Optimization of the Side Lobes of Antenna Station as an Array Element.

L. Kogan[1]

(1) - National Radio Astronomy Observatory, Socorro, New Mexico, USA

January 6, 2003

Using a group of antennas (antenna station) as an array element is widely discussed now (the projects LOFAR and SKA for example). An antenna station beam usually has high level of side lobes. Thus minimizing side lobes of an antenna station is rather actual.

The AIPS task CONFI has been used to optimize the configuration of the antenna station minimizing the maximum side lobe inside of the antenna primary beam. The hexagon was chosen as an initial configuration for the given number of antennas at the station. For each number of antennas the cell size of the hexagon was chosen as two antenna diameter. The antenna diameter was taken $d = 12m$. The illumination of the antenna dish is considered to be flat. The minimum spacing between antennas is chosen as 15 meters. So the configuration has some freedom at the cost of the shadowing.
The following table gives the achieved side lobes for different number of antennas N_{ant} and the array size D_{array} in comparison with the side lobes of the single dish with flat illumination. As seen from the

Table 1: The side lobes of the antenna station with different number of antennas

N_{ant}	13	19	37	61	dish
D_{array}, m	83	96	144	192	
Worst Side lobe	0.04	0.028	0.019	0.013	0.017

table, the side lobes (worst) of the antenna station beam can be minimized to the level of the single dish beam ($\sim 2\%$). The side lobe of an antenna station beam can be made even better at the cost of more shadowing. The following problems can limit using antenna station as array element.

A single antenna follows the source always during the observation. Therefore its directivity and collecting area stay the same for all elements of the array and during the whole experiment if the antennas of the array are identical.

At the antenna station case the collecting area stays constant during observation but its directivity does not because change of the station projection. Therefore the array is not homogeneous during the observation. For the very large arrays, when the elevation is different for different stations, the directivity can be different for different antenna stations. Effect of mutual shadowing of the station antennas makes additional contribution to the problem.