Optimization of Compact Array Configurations to Minimize Side-Lobes for Two Cases: The New E-configuration for the EVLA and Phased Array for the LWA Station

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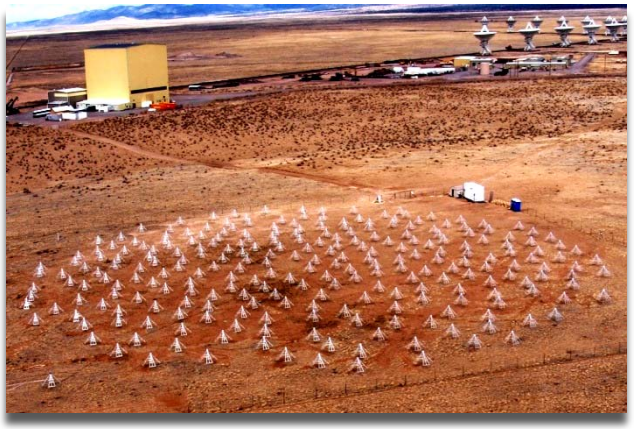


Configuration figures of merit…

- Minimum side lobes
- Gaussian shape of the main beam
- Minimum gaps in the UV coverage
- Others

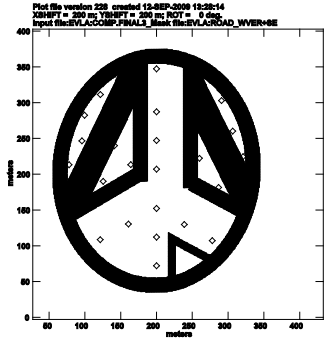
We optimize the array configuration minimizing the maximum positive side lobe inside of the primary beam!

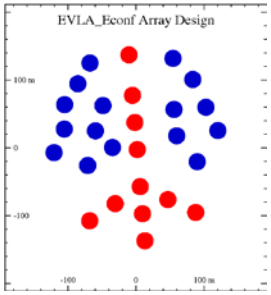
Kogan 2000, IEEE Transaction on Antennas and Propagation, 48, 7, 1075

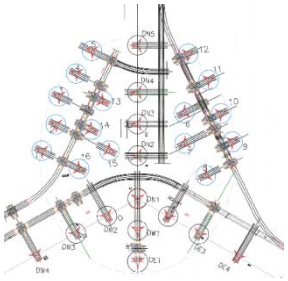
The algorithm is coded in AIPS as task CONFI

The achieved small side lobes for the considered arrays promise high image fidelity for maximum scientific results!!!

The VLA-E configuration



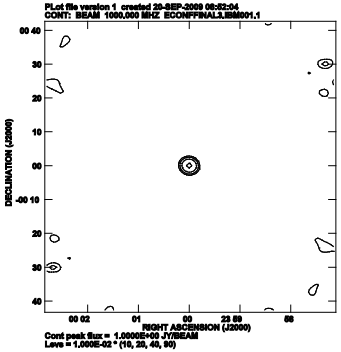


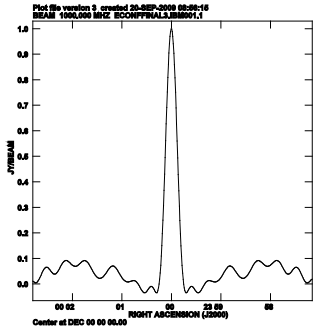


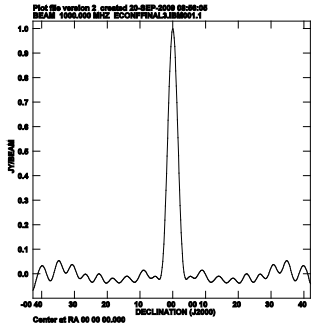
Left: Mathematically created mask to prevent appearance of antennas (during optimization) on the prohibited places: proximity to tracks, proximity to fixed antennas……

Center: The designed configuration.11 existed antenna pads: red; 16 new antenna pads: blue. Diameters of the circles are in scale with 25m.

Right: The tracks and connections are included.



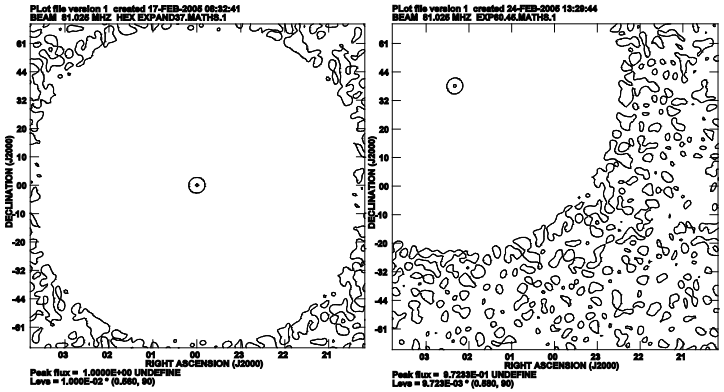


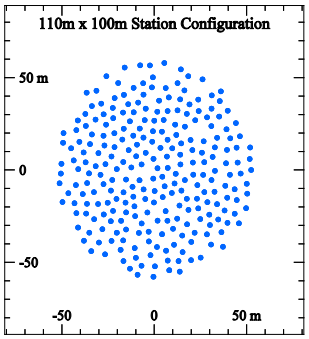


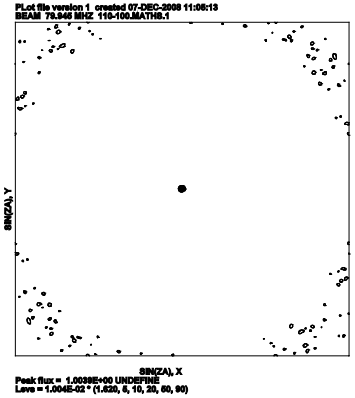
The two dimensional beam is at the left. The two orthogonal cross sections are at the right

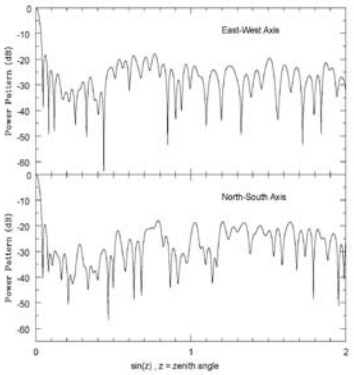
1. The designed VLA-E configuration has maximum side lobe ~12% for snapshot observation. VLA-D for comparison has ~60%.
2. The brightness temperature sensitivity is expected ~10 times better than VLA-D
3. The cost of the array is minimized using the 11 existing antenna pads and the existing track at the north–east sector at the central part of VLA. Only one extra track (at the north-west sector) is added.
4. Obviously the same 27 antennas are used

LWA station: 256 dipoles inside of ~100m diameter circle









Beam pattern at 80MHz. Minimum spacing 2m. The optimization is done for $|\sin(z)| \le 1$

The maximum side lobe is 0.6% within the optimizing region.

The left beam pattern is phased towards the zenith. The right beam pattern is phased towards $z0 = 60^\circ, az0 = 45^\circ$. The low right part of the hemisphere is not covered by the optimizing region.

The optimization for $|\sin(z)| \le 2$ *is required!*

The final LWA configuration design.

Left: The configuration itself . The minimum spacing is increased to 5m to compromise with the mutual coupling between the dipoles. The optimization is done for $|\sin(z)| \le 2$

Center: The two dimension beam pattern.

Right: The two orthogonal cross sections of the beam pattern.

The side lobes of the designed LWA station configuration are never bigger than 1.6% **at any point in the sky regardless of phased direction or operating wavelength.**

The side lobes can be achieved much lower, if the minimum spacing is chosen less.

Thanks