Interoffice

SGP MEMO NO. 8A

National Radio Astronomy Observatory

Very Large Array

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To: G. Hunt

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Subject: Grider Timing

The following tables give some indication of the timing of the Grider System. The headings are:

SETUP: Start program, scan index records, gain tables, type out some data on terminal.

GRFT1: Feed data into AP, correct for gain, grid, do first phase FFT, pass data to Transpose memory.

FT2: Read data from Transpose memory, do second phase FFT, read data from AP onto disk.

REFORM: Reformat data on disk from scaled per line to scaled per map on disk.

SIZE: LxM pixel size of Fourier tranformed map.

Re input data were 2-continuum, old visibility data. For all cases the data were sorted for the first run of the program. The sorting times are:

82 sec for 18643 visibility records.
49 sec for 9328 visibility records.

Table 1.

The data consists of 18643 visibilities. For all maps an area of the U, V plane of about 130 x 130 cells contained data. Natural weight of data, 1 * 1 box cconvolution. The data was sorted by the program once. Times in seconds.

Size	Setup	GRFTI	FT2	Subtotal	Reform	Total
256x256	10 sec	21 sec	9 sec	40 sec	11 sec	51 sec
512x512	9 sec	20 sec	23 sec	53 sec	18 sec	71 sec
1024x1024	11 sec	21 sec	65 sec	97 sec	52 sec	149 sec
2048x2048	10 sec	20 sec	220 sec	250 sec	189 sec	439 sec
4096x4096	10 sec	21 sec	864 sec	895 sec	1160 sec	2055 sec
8192x8192	10 sec	25 sec	3473 sec	3508 sec	Disk too Small	

Uniform weighting with 1x1 box weighting:

256x256	10	35	9	54	11	65

Using only 9328 visibilitis; natural weighting:

256x256	10	14	10	34	11	45

Using convolution of size y*y:

y=1 256x256	10	20	10	40	11	51
y=2 256x286	10	21	9	40	11	51
y=4 256x256	10	20	10	40	11	51
y=8 256x256	10	21	9	40	11	51

Using different filling of the U, V-Plane; width given as UxV

						TM Use	
U,V=135x135	2048x2048	10	20	220	250	189	439	256k
500x500	2048x2048	10	24	220	254	189	443	1024k
1000x1000	2048x2048	10	31	221	262	189	451	2048k
2000x2000	2048x2048	10	53	220	283	189	472	4096k
125x2000	2048x2048	10	20	220	250	189	435	4096k
2000x125	2048x2048	10	52	222	284	189	473	4096k

Influence of output size:

Size=1024	1024x1024	11	21	65	97	52	149
768	1024x1024	10	20	37	67	39	106
512	1024x1024	10	20	23	53	18	71

From the tables it is clear that the I10 I/O operations between disk and AP take the most time.

a. Visibilities:

Gridding time: 7+.00075 NVIS sec. - natural weight.
7+.0015 NVIS sec. - uniform weight.

Resulting in:

	Natural NVIS/sec	Uniform NVIS/sec	/Real time (natural) (10sec integration)	Uniform
2-IF continuum	1330	665	35	18
4-IF continuum	885	443	23	12
32-channel line	156	78	4	2
64-channel line	81	40	2	1
128-channel line	41	20	1.1	0.5
256-channel line	21	10	0.6	0.3

The above rate is about 38 kbytes/sec and, since SORTER has to read the data from disk as well, representative for the SORTER/GRIDER system as

well. Improvement by a factor 2-3 is possible by increasing the buffer size, and the use of virtual arrays. The maximum throughput of the SORTER/GRIDER link (DA11-B) is 500≈kbaud (50 kbyte/sec).

b. Sorting.

Sorting is only a temporary measure for the old databases. The results are about .0041 sec per VIS record, or about 41 kbytes/sec I/O rate, and a 6.8 kbytes/sec sort rate, resulting in a real-time breakdown for a 10 sec integration time for 32 line channels. However, using 2 independent disk controllers the rate will be twice as high.

c. Gridding/First phase Fourier transform.

From the tables it can be seen that the actual work in the gridding and gain correction process is negligable compared to the I/O time. The second phase of the Fourier transform depends on the filling of the U,V-plane and on the use of the transpose memory. The TM time seems to be a bit better than the earlier estimate of 15 microsec. For a filled U,V-plane I expect about 20 sec of actual AP time for a 2048 square map. Hence, the 52 sec in the table are largely due to the TM timing. I estimate an output rate of about 10 microsec/word at the moment. Improvement by a factor 2-3 will make the transfer time equal to the actual AP time.

d. Second phase FT.

This part is fully dominated by the transfer of data from AP to disk.

The rate is about 41 kbytes/sec. Again, increased throughput for the larger maps is possible with the use of virtual arrays.

A factor of 2 seems feasable this way. In the case of 3 Array Processors running, the actual time spent in doing the second phase will overlap with the gridding/first phase FT. The time spent in both processes will be about equal for a 2048/2048 map if there are about 15000 visibilities for uniform weighting, or 300000 for natural weighting, or reps. 66 and 132 minutes of observing at 10 sec integration time, 2-IF continuum. Note, however, that the output size is the determing factor. A 4k map of which only the central quart is used (aliasing!) takes the same time as a full 2k map.

Output to tape will be faster. Using the same size buffers as currently in the program, output to a 6250 bpi, 120 ips tape unit will reach about 120 kbytes/sec. However, since all I/O is on the unibus, interference will probably lower this number. (In effect a SORTER/GRIDER system with tape in the present set-up will run: 76+240=320 libytes/sec, however, the peak tape rate is 780 kbytes/sec, close to the unibus - maximum of 1.2 M bytes/sec).

e. Reformating