

Seminar Announcement

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Thursday, April 7, 2016
Green Hall, Room 0120
3:00 PM

Electromagnetic Vector Antenna and Constrained Maximum Likelihood Imaging for Radio Astronomy

Abstract: Radio astronomy at frequencies below 50 MHz provides a window into non-thermal processes in objects ranging from planets to galaxies including the very early history of star and galaxy formation in the universe. Ground-based arrays, cannot adequately observe astronomical sources below about 20MHz due to ionospheric perturbation and shielding; so the sky has not been mapped with high angular resolution below that frequency. Radio astronomy at these frequencies must be accomplished in space. A key aspect of space-based sensing is that the cost of each satellite is high so we desire to maximize the information from each satellite. This presentation discusses designs for mapping the sky from space using electromagnetic vector sensors. These sensors measure the full electric and magnetic field vectors of incoming radiation and enable measurement with reasonable angular resolution from a compact sensor with a single phase center. In this presentation a model for imaging is introduced and the constraints imposed by Maxwell's equations and vector sensing of an electromagnetic field are explored. This presentation shows that the covariance matrix inherent in the stochastic process must lie in a highly constrained subset of allowable positive definite covariance matrices. Results are shown that use an expectation-maximization (EM) to form images consistent with a covariance matrix that satisfies the constraints. A conceptual design for a spacecraft to map the sky at frequencies below the ionospheric cut-off is discussed along with progress in developing the concept.

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Bio: Dr. Frank Robey (DSc EE, 1990) is Associate Leader of the RF Technology Group, which develops and demonstrates innovative RF technologies as solutions to emerging national security needs in radar, electronic warfare, and communications at MIT Lincoln Lab. The developments span the spectrum from compound semiconductor material growth, novel devices, and sensor systems, through field experiments, signal processing and analysis.

Host: Dr. Arye Nehorai