ISDL SEMINAR

TIME-FREQUENCY DESCRIPTION OF SIGNALS

Leon Cohen
Professor of Physics
Hunter College and Graduate Center
The City University of New York

Wednesday, December 12, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

We shall present an elementary introduction to the ideas and methods which have been developed to describe a time varying spectrum. For many natural and man-made signals the frequency content changes drastically with time, and standard Fourier analysis is not able to fully describe such highly non-stationary signals. Many methods have been developed to study time varying spectra, the most widely used being the spectrogram. The spectrogram has a number of shortcomings and recently there have been significant innovations aimed at a better understanding of what a time varying spectrum is.

The basic aim is to develop a method to describe the intensity of a signal jointly in time and frequency. Such a distribution would give the frequency content of a signal at each instant of time and would potentially provide a powerful method for the detection and analysis of signals, and for the construction of signals with desirable time-frequency characteristics.

We shall emphasize the fundamental ideas, motivations and myths, current and possible future applications, and the unresolved problems.

* * *

Leon Cohen received the B.S. degree from City College in 1962 and the Ph.D. degree from Yale University in 1966. He is currently Professor of Physics at Hunter College and Graduate Center of The City University of New York. He has done research in astronomy, quantum mechanics, chemical physics, numerical methods and signal analysis. In the past few years he has held visiting research positions at the IBM T.J. Watson Research Center, Center for Advanced Studies at the University of New Mexico, and the Naval Underwater Systems Center.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

MMSE FILTER DESIGN TECHNIQUES

Jim Ritcey
Associate Professor
Department of Electrical Engineering
University of Washington

Wednesday, December 5, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

A common problem in designing FIR filters and phased array antennas is to find the weights that yield a desired frequency response or beam pattern. For classical filter designs such as ideal low-pass, etc., the results are well-known. Many applications require the imposition of constraints. For example, we might require that certain weights are identically zero, thus obviating the need for a multiplier at that tap. In the case of spatial arrays, the problem is a common one due to variations in the array geometry.

One technique that can easily handle these constraints is the MMSE design procedure.

We demonstrate the utility of this method in a tutorial manner.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

APPLICATION OF NEURAL NETWORKS TO POWER SYSTEMS

Professor M.A. El-Sharkawi
Department of Electrical Engineering
University of Washington

Wednesday, November 14, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

Neural networks (NN) have found use in numerous fields, including speech recognition, stock market forecasting, mortgage brokering, and remote sensing. Since the NN is amenable to learning inherently nonlinear and/or complex relationships from examples, a number of power system problems are potentially applicable to NN solutions. Neural networks are especially suited for several power system problems described as classification and generalization, regression, and combinatorial optimization. This includes electric load forecasting, security assessment, harmonic evaluation and detection, stability evaluation, fault diagnosis and alarm processing.

This talk will include the analysis of NN architectures, training algorithms and performance evaluation for the specific application to power systems. Preliminary test results of NN application to security assessment and load forecasting will be presented and discussed.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

NEURAL NETWORK MODELS OF PRIMATE MOTOR SYSTEMS

Professor Eberhard E. Fetz
Department of Physiology and Biophysics
University of Washington

Wednesday, November 7, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

Dynamic neural network models that incorporate time-varying activity and allow unrestricted connectivity were trained by back-propagation to generate discharge patterns of neurons previously observed in behaving monkeys. Neuronal recordings in monkeys performing a simple alternating step-tracking task have shown that forearm motor units and connected premotoneuronal cells fire with characteristic patterns: phasic-tonic, tonic, decrementing, etc. To investigate the properties of networks that could transform a step input of target position to the four observed discharge patterns of flexor and extensor motor units we trained dynamic network models to generate these firing patterns as outputs. These networks have hidden units with either excitatory or inhibitory connections to each other and to the output "motor units." Network solutions have been found for a variety of connection matrices corresponding to different network topologies. The activity of many hidden units resembles the discharge patterns that have been observed in physiological recordings of neurons in motor cortex and red nucleus. In networks receiving both sustained (step) input and transient input signals, preferential connections can develop within subsets of phasic and tonic units.

The function of specific hidden units in the network can be tested by making selective lesions of particular units and determining the behavior of the remaining network. When relatively few hidden units with similar activations are strongly interconnected, removing a particular unit can have appreciable consequences in eliminating corresponding components of activity in other units. The output effects of a given unit can also be tested by delivering a simulated stimulus and analyzing the propagated network response.

Networks are being developed to simulate delayed response tasks, in which transient cues determine the appropriate response to make after a temporal delay.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

THE USE OF NEURAL NETWORKS FOR PROCESS CONTROL AND IDENTIFICATION

Associate Professor Bradley R. Holt
Department of Chemical Engineering
University of Washington

Wednesday, October 31, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

The process industries involve a wide spectrum of different manufacturing procedures and different products. They range from the refining of gasoline to the production of paper; from the manufacturing of paints to the creation of a composite wing section. When viewed from a control standpoint, however, the processes all tend to be unique in design, poorly understood, and inherently non-linear. These characteristics have sparked interest in the use of neural networks.

The first part of the talk will focus on the use of neural networks for control on problems characteristic of the process industries. It will present an overview of the issues involved in process control. It will examine the use and *philosophy* of directly employing neural networks as controllers, and it will examine the *state-of-the-art* in conventional process control in order to both provide a contrast to the direct use of neural networks as controllers and demonstrate a means by which neural networks employed as non-linear dynamic models can be used.

The last part of the talk will focus on the issues involved in identifying non-linear models with neural networks. A novel neural network structure will be presented and the implications and research issues, as well as demonstrations of the use of a neural network for system identification, will be discussed.

BIOGRAPHICAL INFORMATION

Bradley Holt received his B. Chem. Eng. degree from the University of Minnesota and his Ph.D. degree from the University of Wisconsin in chemical engineering. He joined the faculty of the University of Washington in 1984, he received a Presidential Young Investigator Award in 1985, and is now an Associate Professor in the Department of Chemical Engineering. His research activities focus on control and identification – in particular linear non-minimum phase control theory, the application of non-linear optimization theory to control problems, the application of neural networks to identification and control, and the interpretation of sensor data using neural networks.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

HIGHLY ROBUST ESTIMATION OF AUTOREGRESSIONS

Professor R. Douglas Martin
Department of Statistics
University of Washington

Wednesday, October 24, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

This talk describes a method of estimating autoregression models which is highly robust in the following context and sense. Time series occurring in many applications of speech and signal processing are quite non-Gaussian and contain outliers and other kinds of contamination. Often the series will be reasonably Gaussian except for a certain fraction of the data which is contaminated. For contaminated time series the classical approaches to estimating autoregressions, based on minimizing sums of squared residuals, are quite non-robust in that they do not seem to come close to achieving acceptably small biases and mean-squared errors, and they have rather small breakdown points (the "breakdown point" is roughly speaking the largest fraction of contamination the estimator can handle without completely breaking down, e.g, by virtue of all autoregression coefficient estimates being close to zero). Recent results on high breakdown point and bias robust regression in the statistics literature reveal that the use of a highly robust scale estimate for residuals is a key ingredient to achieving a highly robust regression estimate. These results do not carry over directly to pth order autoregressions, the reason being that in the latter case a single outlier in the series can spoil $p+1$ of the prediction residuals. The way to cope with this difficulty is to use modern robust filtering to obtain a highly robust version of autoregression model fitting based on a robustified Durbin-Levinson algorithm. Our procedure gives highly robust reflection/partial correlation coefficients. By using the robustified Durbin-Levinson approach we are able to solve the nonlinear optimization problem by a sequence of one-dimensional nonlinear optimization problems. Simulation results show that our procedure indeed achieves by far the best robustness to date in terms of high breakdown points as well as small maximal biases and variances for a large range of fractions of contamination. Use of the method is illustrated in the context of autoregression spectrum estimation and estimation of AR/LPC coefficients for noisy speech data.

Presented by
Interactive Systems Design Laboratory, FT-10
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Seattle, Washington 98195

University of Washington STATISTICS

SEMINAR

This is a Joint Seminar with the Department of Electrical Engineering

Speaker: James F. Kaiser
Bell Communications Research, Inc.

Title: **On Teager's Energy Algorithm and Its Generalization to Continuous Signals**

Date: Monday, October 15, 1990

Time: 4 p.m.

Place: Thomson Hall, Rm. 101

Abstract:

A Simple algorithm is derived that enables on-the-fly calculation of the "energy" required to generate, in a certain sense, a signal. This algorithm known as Teager's Energy Algorithm is given in both its continuous and discrete forms. The results of applying this algorithm to a number of well-known signals are shown. Some of the properties of the algorithm are derived and then verified by simulation. The implementation of the algorithm and its application to speech processing and time series analysis are discussed.

(Tea and cookies in Statistics lounge B313D Padelford at 3:30 P.M.)

ISDL SEMINAR

NEURAL NETWORK APPLICATIONS FOR PERSONAL COMPUTERS

Russell Eberhart
JHU Applied Science Lab.
Johns Hopkins University

Wednesday, October 10, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

BIOGRAHICAL INFORMATION

Russell C. Eberhart, a Senior Member of the IEEE, received his Ph.D. in Electrical Engineering from Kansas State University in 1972. He is Program Manager in the Biomedical Programs Office of the Johns Hopkins University Applied Science Laboratory. He is Vice President of the IEEE Neural Networks Council, and Vice Chairman of the Baltimore Chapter of the EMBS.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

A VLSI ARCHITECTURE FOR HIGH-PERFORMANCE, LOW-COST, ON-CHIP LEARNING

Dan Hammerstrom
Adaptive Solutions, Inc.

Wednesday, October 3, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

This talk presents a new chip architecture for inexpensive, high-performance ANN (Artificial Neural Network) emulation, and the design rationale that led to the final chip architecture.

Our primary design assumption was that for real applications, inexpensive, high-performance neural network emulation is required, yet as much flexibility as possible must be retained. There are a number of reasons for this philosophy. Due to the current state of ANN research, we need to perform a large range of arbitrary learning algorithms (both existing and yet to be conceived). And, because most ANN applications will require non-ANN pre-processing and post-processing, the more functionality that can be moved into a single chip, the lower the total system integration costs.

The basic architecture of the chip consists of an array of simple digital processors that communicate via a simple interconnect structure. The digital design provides sufficient precision and flexibility to allow not only on-chip learning, but the execution of a number of algorithms of a non-neural network nature, such as fuzzy logic, rule based systems, traditional statistical classification, and standard digital signal processing. Nevertheless the chip is optimized for ANN processing and has a number of features to support that application domain.

The small processor size and the use of ULSI (Ultra Large Scale Integration) allow a large number of processors to be placed onto a single die, giving single chip performance of over one billion connections computed per second.

BIOGRAHICAL INFORMATION

Dan Hammerstrom received a B.S. degree from Montana State University, an M.S. degree from Stanford University, and his Ph.D. degree from the University of Illinois, all in Electrical Engineering. He was on the faculty of Cornell University from 1977 to 1980 as an Assistant Professor. From 1980 to 1985 he worked for Intel where he participated in the development and implementation of the iAPX-432 and iAPX-80960, and, as a consultant, on the iWarp systolic processor. He is founder and Chief Technical Officer of Adaptive Solutions, Inc., and is also an Associate Professor at the Oregon Graduate Institute. He has been a Visiting Professor at the Royal Institute of Technology in Stockholm, Sweden. Dr. Hammerstrom's research interests are in the area of the VLSI implementation of neural network structures.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

DEPARTMENT OF ELECTRICAL ENGINEERING & INTERACTIVE SYSTEMS DESIGN LAB

University of Washington

EE 500A WEEKLY RESEARCH SEMINARS

4:30 - 5:30 p.m.
Electrical Engineering Building, Room 108

Oct. 3, 1990	Dan Hammerstrom, Ph.D. Adaptive Solutions, Inc. Beaverton, Oregon
Oct. 10, 1990	Russ Eberhart, Ph.D. JHU Applied Physics Laboratory Johns Hopkins University
Oct. 17, 1990	Tom Caudell, Ph.D. Boeing Computer Services Seattle, Washington
Oct. 24, 1990	R. Douglas Martin, Professor Department of Statistics University of Washington
Oct. 31, 1990	Bradley Holt, Assistant Professor Chemical Engineering University of Washington
Nov. 7, 1990	Eberhard E. Fetz, Professor Physiology and Biophysics University of Washington
Nov. 14, 1990	Mohamed El-Sharkawi, Professor Department of Electrical Engineering University of Washington
Nov. 21, 1990	Kwan F. Cheung, Ph.D. Acting Assistant Professor University of Washington
Nov. 28, 1990	No Seminar
Dec. 5, 1990	James A. Ritcey, Associate Professor Electrical Engineering University of Washington
Dec. 12, 1990	Leon Cohen, Professor Hunter College and Graduate Center City University of New York

INDIVIDUAL SEMINAR ANNOUNCEMENTS WILL BE SENT WEEKLY

DEPARTMENT OF ELECTRICAL ENGINEERING & INTERACTIVE SYSTEMS DESIGN LAB

University of Washington

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INDIVIDUAL SEMINAR ANNOUNCEMENTS WILL BE SENT WEEKLY

ISDL SEMINAR

QUADRATIC FUNCTION NEURAL NETWORKS WITH MINIMUM CROSS CONNECTIONS

Kwan F. Cheung
Visiting Assistant Professor
Department of Electrical Engineering
University of Washington

Wednesday, November 21, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

A very popular usage of the backpropagation neural network (BPNN) models is to train the network as classifiers. In the first order model (or linear model), linear neurons are used. When computing on continuously valued features, quadratic function neurons (QFN) provides a capability for prototypic categorization which linear neurons provides for binary features. We refer to the BPNN models utilizing the QFN's as the quadratic function neural network (QFNN) models.

The QFNN model is architecturally identical to its linear counterparts. Each neuron in the i^{th} layer receives the outputs of the neurons in the $(i-1)^{th}$ layer. In a QFNN, the neuron receives, in addition to the linear terms, the quadratic terms as well. The increases of the second order terms can be dramatic even for moderate m. The dramatic increase of terms poses two problems: 1) fan-in problems; and 2) the dramatic increases of cross connections among layers. Clearly, these two problems poses a challenge to the neural network designer in particular in mapping the QFNN model onto silicon.

In this talk, we present an alternate architecture to implement the QFNN model. The new architecture expresses the interconnect weights for every term as a function of a few parameters, with only a minor loss of the degree of freedom. In exchange, the fan-in for each neuron is reduced down to m again. Hence, the amount of cross connections is also down to that of the linear models. The new architecture also allows the designer to know the exact number of neurons used given that the number of clusters is known. In part 2 of the talk, we will discuss the design methodology of the QFNN of one hidden layer in the scenario of capturing one class of data and also of multiple classes of data. We will also discuss the design methodology of expanding the network into two layers. By incorporating this second layer, clusters of higher than quadratic order can be captured. Different learning paradigms for this new architecture will be presented along with examples.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

University of Washington Correspondence

INTERDEPARTMENTAL

Interactive Systems Design Laboratory, Department of Electrical Engineering, FT-10

11/4/88

TO: EE Faculty
FROM: Robert J. Marks II
SUBJECT: Visit of Bill Rhodes and Theresa Maldonado

8:30 Coffee & Doughnuts (EEBldg. Room 420)

8:45 Meeting with R. Aaron Falk, Boeing Aerospace

9:15 Seminar Preparation

9:30 Seminars:

Nonlinear Optical Image Filtering
Wm. T. Rhodes

Eigenstates of Polarization in Electro-Optic and Gyroscope Media
Theresa A. Maldonado

10:45 Meet with Endrik Noges, Department Chair

11:00 Meet with Prof. Marks

11:45 Leave for airport

ISDL SEMINAR

NEURAL NETWORK MODELS OF PRIMATE MOTOR SYSTEMS

Professor Eberhard E. Fetz
Department of Physiology and Biophysics
University of Washington

Wednesday, November 7, 1990, 4:30 p.m.
Electrical Engineering Building, Room 108

ABSTRACT

Dynamic neural network models that incorporate time-varying activity and allow unrestricted connectivity were trained by back-propagation to generate discharge patterns of neurons previously observed in behaving monkeys. Neuronal recordings in monkeys performing a simple alternating step-tracking task have shown that forearm motor units and connected premotoneuronal cells fire with characteristic patterns: phasic-tonic, tonic, decrementing, etc. To investigate the properties of networks that could transform a step input of target position to the four observed discharge patterns of flexor and extensor motor units we trained dynamic network models to generate these firing patterns as outputs. These networks have hidden units with either excitatory or inhibitory connections to each other and to the output "motor units." Network solutions have been found for a variety of connection matrices corresponding to different network topologies. The activity of many hidden units resembles the discharge patterns that have been observed in physiological recordings of neurons in motor cortex and red nucleus. In networks receiving both sustained (step) input and transient input signals, preferential connections can develop within subsets of phasic and tonic units.

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Networks are being developed to simulate delayed response tasks, in which transient cues determine the appropriate response to make after a temporal delay.

Presented by
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, Washington 98195

ISDL SEMINAR

THE USE OF NEURAL NETWORKS FOR PROCESS CONTROL AND IDENTIFICATION

Associate Professor Bradley R. Holt
Department of Chemical Engineering
University of Washington

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ISDL SEMINAR

NEURAL NETWORK MODELS OF PRIMATE MOTOR SYSTEMS

Professor Eberhard E. Fetz
Department of Physiology and Biophysics
University of Washington

Wednesday, November 7, 1990, 4:30 p.m.
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Seattle, Washington 98195

ISDL SEMINAR

PUGET POWER'S EXPERIENCE FORECASTING WITH STRUCTURAL MODELS

Milan Casey Bruce
Puget Power and Light Company

Wednesday, November 15, 1989, 3:30 PM
Electrical Engineering Building, Room 108

ABSTRACT

During the past year Puget Sound Power and Light Company used a new forecasting technique, structural models, to forecast a variety of time series. Structural modeling was developed over the past five years by Andrew Harvey and James Durbin at the London School of Economics. The method consists of expressing a time series in terms of level, trend, seasonal and cyclic components and then translating this expression into state space format. Once in state space format, model parameters can be estimated using a Kalman fileter.

Puget Power's experience with structural models has been very positive with the methodology exhibiting a number of favorable attributes. These include ease of developing a forecast, decomposition of the forecast into easily understood components and the ability to incorporate explanatory variables when needed. Because of the time-varying nature of the model parameters, structural models have been especially useful in forecasting series that have a changing seasonal pattern.

A PC based software package, Structural Time Series Analysis and Modeling Package (STAMP) is available to make the use of structural models practical.

For more information about this seminar series, contact:
Prof. Les Atlas or Prof. Robert Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)545-1315 or (206)543-6990

ISDL SEMINAR

Computing Linear Parts of Nonlinear Smoothers

Prof. R. Douglas Martin
Department of Statistics
University of Washington

Wednesday, October 25, 1989, 3:30 PM
Electrical Engineering Building, Room 108

ABSTRACT

In 1980 Mallows introduced the concept of the *linear part* of a nonlinear smoother. This concept allows one to characterize the properties of nonlinear smoothers in a useful way. Except in special cases the linear part is not analytically computable. This talk discusses simulation methods for computing the linear part. Through using such methods we are able to show that a suitably defined *bandwidth* of moving median smoothers is roughly inversely proportional to the span of such smoothers.

For more information about this seminar series, contact:
Prof. Les Atlas or Prof. Robert Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)545-1315 or (206)543-6990

ISDL SEMINAR

Photoconductive Switch Based Combinatorial Logic

Dr. R. Aaron Falk
Boeing Aerospace

Wednesday, December 6, 1989, 3:30 PM
Electrical Engineering Building, Room 108

For more information about this seminar series, contact:
Prof. Les Atlas or Prof. Robert Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)545-1315 or (206)543-6990

ISDL SEMINAR

NEURAL NETWORKS FOR NONLINEAR SYSTEM MODELLING

Les E. Atlas

Department of Electrical Engineering
University of Washington

Wednesday, October 26, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

This talk will be a tutorial on learning for multi-layer neural networks with application to large nonlinear problems. The link to nonlinear problems will be made by Lapedes and Farber ["Nonlinear Signal Processing Using Neural Networks: Prediction and System Modelling," submitted to *IEEE Proceedings*]. The practical issues in large problems will be described through the work of Moody and Darken ["Learning with Localized Receptive Fields," to appear in *Proc. 1988 Connectionist Models Summer School]*.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

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Milan Casey Bruce
Puget Power and Light Company

Wednesday, November 15, 1989, 3:30 PM
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ISDL SEMINAR

Musical Chord Classification by Neural Networks

Dr. Bernice Laden
School of Music
University of Washington

Wednesday, November 1, 1989, 3:30 PM
Electrical Engineering Building, Room 108

ABSTRACT

Most musicians are able to classify musical chords as major, minor, or diminished quite easily. The task requires the ability to recognize the invariant structure underlying each chord type. Because artificial neural networks have tackled a variety of invariance problems, the chord classification task appeared to be a good candidate for a neural network application.

The main focus of this talk is upon the representation of input to the network. Three types of chord representations are explored: (1) pitch class, (2) harmonic template, and (3) subharmonic template. The pitch class representation names the fundamental pitch of each chord tone. A harmonic template represents each chord tone as a complex of its first five harmonics, while a subharmonic template represents each chord tone as a complex of its first six subharmonics. Each network was trained to recognize the 36 root position major, minor, and diminished chords using back propagation. Networks were tested using incomplete template patterns, chord inversions, and simulated power spectrum input.

For more information about this seminar series, contact:
Prof. Les Atlas or Prof. Robert Marks II
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ISDL SEMINAR

A PERFORMANCE COMPARISON OF TRAINED MULTI-LAYER PERCEPTRONS AND TRAINED CLASSIFICATION TREES

Professor Les Atlas,
Department of Electrical Engineering
University of Washington

Wednesday, October 4, 1989, 3:30PM
EE Bldg., Room 108

ABSTRACT

Multi-layer perceptrons (also known as backpropagation neural networks) and trained classification trees are two very different techniques which have recently become popular. Given enough data and time, both methods are capable of performing arbitrary non-linear classification. These two techniques, which developed out of different research communities, have not been previously compared on real-world problems. We first consider the important differences between multi-layer perceptrons and classification trees and conclude that there is not yet enough theoretical basis for the clear-cut superiority of one technique over the other. For this reason, we performed a number of empirical tests on quite different problems in power system security, power system load forecasting, and speaker-independent vowel identification. We compared the performance for classification and prediction in terms of accuracy outside the training set. In all cases, even with various sizes of training sets, the multi-layer perceptron performed significantly better than the univariate version of the classification trees. These results were also looked at in detail to suggest theoretical reasons for the relative superiority of multi-layer perceptrons.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

SYSTOLIC ARRAY DESIGNS FOR KALMAN FILTERING

Professor Jenq-Neng Hwang
Department of Electrical Engineering
University of Washington

Wednesday, September 27, 1989, 3:30PM

EE Bldg., Room 108

ABSTRACT

This talk presents systolic Kalman filter (SKF) designs based on a triangular array (triarray) configuration. A least squares formulation, which is an expanded matrix representation of the state space iteration, is adopted to develop an efficient iterative QR triangularization and consecutive data pre-whitening formulations. This formulation has advantages in both numerical accuracy and processor utilization efficiency. Moreover, it leads naturally to pipelined architectures such as systolic or wavefront arrays. For an n states and m measurement dynamic system, the SKF triarray design uses $n(n + 3)/2$ processors and requires only $4n + m$ timesteps to complete one iteration of pre-whitened Kalman filtering system. This means a speed-up factor of approximately $n^2/4$ when compared with a sequential processor. Also proposed for the colored noise case are data pre-whitening triarrays which offer compatible speed-up performance for the preprocessing stage. Based on a comparison of several competing alternatives, the proposed array processor maybe considered a most efficient systolic or wavefront design for Kalman filtering.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
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ISDL SEMINAR

EAR:
English Alphabet Recognizer

Professor Ron Cole

Oregon Graduate Center
Beaverton, Oregon

Wednesday, October 11, 1989, 3:30pm
EE Bldg., Room 108

ABSTRACT

The English alphabet is one of the most difficult vocabularies for automatic speech recognition because of the acoustic similarity of the letters. For example, the letters in the "E set," B D E P T G V Z C, include several pairs that differ by a single phonetic feature (e.g., B vs. D, B vs. V, B vs. P, P vs. T, V vs. Z, C vs. Z). Although human listeners can recognize spoken letters with an error rate of less than 1%, no computer recognition system has been able to perform speaker-independent letter recognition with error rates of less than 10%. Until speech recognition systems are able to perform fine phonetic distinctions, they will remain laboratory systems rather than commercial products.

We have recently developed a letter recognition system called EAR (English Alphabet Recognizer) that combines speech knowledge and neural network classifiers to recognize spoken letters. EAR performs four basic functions:
(1) Speech is digitized and the spoken letter is located within a two second buffer containing the waveform,
(2) Representations useful for segmentation and phonetic classification are computed (e.g., DFT, zero crossing counts, pitch estimate),
(3) Rules applied to the representations locate speech segments and assign a broad category label to each segment (stop, fricative, vowel or silence),
(4) Neural network classifiers use features derived from the representations to identify the letter.

EAR was first demonstrated on September 15, 1989. Performance is currently 85% on speakers that were not used to train the system. We will describe the problems associated with spoken letter recognition, the reasons for the errors that are made, and detail the research now underway to improve performance.

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ISDL SEMINAR

Computing Linear Parts of Nonlinear Smoothers

Prof. R. Douglas Martin
Department of Statistics
University of Washington

Wednesday, October 25, 1989, 3:30 PM
Electrical Engineering Building, Room 108

ABSTRACT

In 1980 Mallows introduced the concept of the *linear part* of a nonlinear smoother. This concept allows one to characterize the properties of nonlinear smoothers in a useful way. Except in special cases the linear part is not analytically computable. This talk discusses simulation methods for computing the linear part. Through using such methods we are able to show that a suitably defined *bandwidth* of moving median smoothers is roughly inversely proportional to the span of such smoothers.

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ISDL SEMINAR

Musical Chord Classification by Neural Networks

Dr. Bernice Laden
School of Music
University of Washington

Wednesday, November 1, 1989, 3:30 PM
Electrical Engineering Building, Room 108

ABSTRACT

Most musicians are able to classify musical chords as major, minor, or diminished quite easily. The task requires the ability to recognize the invariant structure underlying each chord type. Because artificial neural networks have tackled a variety of invariance problems, the chord classification task appeared to be a good candidate for a neural network application.

The main focus of this talk is upon the representation of input to the network. Three types of chord representations are explored: (1) pitch class, (2) harmonic template, and (3) subharmonic template. The pitch class representation names the fundamental pitch of each chord tone. A harmonic template represents each chord tone as a complex of its first five harmonics, while a subharmonic template represents each chord tone as a complex of its first six subharmonics. Each network was trained to recognize the 36 root position major, minor, and diminished chords using back propagation. Networks were tested using incomplete template patterns, chord inversions, and simulated power spectrum input.

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ISDL SEMINAR

HIDDEN MARKOV MODELING OF FORCES AND TORQUES IN ROBOTIC MANIPULATION

Prof. Blake Hannaford
Dept. of Electrical Engineering
University of Washington

Wednesday, October 18, 1989, 3:30PM

EE Bldg., Room 108

ABSTRACT

The Hidden Markov Model (Stochastic Functions of a Markov Process: HMM) has recently proven extremely useful in modeling the sensor information received when a robot performs an energetic-interaction task such as assembly, within a loosely structured environment. The HMM has several properties that make it attractive for use as a near-real-time executuion monitor and post hoc "explainer" in practical applications. Among them are:

- Explicit Representation of uncertainty.
- Support for "knowledge based" operation (the HMM can be constructed heuristically by an expert).
- Closed form, thoroughly developed, efficient algorithms for state estimation (Viterbi) and model identification (Baum-Welch).
- A "P value" can be obtained indicating degree of model fit to data.
- Support for multi-sensor fusion.

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ISDL SEMINAR

MULTIDIMENSIONAL MAXIMUM ENTROPY SPECTRAL ESTIMATION

Xinhua Zhuang

Visiting Professor
Department of Electrical Engineering
University of Washington

Wednesday, August 23, 1989, 3:30PM

EE Bldg., Room 108

ABSTRACT

The well known power spectrum is the most widely used concept in application of one dimensional or multidimensional random signals. Since Burg's pioneering work, among a number of spectral estimators, the maximum entrop (ME) method of spectral estimation has generated an enormous amount of interest in the field of time series analysis. This is primarily due to that the ME spectral estimate can provide excellent frequency resolution and that the 1-D ME estimate can be efficiently computed from linear equations of AR-signal modeling. In the m-D case, however, the true maximum entropy spectral estimate is distinctly different from the spectrum derived by AR-modeling. It is also more general than the AR spectral estimate. Moreover, the m-D AR spectral estimate will usually not satisfy the correlation matching property, whereas the true m-D ME spectrum will. Unfortunately, the computation of the m-D ME spectral estimate appears to require the solution of a difficult nonlinear optimization problem. In this talk, we present a general algorithm to solve the m-D maximum entropy spectral estimation with computational efficiency. We also explain the possibility of implementing the proposed m-D ME spectral estimator via an analog neural net.

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ISDL SEMINAR

TIME-FREQUENCY SPEECH DISPLAYS THAT ARE AN IMPROVEMENT OVER THE SPECTROGRAM

(M.S.E.E. Final Exam)

William Kooiman

Wednesday, August 9, 1989, 3:30PM

EE Bldg., Room 108

ABSTRACT

The use of a cone-shaped kernel (originally introduced by Zhao, Atlas and Marks in 1987) resulted in a breakthrough in generating time-frequency distributions of non-stationary signals. It is similar to the Wigner distribution, in that a true non-stationary assumption yields displays with high simultaneous resolution in time and frequency. The cone shaped kernel however smooths crossterms to drastically reduce interference, but still maintains finite time support. The result is a spectrogram-like display with much greater detail and clarity than has been previously obtained. The main work of this Master's Thesis was to design an experiment environment which shows that these new results are potentially applicable to speech, sonar transients, and other non-stationary signals.

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ISDL SEMINAR

A COMPARATIVE STUDY OF CODEBOOK GENERATION TECHNIQUES FOR IMAGE VECTOR QUANTIZATION

(M.S.E.E. Final Exam)

Jean D. Mc Auliffe

Wednesday, August 16, 1989, 3:30PM

EE Bldg., Room 108

ABSTRACT

The storage or transmission of images requires either large capacity and/or bandwidth. Many diverse fields such as medical imaging, satellite transmission, military communication and displays, all show requirements for reducing the amount of information contained in images. Image vector quantization seeks to reduce the bit-rate while minimizing distortion. A Kohonen neural network is compared to the traditional method of Linde, Buzo, Gray (LBG). It will be shown that this neural network can offer a viable and perhaps better alternative for low bit-rate image compression.

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SPECIAL ISDL SEMINAR

SPEECH RECOGNITION USING CONNECTIONIST NETWORKS

Raymond L. Watrous

Dept. of Computer Science, University of Toronto

Thursday, February 16, 1989, 3:30 PM
EE Bldg., Room 420

ABSTRACT

The use of connectionist networks for speech recognition is assessed using a set of representative phonetic discrimination problems. A connectionist network model called the Temporal Flow Model is defined which represents temporal relationships using delay links and permits general patterns of connectivity including feedback. It is argued that the model has properties appropriate for time varying signals such as speech.

Methods for selecting network architectures for different recognition problems are presented. The architectures discussed include random networks, minimally structured networks, hand crafted networks and networks automatically generated from samples of speech data.

Networks are trained by modifying their weight parameters so as to minimize the mean squared error between the actual and the desired response of the output units. Training is accomplished by a second order method of iterative nonlinear optimization by gradient descent which incorporated a method for computing the complete gradient of recurrent networks.

Network solutions are demonstrated for all eight phonetic discrimination problems for one male speaker. The network solutions are analyzed carefully and are shown in every case to make use of known acoustic phonetic cues. The network solutions vary in the degree to which they make use of context dependent cues to achieve context invariant phoneme recognition. New concepts of biological auditory processing are suggested by the ways in which these cues were extracted and combined.

The network solutions were tested on data not used for training and achieved an average accuracy of 99.4%. It is concluded that acoustic phonetic speech recognition can be accomplished using connectionist networks.

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DEPT OF EE AND ISDL SEMINAR

A UNIFIED MODELING/ARCHITECTURE FOR CONNECTIONIST NEURAL NETWORKS

Jenq-Neng Hwang, Ph.D.

Princeton University

Thursday, February 23, 1989, 9:30-10:30 AM
EE Bldg., Room 420

ABSTRACT

Neural networks offer an attractive new computational tool for many applications. Their real potential lies in the ability to learn and self-adapt. To fully realize this potential, there is a need for reexamination of the theoretical foundations of existing neural networks. To this end, a unified formulation of iterative neural networks is proposed. The formulation will allow us to better understand several critical issues in the existing neural networks, such as network dynamics, convergence and connectivity issues.

It can also help further our understanding of the relationship between neural networks and conventional pattern classification approaches. New models may be derived by appropriately characterizing the parameters in this iterative neural network. This formulation also leads to a unified programmable ring systolic architecture, which maximizes the strength of VLSI in terms of intensive and pipelined computing and yet circumvents the limitation on communication. It may be adopted as a basic structure for a universal simulation tool and neurocomputer architecture.

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ISDL SEMINAR

PERCEPTIONS AND INTELLIGENCE; PIAGET, PERCEPTRONS AND PUBERTY

Prof. David Johnson

Dept. of Electrical Engineering, University of Washington

Wednesday, February 22, 1989, 3:30 PM
EE Bldg., Room 108

ABSTRACT

There has been endless lay-discussion in reference to the analogy between human learning and that exhibited by neural nets. We will attempt to provide a framework based upon the theories of Piaget by which intelligent behavior, perception and neural net activity can be compared. Such comparisons may be of vital significance in assessing the utility and application of various neural architectures as a part of intelligent systems.

While neural net research is developing its own structural and application theories, it is still a sufficiently new domain that there is time to influence and orient these theories (or perhaps simply interpret them from a given observation window) in such a way that we do not once again end up with a more or less accomplished scientific artifact which has been completed without a theoretical consideration of the general base to which it will be put.

If time remains, we will briefly discuss some upper-level neural net architectures that might be suggested by moving from AI to neural nets, rather than the inverse process.

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ISDL SEMINAR

ARCHITECTURES FOR MULTI-SCALE NEURAL NETWORKS

Prof. Les E. Atlas

Interactive Systems Design Laboratory
Dept. of Electrical Engineering, University of Washington

Wednesday, February 15, 1989, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The notion of multi-scale signal processing is based upon parallel operations on different scales of resolution. For example, the recognition of a word could involve simultaneous matching at the levels of successive short-time spectra, phoneme context, and surrounding word context. These different levels of matching could be considered to be successively cruder representations of resolution. In this talk we will propose several new (and biologically inspired) neural network architectures which make use of multi-scale signal processing to allow for 1)faster training, 2)very regular implementation, and 3)much better scalability. 1-dimensional, 2-dimensional isotropic and 2-dimensional anisotropic cases will be discussed. It will also be shown how the 2-dimensional anisotropic case is particularly well-suited to recognition of signals (including context) which are functions of time and how this case is a generalization of our previously-discussed dynamic neural net.

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RESCHEDULED

ISDL SEMINAR

A GALLIUM ARSENIDE BASED PERIPHERAL VISUAL SYSTEM

Bahram Nabet; Ph.D. Candidate

Department of Electrical Engineering, University of Washington

Wednesday, February 8, 1989, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The biological visual system has many processing capabilities which cannot be found in the most sophisticated present computers. In this talk we introduce a neural network model, derived from studies of insect vision, that captures some of these capabilities and shows that the network can be implemented extremely efficiently in a variety of solid-state technologies including gallium arsenide. Specifically, contrast enhancement, data compression, and adaptation to mean input intensity properties of the network will be demonstrated by a discrete component implementation. Finally, since the network implements a mathematically well described and stable model, its relation to the multi-layer self-organizing neural network architecture of Adaptive Resonance Theory (ART) will be mentioned.

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ISDL SEMINAR

RADAR CFAR DETECTION TECHNIQUES

James A. Ritcey

Department of Electrical Engineering
University of Washington

Wednesday, January 18, 1989, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Radar constant false alarm rate (CFAR) detection is concerned with the detection of targets in cluttered environments. In MTI radar, the classical problem is the detection of a point target ia a background of Gaussian noise of unknown level. The classical solution is to use an adaptative threshold, whereby the cell-under-test variate is compared to a weighted estimate of the unknown noise level. The optimal technique for Rayleigh clutter is to use the sample mean, composed of a average of nearby resolution cell variates. Distribution-free or nonparametric tests as well as nore complex adaptative threshold tests are possibilities for more general non-Gaussian clutter distributions.

The purpose of this talk is to review the classical techniques and introduce alternative, outlier-resistant methods based on order statistics, or sorted data values. We analyze the probability of detection for the Censored Mean Level Detector (CMLD) in a multiple target environment and go on to consider techniques designed to deal with clutter edges. This leads to the so-called MAX family of CFAR detectors, and we provide performance curves, simulation results, and some design advice.

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ISDL SEMINAR

VLSI ARCHITECTURES FOR COMPLEX DIGITAL FILTERING

Dr. Ramasamy Krishnan

Information Processing Laboratory
Boeing High Tech Center

Wednesday, January 11, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Many complex digital signal processing (DSP) applications require high quality computational hardware to process complex data. To process complex data, the dedicated digital signal processing architectures are cost effective compared to the general purpose architectures. In order to obtain high quality and low-cost computational hardware, the rapidly growing interaction between VLSI technology and modern signal processing has the natural basis. To meet the computational requirements for complex digital signal processing applications, the number theoretic algorithms are the most appropriate because, each complex multiplication can be performed with two/three real multipliers.

Although the computational demand is influenced by faster circuit design and efficient algorithm development, it can also be dramatically affected with clever architecture design. In the design of DSP architectures, a good algorithm-architecture mapping is critical in order to achieve efficiency and high performance. Several recent contributions to the literature in signal processing, computer architecture, and VLSI design showed that systolic architectures are extremely useful to handle massively parallel operations in the design of special purpose high performance DSP architectures. It is shown how an efficient mapping can be achieved between the number theoretic algorithms and VLSI architectures.

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ISDL SEMINAR

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Wednesday, January 11, 1988, 3:30 PM
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ABSTRACT

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ISDL SEMINAR

THE EFFECTS OF CLOCK SKEW ON THE CONVERGENCE AND STABILITY OF CERTAIN NONLINEAR ITERATIVE ALGORITHMS

Professor Robert J. Marks II

Interactive Systems Design Laboratory
Dept. of Electrical Engineering

Wednesday, January 4, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Certain artificial neural network and signal restoration algorithms make use of iterations to converge to a desired solution. In certain asynchronous implementations of these algorithms, the presence of clock skew can result in either an unstable solution or a solution far different than that desired. We examine a class of such algorithms and show that if the synchronous algorithm includes a (possibly nonlinear) contractive operation in the feedback path, then, if the skewed iteration is stable, skew will not affect the steady state result. Stability criteria can also be established for such iterations. As examples, a number of optical processors that use feedback will be examined for their skew properties. Here, clock skew typically results from differing optical path lengths.

BIOGRAPHICAL INFORMATION

Dr. Marks joined the faculty of the Department of Electrical Engineering at the University of Washington, Seattle, in December of 1977 where he currently holds the title of Professor. He was awarded the *Outstanding Branch Councillor* award in 1982 by IEEE and, in 1984, was presented with an *IEEE Centennial Medal*. He is a Senior Member of IEEE. Prof. Marks is also Chair of the *IEEE Circuits & Systems Society Technical Committee on Neural Systems & Applications* and is Chairman pro tem of the *IEEE Neural Networks Committee* which coordinates all of the activities relating to neural networks in IEEE. He was a co-founder and first President of the *Puget Sound Section of the Optical Society of America* and was recently elected that organization's first honorary member. Dr. Marks has over eighty archival journal and proceedings publications in the areas of detection theory, signal recovery, optical computing and artificial neural processing. He is a member of Eta Kappa Nu and Sigma Xi. Bob is a good engineer and all round swell guy.

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ISDL SEMINAR

NEURAL NET APPLICATIONS TO DATA FUSION

Ken Ogami

Wednesday, December 7, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The application of neural net architectures to data fusion presents an attractive alternative to Bayesian techniques. Although not optimum, neural nets potentially offer superior performance in terms of processing speed for multiple signals. This talk will discuss a methodology by which a neural net solution can be formulated, while tracking the expected performance against an optimum solution.

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ISDL SEMINAR

INTERFERENCE REJECTION TECHNIQUES FOR FAST FREQUENCY HOPPED COM SYSTEMS

James A. Ritcey

Department of Electrical Engineering
University of Washington

Wednesday, November 30, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Fast frequency-hopped spread spectrum (FFH-SS) communications systems are primarily used for military and multi-access networks requiring covert operation and a high degree of processing gain. Difficult operating environments include both partial band noise jamming and stationary narrowband interference. Following an introduction to spread spectrum techniques, and FFH-SS specifically, we discuss recent advances in applying combinations of pre- and post-detection signal processing designed to mitigate the effects of jamming. The signal processing will consist of pre-detection (coherent) linear filtering with a fractionally spaced tapped delay line and post-detection combining using order statistics. Results on this topic were recently presented at the IEEE Military Communications Conference (MILCOM).

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ISDL SEMINAR

POWER SYSTEM SECURITY ASSESSMENT USING ARTIFICIAL NEURAL NETWORKS

M. E. Aggoune

Department of Electrical Engineering
University of Washington

Wednesday, November 16, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The growth of large interconnected power systems demands a high degree of security (robustness vis-a-vis potential contingencies) for normal operation. This requirement emerges from the fact that the possible disturbances in large power systems could have catastrophic results. Following the Northeast United States blackout of 1965, and the New York City blackout in 1977, increasing attention was directed to the problem of security assessment. Despite the procedural difficulties resulting from the amount of data to be gathered, and the number of potential disturbances, rudimentary techniques are available. These techniques are in general time consuming for on-line application

In this seminar, preliminary results of using an Artificial Neural Network (ANN) to assess the steady state (dynamic) security of a power system are presented. The results are encouraging, indicating that ANN is a good candidate for on-line security assessment.

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ISDL SEMINAR

AN ARTIFICIAL NEURAL NETWORK FOR THE VECTOR QUANTIZATION OF SPEECH

Charles E. Pope

Wednesday, November 23, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Vector Quantization is a method for producing low bit rate speech. At the core of a VQ system is the codebook, an assemblage of vectors which are used to represent the entire input space. The standard technique for generating the codebook of a VQ system is the LBG algorithm, an iterative algorithm that is guaranteed to converge to an optimal solution. However, the LBG algorithm often converges to a local optimum; also, it does not allow the real-time adaptation of the codebook to adjust for changing inputs. Kohonen's self-organizational learning algorithm can be used for real-time updates to the codebook and offers the promise of avoiding local optimums. Two versions of Kohonen's self-organizational learning algorithm were employed to produce VQ codebooks, and the results were compared to those produced using the LBG algorithm. Our experiments on low bit rate speech indicate that the self-organizational algorithm produces codebooks that rival those produced using the LBG algorithm.

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SPECIAL ISDL SEMINAR

NONLINEAR OPTICAL IMAGE FILTERING

William T. Rhodes

Georgia Institute of Technology
School of Electrical Engineering
Atlanta, GA

Abstract

During the past two years we have built a research program that has its roots in three disparate but important areas of current scientific and engineering interest: symbolic substitution, mathematical morphology, and human vision. Symbolic substitution is considered by many optical computing researchers to be the most likely computational method to be employed in parallel-processing opto-electronic computers of the future. Mathematical morphology involves the transformation of shapes through interaction of the shapes with a so-called structuring element. And modern vision models place emphasis on simple processing operations performed in the network of neurons immediately behind the retina. The common element in these three areas is a combination of linear, shift-invariant filtering followed or preceded by hard nonlinearities. In this talk we will describe how these roots are leading to new developments in optical image processing that exploits state-of-the-art spatial light modulator technology along with the traditional parallel-processing capabilities of optical systems.

and

EIGENSTATES OF POLARIZATION IN ELECTRO-OPTIC AND GYROTROPIC MEDIA

Theresa A. Maldonado

School of Electrical Engineering
Georgia Institute of Technology
Atlanta, GA

Abstract

Many practical modulator materials include combinations of electro-optically induced birefringence, optical activity, Faraday rotation, and other effects. For example, bismuth silicon oxide is isotropic and optically active. However, when an electric field is applied in an arbitrary direction, the optical properties change due to the electro-optic and electrogyration effects; i.e., both linear and circular birefringence are induced. Hence, there exists a need for a procedure to design and analyze devices fabricated with materials exhibiting any or all of these effects. In this presentation a complete, systematic, and numerically stable design approach (which can be done by hand) employing the general Jacobi method will be discussed for determining the principal indices and axes of any crystal manifesting various optical effects due to arbitrarily directed fields. In addition, a set of simple expressions resulting from an extension of the general Jacobi method applied to Hermitian matrices will be presented for calculating the phase velocity indices of refraction and for fully describing the corresponding elliptical eigenpolarizations for a general direction of phase propagation in a lossless, electro-optic, and gyrotropic medium.

Monday, November 7, 1988, 9:30-10:30 AM
EE Bldg., Room 420

ISDL SEMINAR

DEVELOPMENT OF A DEMISYLLABLE-BASED SPEECH SYNTHESIS SYSTEM

Stephen J. Eady

Centre for Speech Technology Research
University of Victoria, Victoria, B.C.

Wednesday, November 9, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

This presentation will describe various aspects in the development of an automated voice output system that uses prerecorded demisyllables (half syllables) as units of speech synthesis. With an inventory of 850 demisyllables, the system is capable of producing all possible syllables and words of English. In order to produce natural-sounding speech, rules have been developed for joining demisyllables into syllables, words and sentences. These rules involve changes to the spectral and prosodic aspects of the demisyllable units. The description of the system will be accompanied by an audio demonstration of the speech synthesis that it produces.

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ISDL SEMINAR

A THEORY OF LEARNING

Prof. Richard Ladner

Department of Computer Science
University of Washington

Wednesday, November 2, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

In the early 1980's Les Valiant developed a theory of machine learnability. In this talk we describe the theory and the main results to date. The purpose of the theory is to first make precise what it means for a problem to be solvable by learning from examples. The definition of learnability uses concepts from computational complexity. A problem is solvable by learning only if there is a polynomial time algorithm for learning from a polynomial number of examples. Secondly, the theory has been useful in classifying which practical problems have learnable solutions and which do not. In spite of human existence proofs there are a wide variety of problems which do not have learnable solutions.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL REPORT

SPEECH RECOGNITION BY MAN AND MACHINE

Prof. Ron Cole

Oregon Graduate Center
Beaverton, Oregon

Wednesday, October 12, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Human speech perception is accurate and robust. We can understand a stranger over a noisy phone line or a fan shouting insults at the visiting team. By comparison, machine recognition systems are limited and fragile. Despite impressive performance gains in the last five years, today's systems perform well only when the task is highly constrained.

Why do people recognize speech so much better than machines, and what can be done to close the gap? This talk will examine the problems involved in speaker-independent recognition of continuous speech, and the strategies used by man and machine to overcome these problems. A recognition system will be described that attempts to incorporate principles of human perception, in the form of expert knowledge, with the best features of current recognition and neural network technology.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

RECENT RESULTS ON HIGH RESOLUTION TIME-FREQUENCY DISPLAYS FOR NONSTATIONARY SIGNALS

Prof. L. E. Atlas

Dept. of Electrical Engineering
University of Washington

Wednesday, October 5, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

For time-varying signals such as speech and SONAR, it is often useful to be able to see successive slices of short-time spectra. The conventional techniques used for these displays are spectrograms or waterfall displays. A common observation is that these pictures do not accurately represent the simultaneous high resolution in time and frequency that our own ears can achieve. These conventional techniques are based on short-time Fourier transforms of windowed time series, which have the property of never becoming negative. By relaxing this property (allowing some negative values) and looking, instead, at two-dimensional transforms of nonstationary autocorrelation functions, a completely new approach is possible. We have derived two-dimensional window functions for this new approach which lead to markedly improved time-frequency displays. Examples using frequency modulated sine waves and using real speech samples will be presented to contrast these new displays with conventional spectrograms.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

SPECIAL

ISDL SEMINAR

BACK-PROPOGATION NETWORKS FOR EVENT-DRIVEN TEMPORAL SEQUENCE PROCESSING

Dr. Katsunori Shimohara

NTT Human Interface Laboratories
Japan

Monday, August 15, 1988, 1:00 PM
EE Bldg., Room 209A

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

ON STOCHASTIC MODELING AND TIME-FREQUENCY OF SIGNALS WITH APPLICATIONS TO SPEECH RECOGNITION AND IMAGE RESTORATION

(Ph.D. Final Exam)

Yunxin Zhao

Department of Electrical Engineering
University of Washington

Wednesday, August 3, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

INFLUENCE FUNCTIONALS FOR TIME SERIES

Prof. R. Douglas Martin

Department of Statistics
University of Washington

Wednesday, June 1, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

SPECIAL
ISDL SEMINAR

Speech Recognition Efforts in ATR Interpreting Telephony Labs

Dr. Kiyohiro Shikano

ATR Interpreting Telephony Research Laboratories
Osaka, Japan

and

Speech Research Efforts in ATR Auditory and Visual Perceptual Labs

Dr. Shigeru Katagiri

ATR Interpreting Telephony Research Laboratories
Osaka, Japan

Monday, June 6, 1988, 10:30 - 12 Noon
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

IMAGE SAMPLING DENSITY REDUCTION BELOW THAT OF NYQUIST

Kwan Fai Cheung

Wednesday, May 25, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL
&
EE DEPT. SEMINAR

SPEECH RECOGNITION USING TIME-DELAY NEURAL NETWORKS

Dr. Alexander Waibel

Invited Research Scientist
ATR Interpreting Telephony Research Labs
Osaka, JAPAN

(Dr. Waibel is on leave from Carnegie-Mellon Univ.)

Wednesday, May 18, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

SPECIAL

ISDL SEMINAR

CASTING NEURAL NETWORKS INTO SILICON: THERE'S GOOD NEWS AND THERE'S BAD NEWS

DAN HAMMERSTROM

Associate Professor
Computer Science & Engineering
The Oregon Graduate Center

Friday, May 6, 1988, 1:30 PM
EE Bldg., Room 108

ABSTRACT

Researchers are developing neural-like network models that exhibit a broad range of cognitive behavior. Unfortunately, existing computer systems are limited in their ability to emulate such networks efficiently. Consequently, the OGC Cognitive Architecture Project is studying the implementation of massively parallel architectures for the emulation of a range of very large connectionist/neural networks.

The goal of our project is to build ultra-large-scale-integrated, silicon-based computing structures that will be able to emulate connectionist/neural networks with thousands of nodes and millions of connections at rates exceeding that of their biological counterparts. The manufacturing costs for these systems will be a few thousand dollars. Such ultra-large die size (larger than the traditional 1 square centimeter) is made possible by the inherent fault-tolerance of the computational model. This talk will explore some of the problems and potential solutions in developing such architectures.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

LEARNING INVARIANCE, AND GENERALIZATION IN HIGH-ORDER NEURAL NETWORKS

Seho Oh

Mr. Oh will also discuss plans for his Ph.D. research entitled "Flexibility Design in Convex Classification Neural Networks"

Wednesday, May 4, 1988, 3:30 AM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

GENERALIZED SYNTHETIC DISCRIMINANT FUNCTIONS

Dong Chul Park

Mr. Park will also discuss plans for his Ph.D. research entitled "Parametric Image Transformation For Shift, Rotation and Scale Invariant Pattern Recognition"

Wednesday, May 11, 1988, 3:30 AM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

A REAL-TIME FREQUENCY SHIFT DECODER FOR THE LAST TRANSMISSION OF KOREAN AIRLINES FLIGHT 007

John D. Schlatter

Wednesday, April 27, 1988, 3:30 AM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

SPECIAL
ISDL SEMINAR

Research and Development Activities of NTT in Speech Recognition and Synthesis

Dr. Ryohei Nakatsu

NTT Human Interface Laboratories
Yokosuka, Japan

Thursday, April 21, 1988, 9:30 AM
The Hub, Room 200-B

and

Japanese Text Input System Based on Continuous Speech Recognition

Dr. Noboru Sugamura

NTT Human Interface Laboratories
Yokosuka, Japan

Thursday, April 21, 1988, 10:30 AM
The Hub, Room 200-B

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

PRELIMINARY RESULTS ON THE USE OF STOCHASTICALLY CHOSEN INTERCONNECTS ON NEURAL NETWORK CLASSIFICATION

Dong Chul Park

Wednesday, April 13, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

Effects of Clock Skew in Optical Feedback and Iterative Neural Network Processors

Seho Oh

Wednesday, April 6, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
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Seattle, WA 98195
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SPECIAL
ISDL SEMINAR

VLSI Digital Filters: Architectures and Implementation Approaches

Keshab Parhi
U.C.-Berkeley

Thursday, March 31, 1988, 3:30 PM
EE Bldg., Room 108

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

A Massively Parallel Neural Pattern Recognition Architecture

Dr. Mike Healy

Boeing Computer Services

Wednesday, March 2,1988, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

INTELLIGENCE AS INFORMATION PROCESSING

DR. PIETER J. VAN HEERDEN

Wednesday, February 24, 1988, 3:30 PM
EE Bldg., Room 108

PIETER (PETER) J. VAN HEERDEN RECEIVED HIS PHD IN PHYSICS FROM THE UNIVERSITY OF UTRECHT, THE NETHERLANDS, IN 1945. HE TAUGHT PHYSICS IN THE HARVARD PHYSICS DEPARTMENT FROM 1948 TILL 1953. HE THEN MOVED TO SCHENECTADY, NEW YORK, WHERE HE WAS A RESEARCH SCIENTIST IN THE GENERAL ELECTRIC RESEARCH LABORATORY UNTIL 1962. HE THEN WORKED IN THE POLARIOD RESEARCH LABORATORIES IN CAMBRIDGE, MASSACHUSETTS. SINCE 1982, HE HAS BEEN RETIRED, BUT CONTINUES HIS STRONG INTEREST IN THE FOUNDATION OF SCIENCE AND, IN PARTICULAR, IN THE FOUNDATION OF PHYSICS AND MATHEMATICS AND THE FOUNDATION OF KNOWLEDGE IN GENERAL. DR. VAN HEERDEN IS A MEMBER OF THE AMERICAN PHYSICAL SOCIETY, A FELLOW OF THE OPTICAL SOCIETY OF AMERICA AND IS A SENIOR MEMBER OF IEEE.

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

An Example of an Application of Galois Fields to Sub-Sea Communications

Dr. Donn Gabrielson

Honeywell Marine Systems

Wednesday, February 17,1988, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

A Plan for Computer-Aided Systems Engineering

Prof. Robert P. Porter

Chairman, Electrical Engineering Department

Wednesday, February 10, 1988, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

Synaptic Interactions in Real Neural Networks

Prof. Eberhard E. Fetz

Dept. of Physiology and Biophysics
University of Washington

Wednesday, January 27, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
ISDL, Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

The Applied Physics Lab: A Tour of New Research and Development

Prof. Robert C. Spindel

Director. Applied Physics Lab
University of Washington

Wednesday, January 20, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
ISDL, Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

APPROXIMATION ON DISJOINT INTERVALS

DR. MAURICE HASSON

Applied Math Dept.

Wednesday, January 13. 1988, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL CHRISMAS BREAK SEMINAR

A Monte Carlo Study of Fault Tolerant Aspects of the Alternating Projection Neural Network

Ko Hing Ho

Wednesday, December 23, 1987, 1:00 PM
EE Bldg., Room 440

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

A Plan for a Neural Network Based Continuous Speech Recognizer

PROF. LES E. ATLAS

Wednesday, January 6. 1988, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

A TUTORIAL ON SPARSE DISTRIBUTED MEMORY IMPLEMENTATION OF NEURAL NETWORKS

PROF. ARUN SOMANI

Wednesday, December 9, 1987 @ 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

Fast Classification Using Nonlinear Correlation Values

PROF. LES E. ATLAS

Wednesday, November 25, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

Performance Analysis of a Robust MFSK FH-SS Communication System in Partial Band Noise Jamming

Scott Lintelman

Wednesday, November 18, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

Grossberg's Adaptive Resonance

Don Wunsch

Boeing High Tech Center

Wednesday, November 4, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ISDL SEMINAR

Contemporary Methods for Numerical Optimization

Dr. Michael Healy

Boeing Computer Services

Wednesday, October 28, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
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ELECTRICAL ENGINEERING DEPARTMENTAL COLLOQUIM

sponsored by the Graduate School Research Fund through the Department of Electrical Engineering and the Interactive Systems Design Laboratory

"State of the Art in Neural Computing"

PROF. TEUVO KOHONEN

Director of the Laboratory of Computer and Information Science
Helsinki University of Technology
Rakentajanaukio 2C,SF-02150 Espoo, Finland

Abstract:
This presentation contains a survey of the history, motivations, fundamentals and application areas of artificial neural networks as well as some detailed analytical expressions for their theory. References to working neurocomputer systems are given.

Wednesday, October 21, 3:30 PM
EE Bldg., Room 321

ISDL SEMINAR

sponsored by the Graduate School Research Fund through the Department of Electrical Engineering and ISDL

"State of the Art in Neural Computing"

TEUVO KOHONEN

Helsinki University of Technology
Laboratory of Computer and Information Science
Rakentajanaukio 2C,SF-02150 Espoo, Finland

Abstract:
This presentation contains a survey of the history, motivations, fundamentals and application areas of artificial neural networks, as well as some detailed analytical expressions for their theory. References to working neurocomputer systems are given.

Wednesday, October 21, 3:30 PM
EE Bldg., Room 321

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University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

"Modifications of Neural Network Processing for Various Types of Temporal Signal Recognition"

Prof. Les E. Atlas

Wednesday, October 14, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

IN CONJUNCTION WITH
UNIVERSITY OF WASHINGTON DEPARTMENT OF STATISTICS

Speech Recognition Using Hidden Markov Models

Dr. Chin-Hui Lee

Speech Research Dept.
AT&T Bell Labs

Abstract: In this talk, we will first present a brief overview on how to formulate a speech recognition task as a statistical pattern matching problem. We will then focus our discussion on speech signal modeling using Hidden Markov Models (HMM) and show how HMM's are applied to achieve high performance in speech recognition.

Wednesday, October 7, 3:30 PM
EE Bldg., Room 327

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
ISDL, Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

Back Propagation
and
a Directed Generalization Neural Network

Prof. Les E. Atlas

Friday, August 7
2:30 pm,EEB420

For more information on the ISDL seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

Schedule
for
ISDL Group Meeting Presentations

(Thursday, 1 pm, EEB Rm 420)

7/30 : • Prof. Les Atlas : Tutorial on Unix Word Processing Tools
- Teru Homma , Discussion of :
  Phonotopic Maps-etc. By T. Kohonen,K. Makisara and T. Saramak

8/6 : • Seho Oh, Discussion of :
  D. Eichmann and M. Stojancie," Superresolving signal and image restoration using a linear associative memory", Applied Optics, Vol. 26, 1987
- Bahram Nabet, Monolithic Fabrication of a Neural Network

8/13 : • Jai J. Choi, Discussion of :
  R. V. Jones, " Photoneural systems : an introduction ", Applied Optics, Vol. 26, 1987
- John Schlatter , Enhancement of last voice transmission of KAL 007

8/20 : NO MEETING

8/27 : • Yunxin Zhao , Discussion of :
  " Adaptive, Associative and Self-organizing Functions in Neural Computing," By T. Kohonen

Use of a Liquid Crystal Television
as
a Programmable Spatial Light Modulator

Wai Sun Leung

Tue.,Aug. 11,2:30,EEB420

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

Application of Neural Networks in Sonar Target Acquisition

Dr. Curtis E. Lacy
Applied Physics Lab.

Tue., July 28,2:30,EEB 420

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

CMF Performance in the Presence of Input and Processor Noise

Hamidreza Amindavar

Tue.,July 21,2:30,EEB420

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
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ISDL SUMMER SEMINAR SERIES

TUTORIAL ON MULTI-SENSOR, MULTI-TARGET TRACKING AND POTENTIAL NEURAL NET APPLICATION

Prof. Ron Iltis
Dept. of Elect. and Computer Eng.
UC, Santa Barbara

Mon.,2:30,June 8,EEB420

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL SUMMER SEMINAR SERIES

A NEURAL NETWORK SIGNAL PROCESSOR

George J. Bloor

Tue.,2:30 pm,June 9,EEB216

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL SUMMER SEMINAR SERIES

A PERFORMANCE ANALYSIS OF ASSOCIATIVE MEMORIES WITH NONLINEARITIES IN THE CORRELATION DOMAIN

Jai J. Choi

2:30 pm
Tue.,June 23,EEB420

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

OPTICAL COMPUTING
AT
BOEING AEROSPACE

R. Aaron Falk

Tue.,April 28,2:30,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

"An Introduction to Learning in Neural Networks"

Prof. Les E. Atlas

Tues., March 31, 2:30, Rm 321 EE Bldg.

For more information on the seminar series, please contact :

Prof. Robert Marks or Prof. Les E. Atlas
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990 or (206) 545-1315

ISDL Seminar

"Iterative Associative Memories with Nonlinearities in the Correlation Domain"

Prof.Robert J Marks II

Tues,April7,2:30,Rm 321 EE Bldg.

For more information on the seminar series, please contact :

Prof. Robert Marks or Prof.Les E.Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990 or (206) 545-1315

ISDL Seminar

STACK FILTERS:
The Neural Net Implementation and Linear Filter Approximation

George Bloor

Tue.,April 14,2:30,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

NEURAL NETWORKS :
Lateral Inhibition and Receptive Fields

Prof. Robert Pinter

Tue.,April 21,2:30,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

A NEURAL NETWORK MODEL

BASED ON LEAST SQUARE SOLUTION

James Baker

Tue.,May 19,2:30 pm,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

STATE TRANSITION NETWORKS FOR SPEECH RECOGNITION

Yunxin Zhao

1:30-3:30 pm
Tue.,May 26,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

AN APPROACH TO CONTINUOUS INDEPENDENT LEARNING

Brian Tillotson

2:30

Tue.,June 2,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL Seminar

THE PATTERN COMPLEX

Prof. Robert Haralick

Tue.,May 12,2:30,EEB321

For more information on the seminar series,please contact :

Prof. Robert Marks or Prof. Les Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)543-6990 or (206)545-1315

ISDL SEMINAR

" An Introduction to Neural Net Associative Memories "

Prof. Les E. Atlas

Tues, Jan 6, 2:30 in Rm 420 EEB, U of W.

For more information on the seminar series, please contact :

Prof. Robert Marks
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990

ISDL SEMINAR

" Continuous Level Neural Net Implementation using Stochastic Processing "

Dr. Dziem Nguyen
Fred Holt

Boeing High Technology Center

Tues, Jan 20, 2:30 in Rm 420 EEB, U of W.

For more information on the seminar series, please contact :

Prof. Robert Marks
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990

ISDL SEMINAR

" Content Addressable Memory with Neural Nets "

James Douglas

Boeing Computer Services

Tues, Feb 3, 2:30 in Rm 108 EEB, U of W.

For more information on the seminar series, please contact :

Prof. Robert Marks
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990

ISDL SEMINAR

" A Continuous Level Neural Net and its Optical Implementation "

Prof. Robert J. Marks II

Tues, Feb. 10, 2:30 in Rm 108 EEB, U of W.

For more information on the seminar series, please contact :

Prof. Robert Marks
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990

ISDL Seminar

"Iterative Associative Memories with Nonlinearities in the Correlation Domain"

Prof.Robert J Marks II

Tues,April7,2:30,Rm 321 EE Bldg.

For more information on the seminar series, please contact :

Prof. Robert Marks or Prof.Les E.Atlas.
Interactive System Design Laboratory
Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206) 543-6990 or (206) 545-1315

ISDL SEMINAR

Use of Neural Networks to Perform Combinatorial Search Problems

Prof. Robert J. Marks II

Wednesday, September 30, 3:30 PM
EE Bldg., Room 327

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
ISDL, Dept. of Electrical Engineering, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

HIDDEN LAYERS AND GENERALIZATION IN ALTERNATING PROJECTION NEURAL NETWORKS

PROF. ROBERT J. MARKS II

Wednesday, December 2, 3:30 PM
EE Bldg., Room 321

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

Use of Arbitrary Nonlinearities to Increase the Capacity of Self Organizing Classifiers and Associative Memories

Prof. Robert Jackson Marks II

Wednesday, February 3,1988, 3:30 PM
EE Bldg., Room 108

for more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)-545-1315 or (206) 543-6990

ISDL SEMINAR

WHAT THE HECK IS ISDL?

Prof. L. E. Atlas and R. J. Marks II

Dept. of Electrical Engineering
University of Washington

Wednesday, September 28, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The Interactive Systems Design Laboratory has ongoing research projects in signal analysis and synthesis, the theory and applications of artificial neural networks, and optical computing. There are several M.S.E.E. and Ph.D. level graduate students currently working on these projects. Prof. Atlas will discuss the application of neural networks to automatic speech recognition and will describe a possible Ph.D. level Research Assistantship available in this area. Prof. Marks will outline his current research activities in the areas of neural network algorithms, optical computing, and Shannon sampling and interpolation theory.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL REPORT

FOUNDATIONS OF PARAMETRIC TRANSFORMATIONS

Robert J. Marks II

Department of Electrical Engineering
University of Washington

Wednesday, October 19, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

The classic problem of recognition of an image invariant to its rotation, translation and scale is considered. There are many approaches to solving this problem. Most make use of a *template transform* on the image to a space that is invariant to these operations. These include synthetic discriminant mappings, the methods of circular harmonics, image moments and the use of Fourier & Mellin transform magnitudes. In the absence of noise, most of these template transforms perform with 100% detection probability. Their false alarm probability, however, invariably increases in comparison to optimal detection algorithms which have been dismissed on practical grounds due to required computational intensity. The reason for the reduction in performance is simply that image information has been destroyed in the template transform. A template transform that is in some sense invertible would not display such information loss. The *parametric transform* in certain cases has this desirable property.

We illustrate parametric transformation with an example. An image, $g(x,y)$, is passed through two filters with frequency responses $H_X(u,v)$ and $H_Y(u,v)$. The corresponding outputs are $X(x,y)$ and $Y(x,y)$. We form a two dimensional template for the function $g(x,y)$ by parametrically plotting these two functions on the (X,Y) plane. Note that any shifted version of $g(x,y)$ will have the same transform. If the filters are both circularly symmetric, the parametric transform will also be rotationally invariant. If both filters are only a function of the angular frequency variable (*e.g.* fan filters), the transform will be scale invariant. Note that the number of filters and therefore the dimension of the parametric transform can be increased. Significantly, some parametric transforms can be inverted to one of the members of its invariance class. In such cases, the parametric transform contains all of the information of the original image. By applying appropriate detection algorithms, we would therefore expect to maintain a lower false alarm probability than in cases where information is lost.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

Intelligent Systems Lab Series

Foundations of Parametric Transformations

Dr. Robert J. Marks II
Electrical Engineering
University of Washington

Room 108 EEB
October 19, 1988
3:30 PM

ISDL SEMINAR

THE EFFECTS OF CLOCK SKEW ON THE CONVERGENCE AND STABILITY OF CERTAIN NONLINEAR ITERATIVE ALGORITHMS

Professor Robert J. Marks II

Interactive Systems Design Laboratory
Dept. of Electrical Engineering

Wednesday, January 4, 1988, 3:30 PM
EE Bldg., Room 108

ABSTRACT

Certain artificial neural network and signal restoration algorithms make use of iterations to converge to a desired solution. In certain asynchronous implementations of these algorithms, the presence of clock skew can result in either an unstable solution or a solution far different than that desired. We examine a class of such algorithms and show that if the synchronous algorithm includes a (possibly nonlinear) contractive operation in the feedback path, then, if the skewed iteration is stable, skew will not affect the steady state result. Stability criteria can also be established for such iterations. As examples, a number of optical processors that use feedback will be examined for their skew properties. Here, clock skew typically results from differing optical path lengths.

BIOGRAPHICAL INFORMATION

Dr. Marks joined the faculty of the Department of Electrical Engineering at the University of Washington, Seattle, in December of 1977 where he currently holds the title of Professor. He was awarded the *Outstanding Branch Councillor* award in 1982 by IEEE and, in 1984, was presented with an *IEEE Centennial Medal*. He is a Senior Member of IEEE. Prof. Marks is also Chair of the *IEEE Circuits & Systems Society Technical Committee on Neural Systems & Applications* and is Chairman pro tem of the *IEEE Neural Networks Committee* which coordinates all of the activities relating to neural networks in IEEE. He was a co-founder and first President of the *Puget Sound Section of the Optical Society of America* and was recently elected that organization's first honorary member. Dr. Marks has over eighty archival journal and proceedings publications in the areas of detection theory, signal recovery, optical computing and artificial neural processing. He is a member of Eta Kappa Nu and Sigma Xi. Bob is a good engineer and all round swell guy.

For more information about the seminar series, contact
Prof. Les E. Atlas or Prof. Robert J. Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206) 545-1315 or (206) 543-6990

ISDL SEMINAR

POCS DESIGN OF ZAMOGRAMS

Professor Robert J. Marks, II
Department of Electrical Engineering
University of Washington

Wednesday, November 8, 1989, 3:30 PM
Electrical Engineering Building, Room 108

For more information about this seminar series, contact:
Prof. Les Atlas or Prof. Robert Marks II
Interactive Systems Design Laboratory, FT-10
University of Washington
Seattle, WA 98195
(206)545-1315 or (206)543-6990

COURSE ANNOUNCEMENT - SPRING QUARTER, 1989

DEPARTMENT OF COMPUTER SCIENCE

CSci 590N - EE 500A Neural Networks Seminar

This seminar will consist of a series of student presentations on fundamental papers and recent results in neural networks and learning theory. Topics may include speech recognition, recognition of temporal signals, learning algorithms, impedements to learning, multiple layered neural nets and alternative architectures, and implementation.

Students earn credit by presenting a paper. Papers will usually be presented by a small group of students.

Entry into the seminar is by permission of one of the instructors. Students given permission should sign up for 2 credits.

INSTRUCTORS:	Les Atlas, 406 EE Bldg
	Richard Ladner, 311 Sieg Hall
	Bob Marks, 404 EE Bldg
DAY:	Wednesdays
TIME:	1:30—2:20 p.m.
PLACE:	Room 201 Lowe Hall
SLN:	6863