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Weekly Activity Report
Week 6
The Xiao-Dong Li's β-Skeleton Finder

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ABSTRACT

Xiao-Dong Li developed a series of codes to run over LSS data. I used part of the code available from his repo at github. The code was installed at the Magnus Cluster.

1. LSS CODES

Xiao-Dong Li cerated in 2015 a big Fortran90 library whith tools to study the LSS. The β-Skeleton finder is part of the library, as well two and three point correlation functions, redshift corrections, lightcone generators and some statistical tools to run over mocks.

This library was created using the ifort compiler (Intel-Fortran). This is privative software, not available at the Magnus Cluster (the Uniandes HPC facility). Ifort has been developed to run 5-10 times faster than gfortran over Intel-Xeon processores.

During the installation over the Magnus Cluster some errors rise. It was necessary to modify the original code to compile using gfortran.

This fortran code runs in the cluster near to $\sim 100 - 1000$ times faster than the NGL library on my laptop. XDL code divides the space in cells to search closest neighbours instead searching over the whole set of points. This search has the parameter "neighbours" to reduce the number of close points to make the search. The code can switch between exact and non-exact calculaton of nearest neighbours for the β-skeleton graph. It gives some differences in the final graph.

In the table **??** is possible to see how an threshold value of the neighbour parameter gives different running times and number of connections. The author suggests a value around 100 neighbours to make calculations for the fixed value $\beta = 1$. But with valuse from 200 neighbours and above the final β-graph is identical. The files marked with asterisks where checked with the md5sum algorithm.

The output file from booth algorithms differs. NGL shows the full list of connections for each one of the N points. It means that each connection is counted a twice. E.g. If the points 15 and 99 are connected, in the output file appears (15,99) and (99,15). XDL avoids to count repeated pairs, following the example, only (15,99) will appear on the output file. It gives a different size of output files.

2. COMPARING NGL AND XDL β-GRAPHS

A mandatory check when a novel method is implemented is to compare against previous methods and results. I was focused on the 2N:N dataset (N = 9998 observed points from Abacus Simulations), having a total number of points of ~ 30000.

Setting the shearching parameter in 100 neighbours throws the same number of connections as in XDL as in NGL graphs. But a detailed search shows that there are four points missmatching: one pair connection that appears on NGL but not in XDL (indices 1878-13682) and another extra connection on XDL missing in NGL (indices 6765-12474).

Setting the searching parameter in 200 and above throws one extra connection in the XDL graph respect to the NGL graph. (Is the same connection of indices 6752-12474). It means one extra connection in 110225. Plotting the data it seems a legal one (figure **??**).

Table 1. Running Time of β-Skeleton using NGL and XDL libraries.

Number	NGL		Xiao-Dong Li's Library		
Particles	Time (s)	Connections	Time (s)	Neighbours	Connections
20000	1717	139504	1.4	50	69427
			2.4	100	69749
			6.4	300	69752
			11	600	69752
			21	1000	69752
30000	5871	220448	1.8	50	109950
			3.9	100	110224
			5.5	200	110225*
			10	300	110225*
			18	600	110225*
			32	1000	110225*
40000	14259	299912	3.1	50	149666
			5.4	100	149954
			13	300	149957
			26	600	149957
			37	1000	149957

NOTE—* β-graph files have identical md5sums. NGL returns the list of connections for each particle, the pairs (15, 99) and (99,15) appear in the catalog. XDL returns only unique connections, it means that in the output file has the half of the length, then, for example, only (15,99) appears in the output file to avoid repetitions.

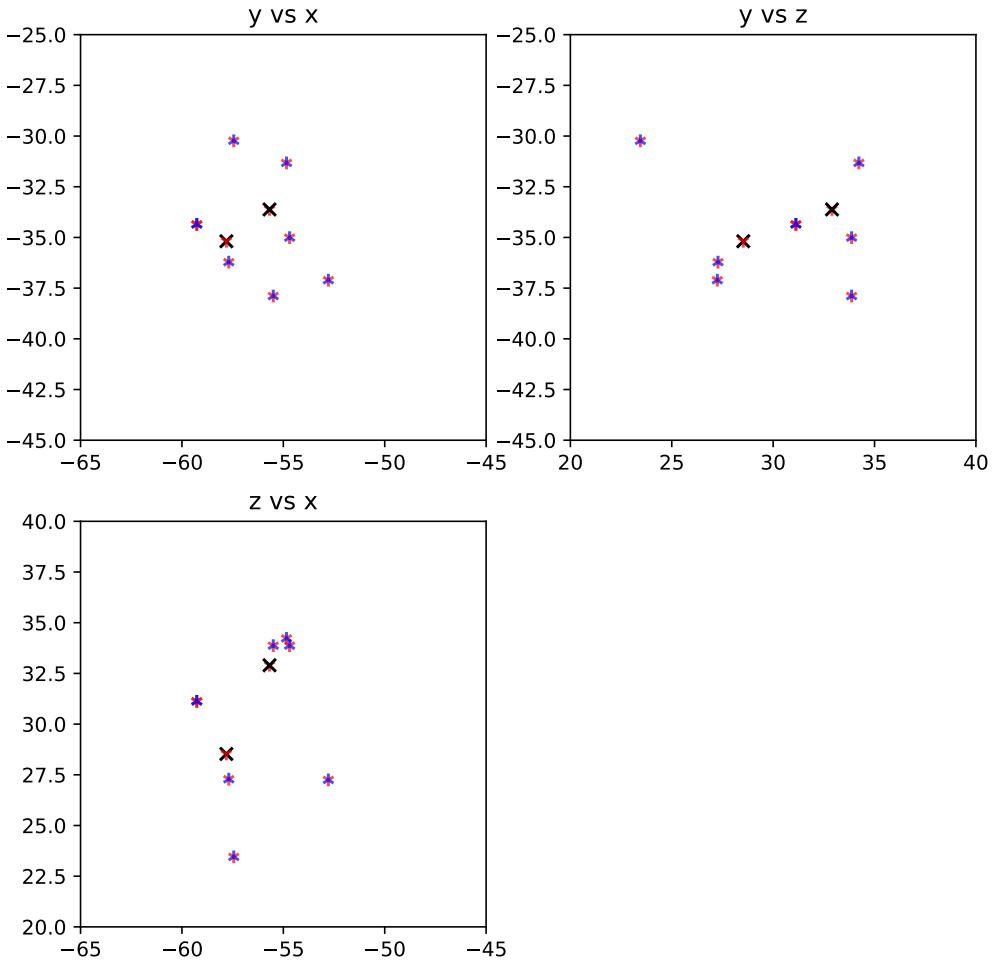

Figure 1. Black crosses shows the new pair of points connected with the XDL graph finder. This is the unique difference with the NGL graph finder.

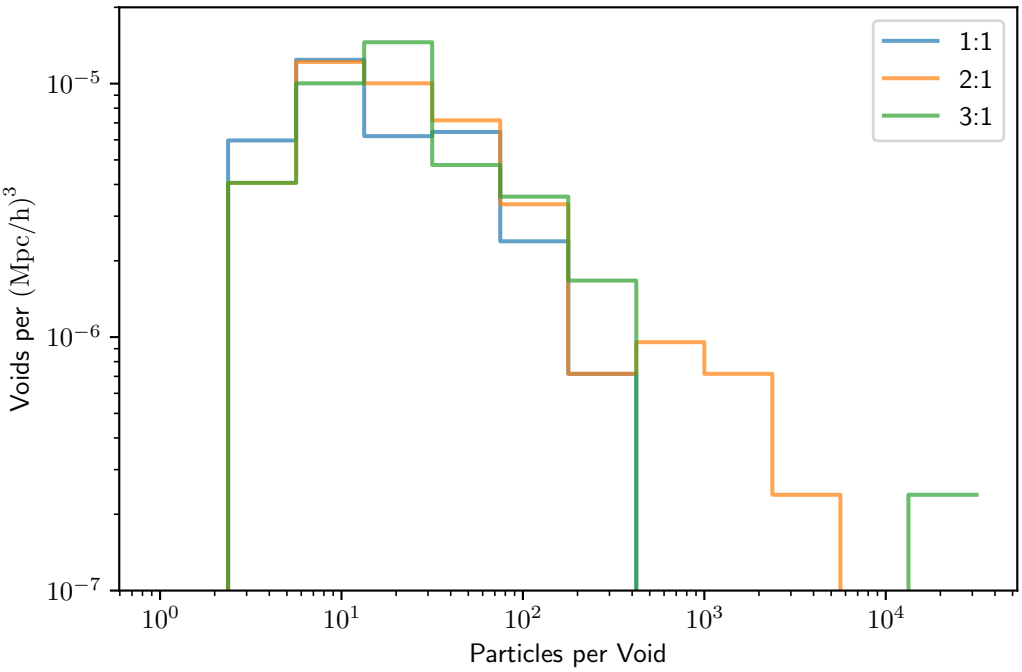

Figure 2. The void density function. It is normalized to the volume of the catalog (a sphere of radius $R = 100\mathrm{Mpc/h}$).

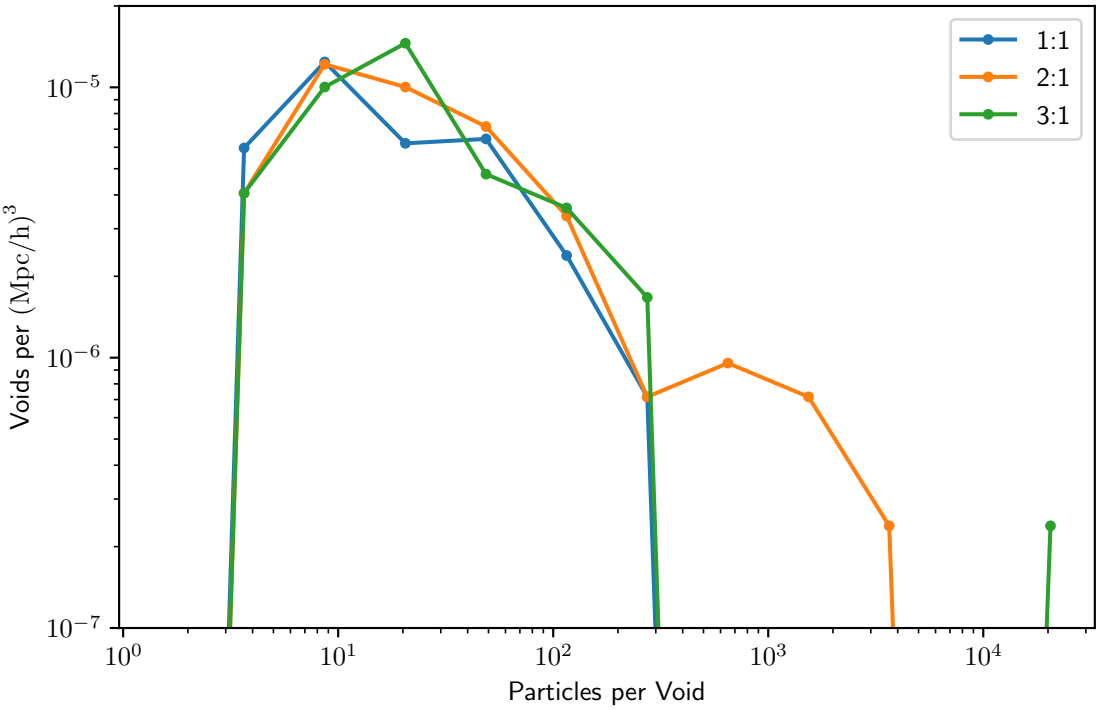

Figure 3. The void density function. It is normalized to the volume of the catalog (a sphere of radius $R = 100\mathrm{Mpc/h}$).