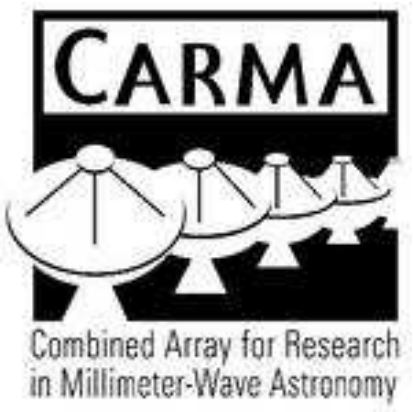

CARMA Memorandum Series #23

Lots in Translation: A Revised Center Location for the CARMA C/D/E Arrays

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ABSTRACT

The inclusion of buildings, roads and updated regions of the site that need to be avoided have resulted in a re-evaluation of the original locations of the antenna pads. We have taken advantage of the nearly decoupled nature of the original A/B and C/D/E arrays to propose a small translation of the inner three arrays to optimize the use of the flattest part of the site. By moving the C/D/E arrays 72 meters to the south, and 35 meters to the west, we avoid both unsuitable areas and geographic obstacles such as the north-south gully. With this move, it is now possible to share 2 pads between the B array and the lower resolution arrays (an improvement of one over the original design). We present the new locations and discuss any changes that needed to be made and the negligible performance costs of each change. A cool photo tour of the C-array can be seen at http://www.astro.umd.edu/~petitpas/carma/site_photos/2004array/

1. Introduction

The first site proofing studies focused primarily on the A and B array pads that lie furthest from the array center. These were originally chosen to avoid geographic obstacles and unsuitable areas. The more compact arrays were roughly checked, but were not studied on a pad to pad basis. The assumption was that there should be no problem fitting those on the flat part, and that fine tuning could be done before ground-breaking to ensure everything fit properly.

The original center resulted in a C-array pad that was uncomfortably close to an unsuitable area, and some that were pretty close to the major gully. It is feared that the banks of this gully may not have soil stable enough to support an antenna pad.

Since the original array had only one pad shared between the A/B and C/D/E arrays, it was decided to decouple them completely and shift the C/D/E/ array center to fix the problems mentioned above.

2. The C/D/E Array Move

Upon close investigation of the perimeter C array pads showed the northwestern pad was too close to an extended unsuitable region. The original data presented to Helfer & Wright (2004), Helfer (2004) and Petitpas & Mundy (2003) marked this area as a point, thus it was not satisfactorily avoided.

The best result is a total net translation of 72 meters south, and 35 meters west. The new pad locations for all changes recommended in this document as well as the changes recommended by Triad for A and B arrays are given in Table 1. The perimeter C array pads are shown in Figure 1. Note only the perimeter ones are shown for clarity, and all pads interior to these lie safely away from unsuitable areas.

Additionally, the control building (see Figure 1) needed to be placed between the array and the Loop Road. There is one pad (Pad 42) that lies too close to the control building, and it needed to be manually moved also.

Pad 42 vs. Control Building:
One C-array pad (labelled 42 in Figure 1) needed to be pushed east by 5 meters to ensure it is clear of the control building, The added advantage of this is that it also moves it out of the trees into the open with the rest of the C-array pads.

The net translation of the entire array obviously does not change the performance. However, the relative move of Pad 42 five meters east does introduce minor changes in performance, but not anything that could be detected in real world observing. For ease of comparison, the performance of the original C array (Helfer 2004) (Cori) compared to the performance with Pad 42 moved 5 meters west (Cctrl) is shown in Table 2. The plots of the beams are not shown since the difference

is not detectable in these plots. Instead, the plots of original and new UV-distances are shown in Figure 2.

Pads 44 and 45 vs. The Gully:
The translation of the C/D/E center resulted in two pads lying within 5 meters of the gully (Pads 44 and 45). Depending on the soil stability, construction of these pads so close to the gully could prove to be problematic. Moving these 5 meters back from the bank results in the performance changes indicated in Table 2 and Figure 2. Again, no noticeable changes in the beam figures was seen, so these plots are not shown.

3. Sharing B Pads

Some slight ($\lesssim 10$ m) changes to B array pad location were recommended by Triad for constructions reasons were tested separately and shown to result in insignificant performance changes. The long baselines of B array makes it pretty robust against small changes in pad location (see Table 2).

Fortuitously, the new array center for C/D/E arrays leaves two B array pads within 10 meters of the C and E array pads. If we were to move B array pads 26 and 29 to lie on top of C pads 56 and 54 (respectively) we could save some money. These small moves make negligible change to the B array performance (see Table 2 and Figure 3).

4. Summary

The new C-array and B-array coordinates are presented in Table 1. These pad locations have been proven to be acceptable and thus the C/D/E arrays are ready to be built. If the soil is deemed to unstable near the two C array pads that lie within 5 meters of the bank, then it is shown that these can be moved up to 5 meters away from the bank with negligible performance costs. The relocation of the C/D/E array center allows the possibility of sharing two B array pads with existing C/D/E array pads.

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REFERENCES

Helfer, T., & Wright, M., 2004, CARMA Memo, 19

Helfer, T., 2004, CARMA Memo, 20

Petitpas, G. R., & Mundy, L. G., 2003, CARMA Memo, 15

Table 1. Pad Coordinates (Post Triad/Site Review)

Reg.	Easting	Northing	A	B	C	D	E	labels
11S	397512.90	4126053.80	X					01
11S	397622.00	4127073.00	X					02
11S	397864.00	4126840.00	X					03
11S	397919.23	4126269.64	X					04
11S	398178.00	4125607.00	X					05
11S	398398.47	4126246.82	X	X				07,21
11S	398419.43	4126529.88	X	X				06,22
11S	398489.55	4125400.09	X					09
11S	398530.91	4126346.93		X				30
11S	398551.48	4126887.54	X					10
11S	398581.17	4126502.14		X				27
11S	398590.00	4125734.63	X					12
11S	398593.60	4126624.61	X	X				11,19
11S	398614.72	4127070.39	X					08
11S	398644.69	4127005.10		X				20
11S	398647.74	4126424.69		X				23
11S	398650.25	4126222.69	X	X				13,18
11S	398664.02	4126304.00		X				25
11S	398718.10	4126579.98		X				24
11S	398721.38	4126764.99		X				28
11S	398733.99	4126422.69			X			42
11S	398767.05	4126504.20			X			41
11S	398772.62	4126279.27			X			44
11S	398773.57	4126363.27			X			43
11S	398786.32	4126176.43			X			45
11S	398808.47	4126548.55			X			40
11S	398813.82	4126402.40				X		57
11S	398819.58	4126390.25			X			33
11S	398828.95	4126434.79		X		X		26,56
11S	398829.17	4126345.41			X	X		35,59
11S	398831.54	4126378.79				X		58
11S	398838.59	4126304.54				X		60
11S	398843.96	4126405.24					X	74
11S	398845.40	4126452.41				X		55
11S	398851.10	4126272.65			X			39
11S	398853.17	4126389.14				X	X	48,67
11S	398853.63	4126371.69			X	X		31,50

Table 1—Continued

Reg.	Easting	Northing	A	B	C	D	E	labels
11S	398854.59	4126425.58					X	73
11S	398861.65	4126382.20				X	X	46,68
11S	398862.35	4126342.78		X	X	X		29,54,34
11S	398865.44	4126392.56					X	63
11S	398870.92	4126372.63				X	X	49,70
11S	398872.34	4126400.01					X	61
11S	398873.19	4126389.51			X	X	X	32,47,65
11S	398879.99	4126422.93					X	72
11S	398880.34	4126393.97					X	64
11S	398881.77	4126402.74					X	62
11S	398885.19	4126380.45					X	69
11S	398885.81	4126367.14					X	75
11S	398892.89	4126393.13					X	66
11S	398896.19	4126356.52				X		51
11S	398897.19	4126414.68					X	71
11S	398908.64	4126411.73				X		53
11S	398916.11	4126387.24				X		52
11S	398936.26	4126307.22			X			36
11S	398961.71	4126447.63			X			38
11S	398982.46	4126121.95	X	X				14,17
11S	398986.40	4126384.53			X			37
11S	399079.73	4126690.08	X	X				15,16

Table of antenna pad coordinates (in UTM, Nad27) for the antenna positions when Pad 42 avoids the control building and Pads 44, and 45 are moved 5 meters away from the gully. The "X"s indicate which pads correspond to which array. The final column is simply a list of pad numbers as stored on the OVRO GPS and various TOPO! files, and is simply 1-15 for A pads, 16-30 for B pads, 31-45 for C pads, 46-60 for D pads and 61-75 for E pads. Note that shared pads have up to 3 numbers assigned to them, one for each array for which they are used.

Table 2. Comparison between original arrays and tweaked arrays

Cfg	δ (°)	HA,inc (hrs)	σ (mJy)	$\theta_{\rm max} \times \theta_{\rm min}$ ($''$)	$\sigma_{\rm T_b}$ mK	SL rms (%)	max (%)	min (%)	Nvis (%)	uv min (m)	uv max (m)
Cori	30	-2,2,.01	0.23	0.90 x 0.75	7.9	2.0	4.4	-5.9	100	24.6	372.6
Cori	0	-2,2,.01	0.27	0.94 x 0.90	7.4	2.7	15.4	-6.9	100	18.3	322.8
Cori	-30	-2,2,.01	0.56	1.88 x 0.92	7.5	2.1	6.0	-6.2	100	10.2	279.3
Cctrl	30	-2,2,.01	0.23	0.90 x 0.75	7.9	2.0	4.9	-5.8	100	24.6	372.6
Cctrl	0	-2,2,.01	0.27	0.94 x 0.90	7.4	2.8	15.4	-6.9	100	18.3	322.8
Cctrl	-30	-2,2,.01	0.56	1.88 x 0.93	7.4	2.1	6.3	-6.1	100	10.2	279.3
Cguly	30	-2,2,.01	0.23	0.91 x 0.75	7.8	2.0	5.2	-6.0	100	24.6	372.6
Cguly	0	-2,2,.01	0.27	0.94 x 0.91	7.3	2.8	15.3	-6.9	100	18.3	324.0
Cguly	-30	-2,2,.01	0.56	1.89 x 0.93	7.4	2.1	5.5	-6.3	100	10.2	283.5
Bori	30	-2,2,.01	0.23	0.37 x 0.30	47.9	3.0	9.7	-6.7	100	81.6	942.6
Bori	0	-2,2,.01	0.27	0.38 x 0.37	44.4	3.3	15.4	-7.1	100	64.8	894.0
Bori	-30	-2,2,.01	0.56	0.75 x 0.38	45.4	2.9	6.7	-6.6	100	30.6	809.1
Bpt	30	-2,2,.01	0.23	0.37 x 0.30	47.9	3.2	8.7	-6.9	100	81.6	945.9
Bpt	0	-2,2,.01	0.27	0.38 x 0.37	44.4	3.7	20.6	-7.1	100	64.8	899.1
Bpt	-30	-2,2,.01	0.56	0.76 x 0.38	44.8	3.1	8.4	-6.6	100	30.6	809.1
Bshare	30	-2,2,.01	0.23	0.37 x 0.30	47.9	2.8	6.6	-6.6	100	82.5	943.5
Bshare	0	-2,2,.01	0.27	0.38 x 0.36	45.6	3.1	13.7	-7.1	100	65.4	894.9
Bshare	-30	-2,2,.01	0.56	0.75 x 0.38	45.4	2.8	7.3	-6.6	100	30.9	809.1

Comparison of beam properties for modified C and B arrays. "Cori" is the original C array performance. "Cctrl" is the original C array with one pad (Pad 42) moved 5 meters to avoid the control building. "Cguly" is the C array with the one pad moved to avoid the control building (pad 42) and two pads moved to avoid the gully (Pads 44 and 45) . "Bori" is the original B array. "Bpt" is the B array after the Triad recommendations (post-Triad), and "Bshare" is with two B array pads moved slightly to lay on top of existing C/D/E pads given their new locations (Pad 26 $\rightarrow$ 56, Pad 29 $\rightarrow$ 54) .

As in Helfer & Wright (2004), Column (1) is the array configuration; column (2) is the declination; column (3) is the LST range and step size of the observations; column (4) is the sensitivity (in mJy); column (5) beam size (in $''$); column (6) is the brightness temperature sensitivity (in mK). Columns (7),(8), and (9) are the side-lobe rms, max and min (respectively) over a $\sim 14 \times 14$ beam area. Column (10) is the percentage of unshadowed visibilities while columns (11) and (12) projected minimum and maximum baselines (in meters).

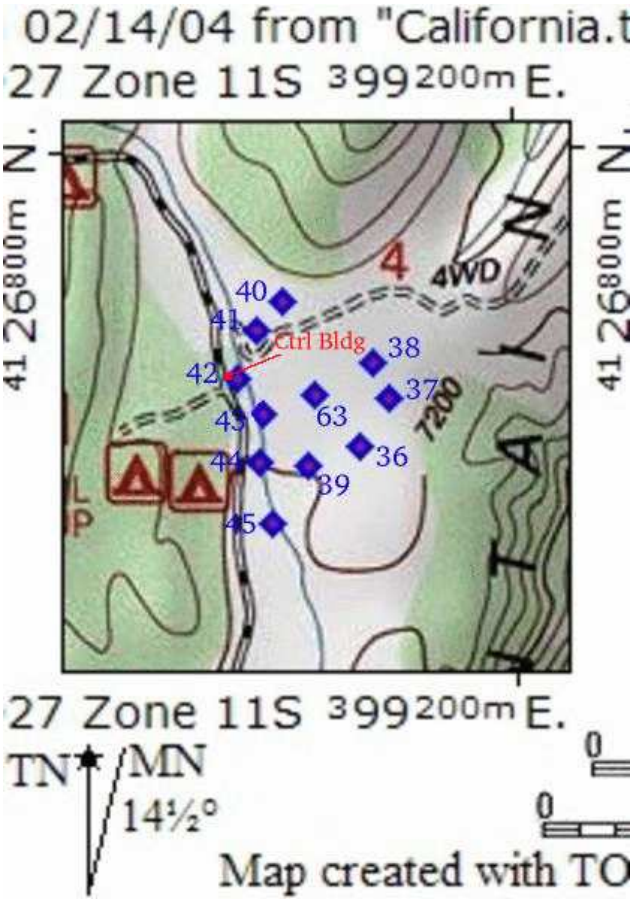

Fig. 1.— Shown is the perimeter C array pads. Only the perimeter pads are shown since they are the only ones that do not lie on the flattest part of Cedar Flats. Included is the adopted center location, and the red dot indicates the position of the control building. An interactive version of this map is available at `http://www.astro.umd.edu/~petitpas/carma/site_photos/2004array/`

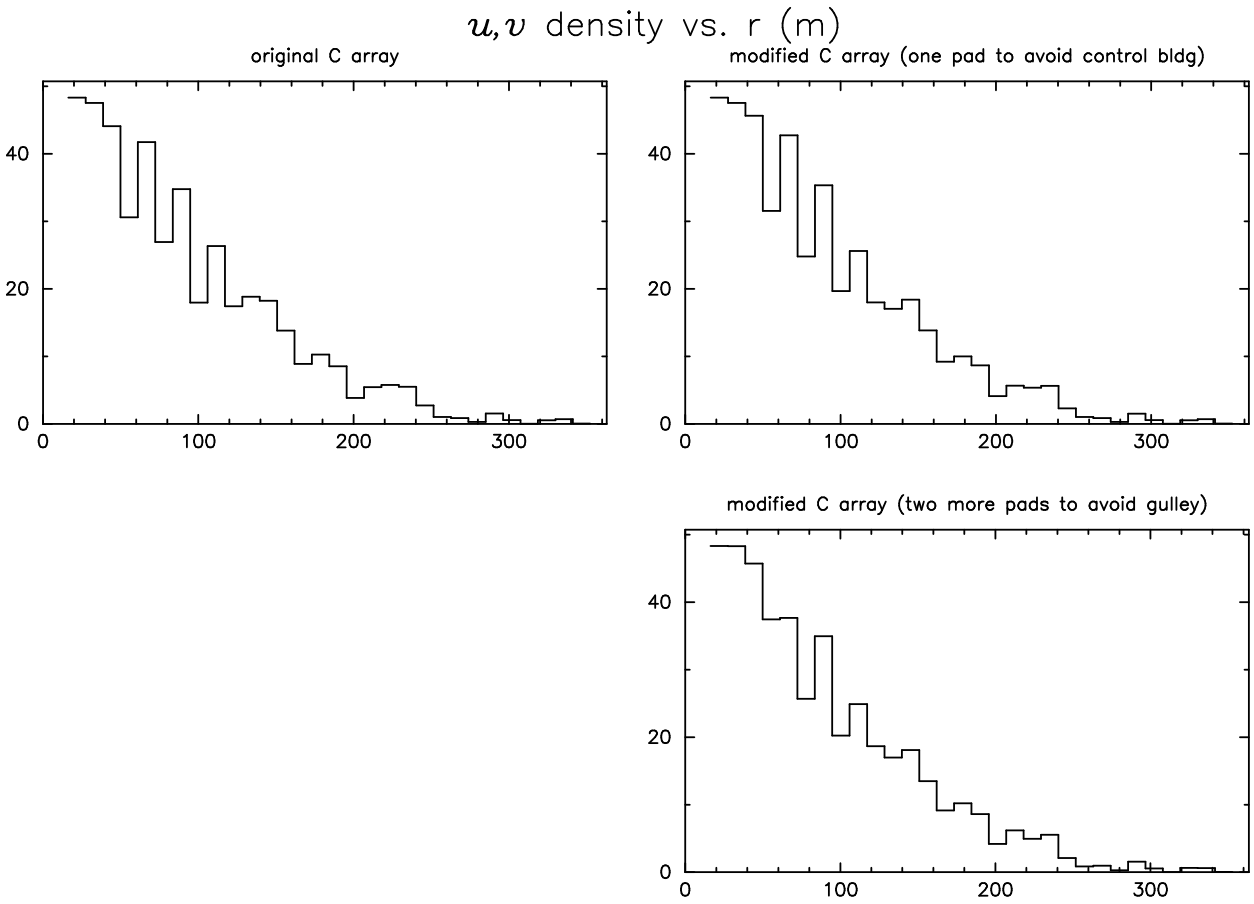

Fig. 2.— *uv* density plots for the C array showing the Gaussian distribution generated by the Boone code. The left panel is the original C array. The upper right panel is with one pad moved 5 m to dodge the control building. The lower right panel is the same with two additional pads moved 5 meters to safely avoid the gully. What is not taken into account is the fact that the larger OVRO will weight some of these baselines differently, resulting in a slightly different (and perhaps non-optimal!) distribution than is shown here.

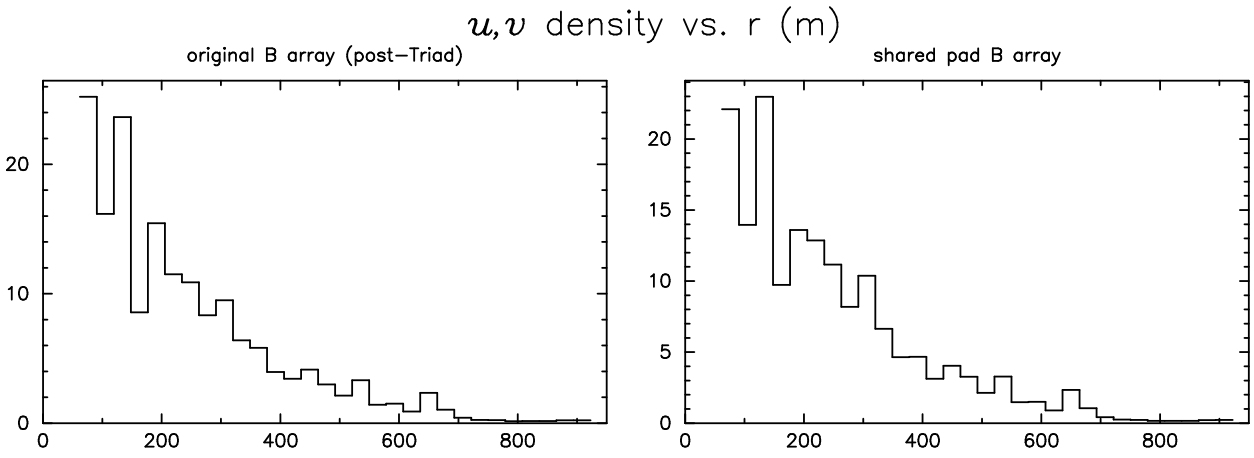

Fig. 3.— *uv* density plots for the post-Triad B array compared to one with two shared D array pads.