MTE 8105 Radar Signal Detection and Data Processing

AIM:

This course builds on the first course in Radar to disucss the signal and data processing principles of radar systems. Fundamental radar system concepts will be developed in this four-hour tutorial session. Each topic will be illustrated using a worked example.

Detailed Course Content:

DETECTION OF RADAR SIGNALS IN NOISE : Matched-filter Receiver ; Correlation Detection ; Detection Criteria ; Inverse Probability ; Detector Characteristics ; Performance of the Radar Operator ; Delay-line Integrators ; Binary Integration

EXTRACTION OF INFORMATION FROM RADAR SIGNALS : Phase and Amplitude Measurements ; Review of Radar Measurements ; Statistical Estimation of Parameters—Likelihood Function ; Theoretical Accuracy of Range and Doppler-velocity Measurements ; Uncertainty Relation ; Angular Accuracy ; Transmitted Waveform ; Pulse Compression ;

CLUTTER, WEATHER, AND INTERFERENCE: Ground Clutter ; Sea Clutter ; Clutter Reduction ; Meteorological Echoes ; Attenuation by Precipitation ; Visibility of Targets in Weather Clutter ; Angels ; Interference ; ECM and ECCM

RADAR DETECTION OF EXTRATERRESTRIAL OBJECTS : Radar Echoes from the Moon and Planets; Radar Detection of the Sun and Meteors; Radar Observation of Auroras and Ionized Media ; Tracking of Earth Satellites and Space Vehicles

Fundamentals, threshold detection, constant false alarm rate detector (CFAR), Doppler processing, Radar measurements, Radar tracking algorithms, fundamentals of pulse compression, overview of radar imaging.

Electronic Defence: Threats, Requirements and Principles, Advanced Radar Threat, Modern Electronic Attach (EA) Systems—Architecture, Types, and Technology, EA against Modern Radar Systems, Digital Radio Frequency Memory, Electronic Defence Support, Expendables and Decoy Systems, Directed Energy Weapons and Stealth Technology , Applications of Electronic Defence Clutter and Detection in Clutter: Ground and Sea Radar Clutter Modelling: and Coherent Radar Target Detection in Heavy Tailed Clutter: High Resolution and Imaging Radar:

Teaching and Learning Pattern

The teaching of students will be conducted through lectures, tutorials, short classroom exercises, case studies, group discussions among the students and projects aimed at solving real life problems. The lecture material will be availed to the students in advance to enable them have prior reading. Solving real life problems in each theme or a number of topics will enhance the students' understanding of the problem based learning techniques.

Assessment method

Assessment will be done through coursework which will include assignments, class room and take home tests, project work and presentations and a written examination. Course work will carry a total of 40% and written examination carries 60%. Coursework marks will be divided into; Assignments 5%, Tests 10% and Practical/project Work 25%.

References:

[1] David K. Barton, Modern Radar System Analysis, Artech House, Inc., Norwood, MA, 1988

[2] G.W. Stimson, "**Introduction to Airborne Radar"** 2nd edition, SciTech, 1998

[3] Jol Ground Penetrating Radar Theory and Applications 2009

[4] Lacomme,Marchais,Hardange & Normant Air and Spaceborne Radar Systems: *An Introduction* 2001

[5] Kolawole Radar Systems, Peak Detection and Tracking 2003