Array configurations and artificial-sky simulations

Report of the working group at the workshop *Technology Pathways to the SKA*
Jodrell Bank, August 4, 2000

compiled by Douglas Bock

Summary

The working group met on Thursday August 3 (Arnold van Ardenne as moderator) and Friday August 4 (Douglas Bock as moderator). This report summarizes the discussions and presents the recommendations of the working group. The group considered principally (a) a description of the problem (the parameter space) and (b) the tools necessary to successfully complete the studies and design the SKA configurations.

Parameter Space – what are we trying to achieve?

The issue of exactly what to simulate is not settled, although there is much agreement. The group noted several factors (parameters) which could be adjusted to obtain desirable imaging and calibration properties of the SKA, and further identified the most commonly specified performance measures (goals). Some of the parameters are themselves goals. Although some parameters (such as element size, latitude) may eventually be set primarily by external factors, it is at present desirable to retain the widest possible parameter space in the simulations.

Parameters

- Element size
- Array configuration/size
- Station size ⇔ number of stations
- Zenith angle coverage
- Latitude
- Calibration errors

Goals (what are we optimizing?)

- *uv*-distribution/sidelobe level (both station beam and instrument p.s.f.), for continuum snapshot/spectral line/'typical' tracks on the required spatial scales
- Length of the 'typical' track
- Ease of calibration (instrumental/atmospheric/ionospheric errors)
- Dynamic range
- Sensitivity as a function of angular scale
- Connectivity/site/infrastructure costs
- More than one SKA?

Resources

In addition to improved communication within the group and with the scientific users (see recommendations) the working group felt that much improved simulation software was required to design the SKA. Present systems (miriad/AIPS/aips++, etc) have a variety of useful tasks. However, no package has everything required, some have useful tasks that run too inefficiently, and several of the present packages are not being actively developed. aips++ appears best appear to meet the challenge, but much additional work is needed. Clearly the simulators need to be involved in this development, specifying and continuing to evaluate the tools throughout. Assuming that support for the project is available, it is thought that development of the tools could take about the next 18 months, before large-scale simulations are usefully attempted. In the meantime, simple studies with existing tools should form part of an analytical approach to discover simple but general principles (such as John Bunton's work on *uv*-densities in self-similar arrays).

Recommendations

The working group recommends that:

(a) There exist a document exchange website, email exploder and archive, similar to the 'intmit' arrangement at ATNF. Mark Weiringa was suggested (in his absence) as a possible coordinator. A formal group is probably not required at this stage.

(b) There be close interactions with a science advisory committee to guide the configuration and sky simulation work, with an early update to the 'strawman' specifications. Any externally-set goals, parameters or other inputs (things such as longest baselines, connectivity costs etc.) should be communicated as soon as known.

(c) Additional resources be devoted to developing tools for configuration and artificial sky simulations. The aips++ package appears to have the most appropriate range of tools at present and the working group suggests that this package be further developed to support SKA simulations explicitly. Parallel-processor computing systems should be supported.

(d) A suitable timetable for the SKA configuration and sky-simulation work could be:

present—2001: develop tools; work on an analytical approach, including simple simulations to discover basic principles and develop real understanding

2002: more extensive sky simulations, with the goal of reducing the parameter space of possible configurations

2003—2004: prepare draft configurations for proposed instrument(s)