



Signal Analysis Techniques: Time, Frequency, and Spatial Algorithms

Prof. Larry Marple

Oregon State University, Corvallis, Oregon, USA

Conference Centre
Technology Park Adelaide
Mawson Lakes SA

How to register

Please fill out the registration form overleaf if you wish to register for 1 or 2 courses and/or a field trip to the HFSW Radar site.

Presenter:

Professor Larry Marple

Oregon State University
Corvallis, Oregon, USA



Larry Marple received the BS and MEE degrees (Rice University, 1969,1970) and EngrD (Stanford University, 1976) in electrical engineering. He spent 33 years in defense and

commercial industry working sensor signal processing for radar (ELINT and SAR), sonar (active and passive), geoseismic, ultrasonic medical imaging, and audio applications, before joining the academic staff at Oregon State University in 2002, where he is currently a Professor in the Electrical and Computer Engineering Department.

His recent work has been in the area of new feature exploitation (both imaged and nonimaged target features) from synthetic aperture radar, also including special focusing for moving targets. He is a former employee of Acuson, Martin Marietta Aero and Naval Systems, Schlumberger Well Services, TASC, Advent Systems, and ARGO-Systems.

Marple has published widely in refereed journals, he is the author of the textbook *Digital Spectral Analysis* (Prentice Hall, 1987). He was elected a Fellow of the IEEE in 1989 for work in advanced spectral estimation. He has given short courses since 1977 in the area of signal analysis techniques, and has two new texts for release in 2008 on the subject.

Course Fees

- AU\$ 1122 (register by 1 May 2008)
- AU\$ 1320 (register by 25 Aug 2008)

20% discount will be given if registered for 2 courses during Radar Week

Student scholarships available, please enquire.

About

Signal Analysis Techniques

Conventional tools for analyzing and mining the feature content of signals are filters (time content) and Fourier transforms (frequency content). This course explores alternative tools to these conventional techniques, which can often produce signal analysis results with finer temporal detail and higher spectral resolution. It will also be shown how to extend these tools to process spatial sensor arrays with a similar increase in spatial detail (higher resolution direction finding).

The course uses a systematic approach based on a signal modelling theme, while focusing on fast computational procedures that make the alternative higher performance analysis techniques feasible to implement in practical applications. An extensive software toolbox (MATLAB and C) is provided students for all the algorithms and computational techniques introduced in the course.

Target Audience

The course is suitable for practicing engineers and scientists in academia and industry as well as graduate students working on signal processing problems. The course will assume a basic knowledge of digital signal processing algorithms. Some matrix algebra and an introductory understanding of random processes are desirable.

Brief Course Outline

Introduction to Signal Analysis Tools and Classical Spectral Analysis. Complex Signal Representations; Concepts from Fourier Transform Theory; Tutorial Review: Random Signal and Matrix Algebra Concepts; Autocorrelation and Cross Correlation; Power Spectral Density; Correlogram Method; Periodogram Method; Blackman-Turkey Method.

Parametric and Autoregressive Methods of Spectral Analysis. Parametric Time Series Models: Autoregressive (AR), Moving Average (MA), and Autoregressive Moving Average (ARMA); Parameter and Autocorrelation Relationships among Parametric Models; AR, Linear Prediction, and Lattice Filters; AR Spectral Estimation: Yule-Walker algorithm, Burg algorithm, least squares linear prediction algorithms.

Exponential Frequency Estimation and Minimum Variance Spectra. Prony's Method; Damped Exponential Parameter Estimation; Relationship to AR Methods; Least Squares Prony Algorithms; Noise Excision by Eigenanalysis / Principal Components Analysis; Minimum Variance Estimation; Signal and Noise Subspace Concepts; Pisarenko's Technique; MUSIC Algorithm; ESPRIT Algorithm.

Non-Stationary Time-Frequency Analysis (TFA). Short Time Fourier Transform; Linear and Quadratic Time-Frequency Representations; Short Time Fourier Transform (STFT); Wigner-Ville Distribution; 2-D Methods of TFA.

Multi-Resolution and Spatial Analysis. Scaling (time compression/time expansion) Properties of Analyzing Wavelets for Time-Frequency Analysis; Scalograms vs Time-Frequency Grams; Relationship of Temporal and Spatial Spectral Analysis Techniques; High Resolution Direction Finding and Beamformation.

