

Practical validation of the DoA algorithm using Tripole antenna for SEAMS

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The Ultra-Low frequency (ULF) band is one of the regions of the Electromagnetic (EM) spectra which remained unexplored by radio astronomers. Detection of the frequency below 30MHz (ULF band) is a challenge as Earth’s Ionosphere blocks this part of electromagnetic spectra[1]. The studies under 30MHz or the ULF band, aid in understanding the key aspects of signals from the early universe, magnetospheric emissions in radio frequency from planets and exoplanets etc,. The study of space-based antennas and radio telescopes in the extra-terrestrial region has been a point of research in radio astronomy[1]. However, a space-based radio telescope in the ULF band can be an option to overcome the challenges that radio astronomers face due to the presence of the ionosphere.

In order to study a radio source one should know the direction of the radio emission. To detect the direction of the EM wave, most of the astronomers use the triangulation method or direction finding algorithms like MUSIC, ESPRIT[3, 4]. The aforementioned techniques and methods requires multiple telescope arrangements. In fact array of space-based radio telescopes (interferometer) can be used to find the direction of the EM wave. Building an interferometer using space-based telescopes is an expensive engineering challenge. This leads to development of direction finding or Direction of Arrival (DoA) techniques and algorithms. The DoA techniques can find direction of the EM wave with the limited number of co-located antenna on-board a satellite. The DoA techniques depend on the orientation of the co-located antenna on the satellite. In this work, we describe a DoA technique which is being developed for Space Electric and Magnetic Sensors (SEAMS) project. SEAMS is an Indian origin project for probing the ULF band region.

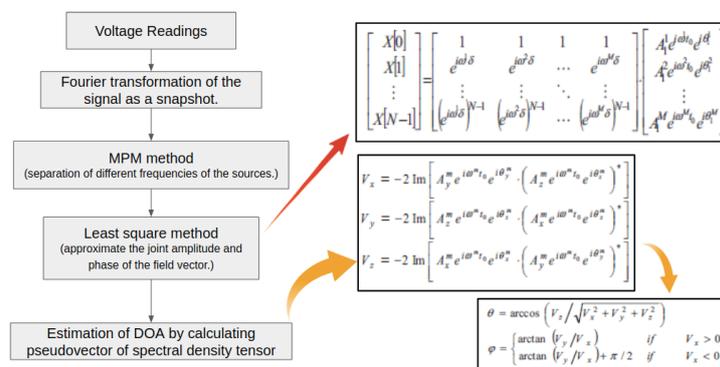


Figure 1. A schematic representation of the DoA estimator

The DoA estimation algorithm been developed for a Tripole antenna (3 co-located orthogonal mono-poles). The algorithm uses the Matrix Pencil (MP) method and the least square method (LSM) to estimate the frequency[3, 4]. To estimate the DoA pseudo-vector from the anti-symmetric part of the spectral density tensor is calculated[2].

References

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