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Imaging with the SKA core

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The moderate resolution and high brightness sensitivity of the SKA core may be exploited to study the diffuse structures in our Galaxy, the IGM and the cosmic web. The combination of high sensitivity and moderate resolution leads to confusion limited maps at each frequency from which the source components along each line-of-sight may be extracted by exploiting the difference in spectral characteristics of the individual sources. This extraction can only be successful if the individual maps are made using a reliable and consistent method.

Least squares imaging has several attractive features that make it well suited for imaging with the SKA core:
- The model based imaging (deconvolution) problem can be solved in closed form [1].
- The closed form solution for the complete grid of pixels in the image is mathematically identical to the solution for simultaneous source power estimation in the self-calibration process (see [4]), which should facilitate integration of the calibration and imaging processes.
- The availability of a closed form solution allows for a complete error and noise propagation analysis [3].
- It implicitly handles arbitrary direction dependent effects that may vary over time and frequency during the observation [1].
- The numerical complexity of the deconvolution operation only depends on the number of image parameters regardless of the amount of visibility data [1].
- It has been demonstrated that the algorithm reaches the Cramer-Rao bound on actual data [2]. The Cramer-Rao bound is the lower bound on the total variance on the estimated parameters for an unbiased estimator.

In this presentation I discuss the strengths and weaknesses of l_2-based image optimization to demonstrate its suitability for imaging with the SKA core. I illustrate this by application to actual LOFAR data. I also discuss the numerical complexity of the algorithm demonstrating that this is a viable option for imaging with the SKA core.

References

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