of the β-Skeleton library on a sphericall distribution, along to the number of detected voids.

A kind of volume function was calculated asuming that the volume of the void is directly proportional to the number of particles. Then the void volume is compared to the total catalog volume in order to get a volume fraction having the same scale and allowing comparissons between the three datasets. (The straightforward interpretation is particle fraction instead volume fraction). In the figure **??** the volume fraction function is shown. Is early to make conclusions, due to frontier effects.

The outer voids are connected by the algorithm. A proposed solution is to create a random point catalog slightly smaller (in volume) than the observed catalog. Those detected outer voids will be trunked, they must be deprecated on the statistics at that time.

Is not possible to make a good estimation using only three points, but seems interesting that the higher number of detected voids was achived with the ratio 2:1. Another intriguing area is the low volume voids regimen. Is there a sweet spot in the ratio that maximises the number of small voids? Few runnings more are necessary.

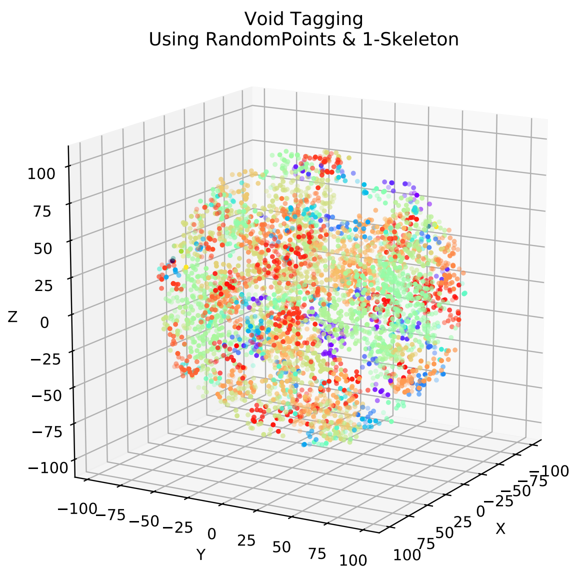
Table 1. Running Time of NGL β-Skeleton

Number of Particles	Time (s)	Detected Voids
5000	35	n.a.
10000	189	n.a.
20000	1717	142
30000	5871	165
40000	14259	163

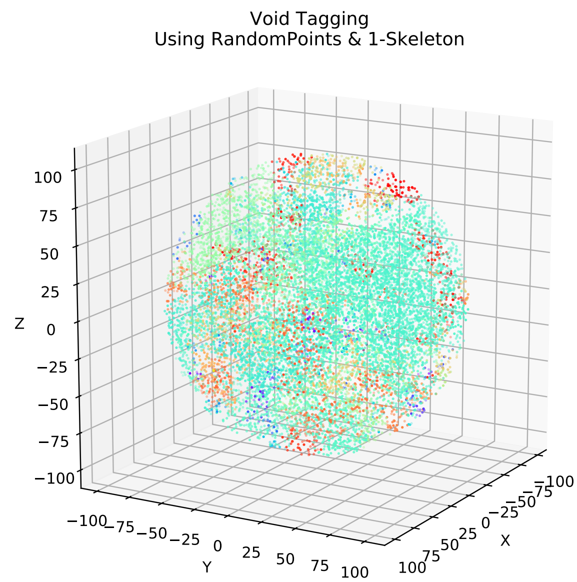
NOTE—Running on my laptop: Acer Aspire 4750 (Core i5 2nd gen.). The first two runs where in order to measure running time.

2. TO DO:

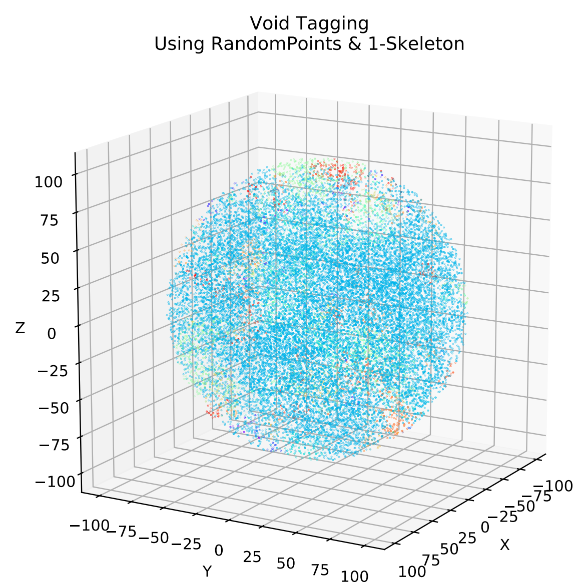
- Change the shape of the Random Points Catalog (maybe outer voids are connected by mistake) taking a sphere of radius $R_{\rm rnd} = 0.95R_{\rm obs}$
- Run using other number of random particles.
- Think about how to calculate volume (not just particle number times density).
- Calculate Intertia Tensor and find eigen-values.



(a)



(b)



(c)

Figure 1. Tagging Abacus-Cosmos Voids. This is the first test over "real" data, not a toy model. The LSS shows highly dense packed halos, where voids have almost none of them. The idea is to increase the ratio of Random Points over Catalog points to study (in later weeks) how void detection can be affected. (a) Ratio 1:1 detected 142 voids, (b) ratio 2:1 detected 165 voids and (c) ratio 3:1 detected 163 voids. The catalog is a spherical set of points, with radius 100Mpc/h, N halos = 9981, N random points = 10000 (a), 2N (b) and 3N (c).

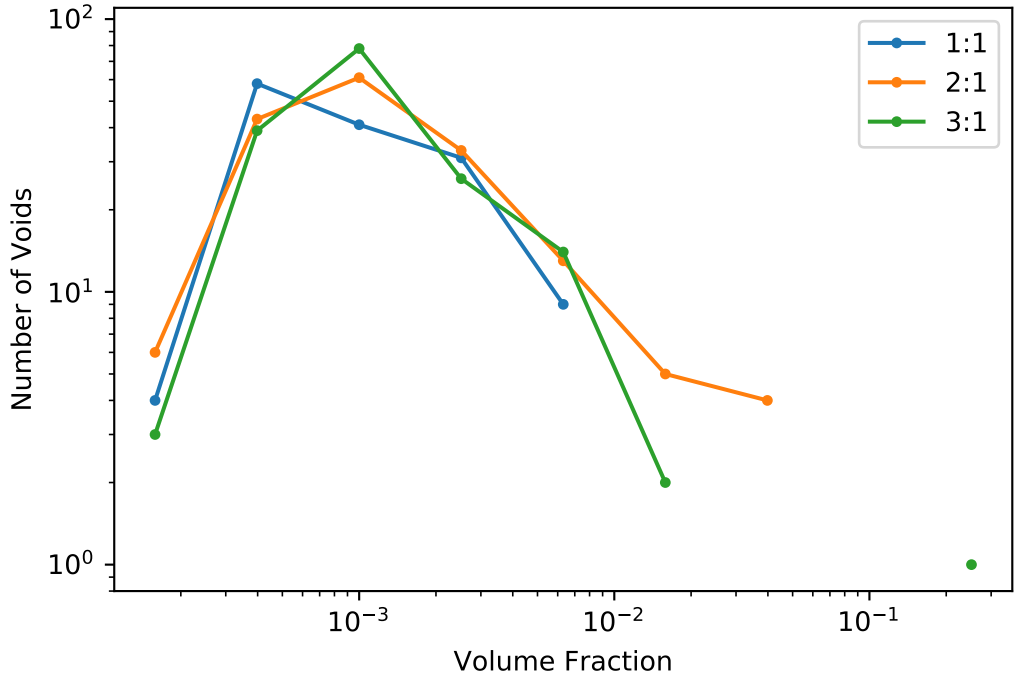


Figure 2. A kind of Volume Function. The volume fraction is calculated as the particle number in the halo over the total Random Points in the catalog. The percolaton over the frontier can be seen as four big voids (2:1 in orange) (around the 4% each one), and one huge void (3:1 green) that occupies almost the 20% of the total volume.