ARRAY SIGNAL PROCESSING
(ELECTIVE – I)

Course Code: 13EC2107

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Course Outcomes:

At the end of the course, student is able to

CO1: Extrapolate the fundamentals of arrays, signal models in various domains.

CO2: Distinguish the performance of various types of sensor arrays like ULA's, Planar and Random arrays.

CO3: Predict the importance of spatial domain analysis under the influence of adverse effects like Aliasing and white noise signaling conditions.

CO4: Interpret the basics and types of beam forming techniques that can be used to Obtain effective beam patterns.

CO5: Outline various non-parametric methods and spatial smoothing techniques to effectively solve the Direction of arrival estimation problems.

UNIT-I

SPATIAL SIGNALS:

Array fundamentals, Array signal Model, Signals in space and time, spatial frequency, Direction vs. frequency, Wave fields, far field and near field signals.

UNIT-II

SENSOR ARRAYS:

Spatial sampling, Nyquist criterion, Sensor arrays, Uniform linear arrays, Planar and random arrays, Array transfer (steering) vector, Array steering vector for ULA, Performance analysis, Broadband arrays.

UNIT-III

SPATIAL FREQUENCY

Aliasing in spatial frequency domain, Spatial Frequency Transform, Spatial Domain Filtering, Beam forming, tapped Beam forming, Eigen analysis of the optimum beam former, spatially white signal.

UNIT-IV

ADAPTIVE BEAM FORMING:

Sample matrix inversion, Diagonal loading with the SMI beam former, Implementation of the SMI beam former, linearly constrained Beam formers, Partially Adaptive arrays, Side lobe cancellers, angle estimation, Beam splitting algorithms, Model based methods, Space-time adaptive array processing.

UNIT-V

DIRECTION OF ARRIVAL ESTIMATION:

Non parametric methods – Beam forming and Capon methods, Resolution of Beam forming method, Subspace methods – MUSIC, Minimum Norm and ESPRIT TECHNIQUES, Spatial Smoothing.

TEXT BOOKS:

[1] D.G. Manolakis, V.K. Ingle, S.M. Kogon, "*Statistical and Adaptive Signal Processing*", 2000.

[2] S.Unnikrishna Pillai, "*Array Signal Processing*", Springer, 2011.

[3] H. L. Van Trees, "*Detection, Estimation and Modulation Theory, Optimum Array Processing, Part 4 of Detection, Estimation & Modulation Theory*", John Wiley& Sons, 2004.

REFERENCE BOOKS:

[1] PetreStoica and Randolph L. Moses, "*Spectral Analysis of Signals*", Prentice Hall.

[2] Bass J, McPheeters C, Finnigan J, Rodriguez E., "*Array Signal Processing"*, 2005.

[3] Dan E. Dugeon and Don H. Johnson, *"Array Signal Processing: Concepts and Techniques*", Prentice Hall, 1993.

[4] http://cnx.org/content/col10255/latest/