Array Configurations with Uniform UV Coverage

John Bunton,
CSIRO Telecommunications and Industrial Physics, Australia

Introduction

The object of this poster is to free up thinking with regard to array configuration design. In particular, the array can be asymmetric. This leads to the possibility of siting the central site of the SKA on a continental coast and maximising the VLBI baselines.

Single Compact Component Designs

It is very likely that that the SKA will have a compact component of 1-3 km diameter containing almost half the collecting area. Adding a regular grid of antennas around the compact component gives a uniform UV coverage for correlations between the compact component and the grid of antennas. It is important to note that for these correlations an antenna at (x,y) with respect to the compact component generates the same information as one at (-x,-y). This means one half of the surrounding grid can be removed. In general:

With a single compact component, remote antennas of a given baseline length can be restricted to a 180^0 arc length.

Removing half the surrounding grid of antennas gives the antenna configuration is shown in Fig 1. If the spacing of the grid is equal to the diameter of the compact component then:

Complete sampling of the UV plane is achieved with a sampling interval equal to the diameter of the compact component.
gives very high quality snapshot imaging

Antenna configuration

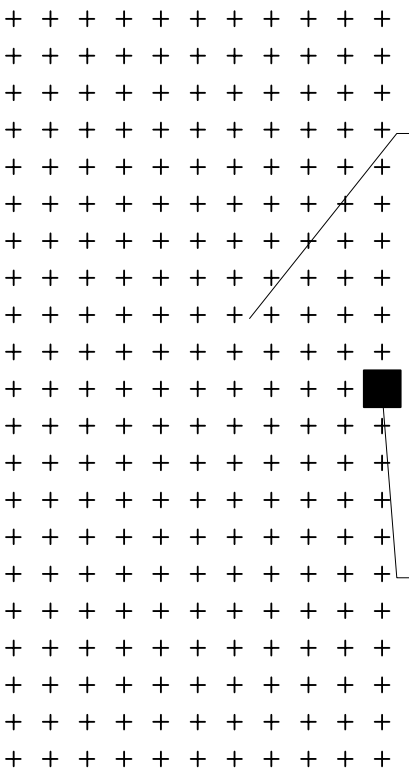

Figure 1 Asymmetric Antenna Configuration with single compact component

Adding the correlations between the antennas of the grid does not greatly affect the sensitivity. If the grid is used to increase the maximum base line to 10 times that of the compact component and there are about twice as many antennas in the compact component. Assume N antennas in the grid and 2N in the compact component then the distribution of correlations is:

Correlation type	Number	
Compact - compact	$2N^2$	Short baselines
Compact - grid	$2N^2$	80% of Long baselines
Grid-grid	$0.5N^2$	20% of Long baselines

It is seen that the grid-grid correlations contribute only 20% of the sensitivity and 75% of that is in common with the compact-grid correlation.

Correlation between remote antennas can be largely ignored in designing the configuration.

This greatly simplifies the design. The resulting UV coverage for the configuration in Fig 1 is shown below.

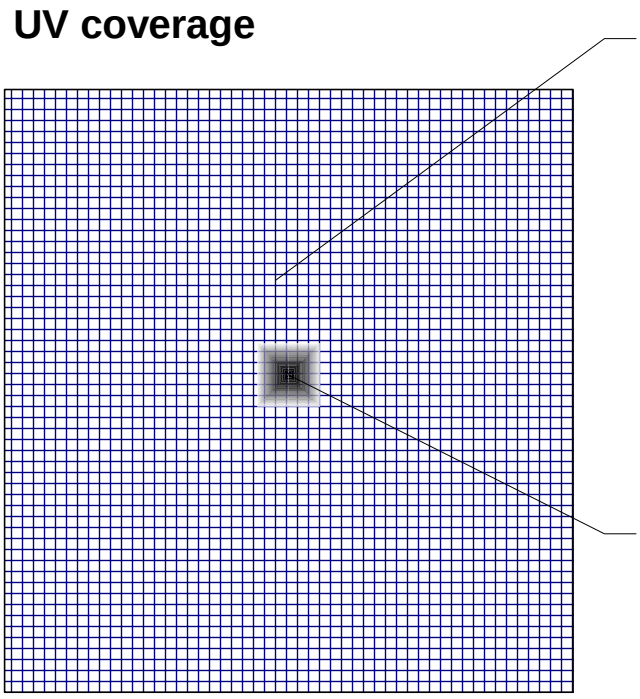

Figure 2
Simplified UV coverage for antennas shown in Figure 1

Examples of Multiple Compact Component Designs

If there are multiple compact components then uniform coverage for compact-grid correlation is still possible. Cases for 2,3 and 4 components are shown below. In the limit as the number of compact components increases, the roles of the grid of antennas and compact components reverse. Long baselines occur between compact components. The antenna of the regular grid provide short baseline correlations.

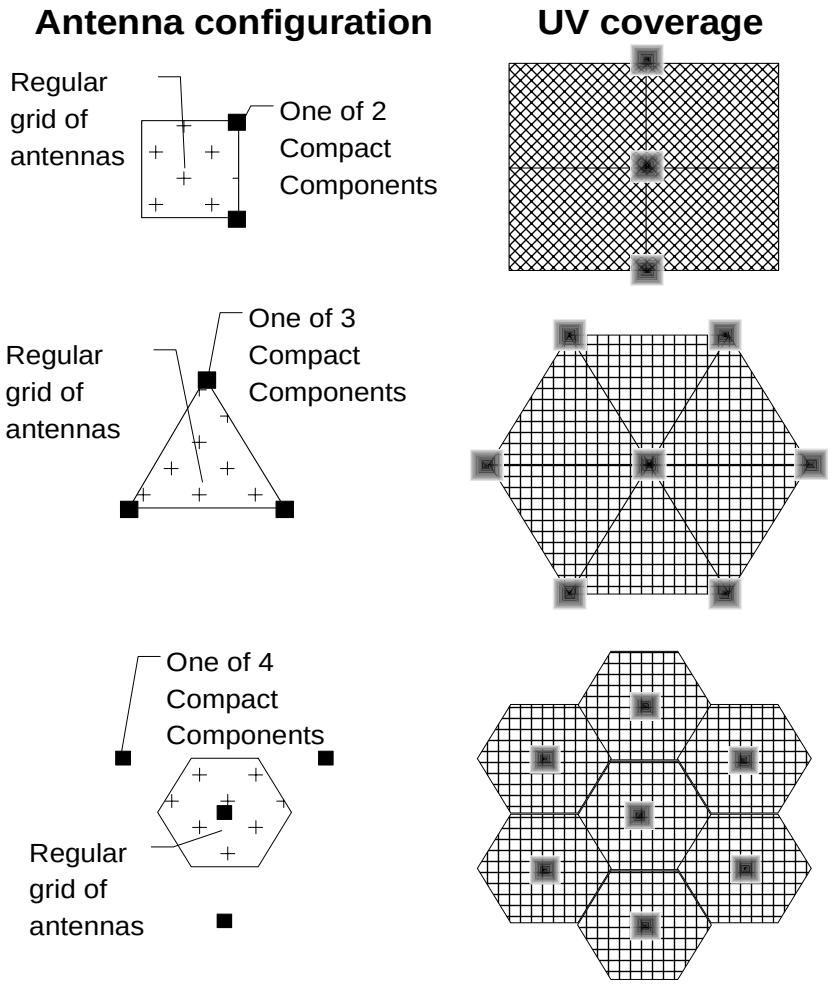

Figure 3 Configurations with 2, 3 and 4 compact components

Figure 4 Examples of antenna configuration with a large number of compact components. Asymmetric and Spiral forms shown