RADAR INTERFEROMETRIC IMAGING FOR THE EISCAT SVALBARD RADAR

Grydeland Tom, Jorge L. Chau, César La Hoz
Dept. of physics, University of Tromsø,The Auroral Observatory,Tromsø,Norway

Abstract:

In the high-latitude ionosphere, incoherent scattering radars at VHF and UHF frequencies have revealed a number of interesting phenomena which result in strong radar backscattering. From previously obtained interferometric observations or from purely physical considerations we already know that several of these phenomena arise in localized structures, often much smaller than the radar beam. One of the strongest and most dynamic of these are the naturally enhanced ion-acoustic echoes. Other interesting phenomena which arise in localized structures are meteors and Polar Mesospheric Summer Echoes (PMSE). Radar interferometric imaging is a relatively recent technique which can reveal details of such spatially localized phenomena, using a number of receiving antennas. The technique is closely related to the interferometric techniques in use in radio astronomy, and many of the techniques used by astronomers can be adapted for radar applications without too much trouble. There are two important differences, however.One is the existence of a third (range) axis, which means that images are formed for every range. The other important difference is the rapid evolution of the target. This means that images must be formed using the baselines available in a given instant, while in radio astronomy, additional baselines can be formed over weeks or months of time. If radio astronomy interferometric imaging is considered analogous to a camera, then radar interferometric imaging is the analogue of a camera with a flash.When the scattering process is strong, the receiving antennas can be made much smaller than what is typically required for incoherent scattering. In the case of naturally enhanced ion-acoustic echoes, enhancements of 20 dB over the thermal level are not uncommon, and meteor echoes can be as much as 30 dB over the thermal level.We describe the progress of our plans to add an imaging interferometry facility to the EISCAT Svalbard Radar (ESR), using a number of small receiving arrays of Yagi antennas. The first such antenna array has been deployed, and we present the first observations of natural and artificial targets (satellites) using this setup, as well as correlation estimates between the different pairs of antennas. A crucial question in all such set-ups is proper phase calibration between receiving antennas. We intend to use scattering from artificial satellites for phase calibration.The current state of the project does not produce the short baselines necessary to eliminate ambiguity in imaging. We present instead simulations of the type of images obtainable once the plans have been realised.