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OES

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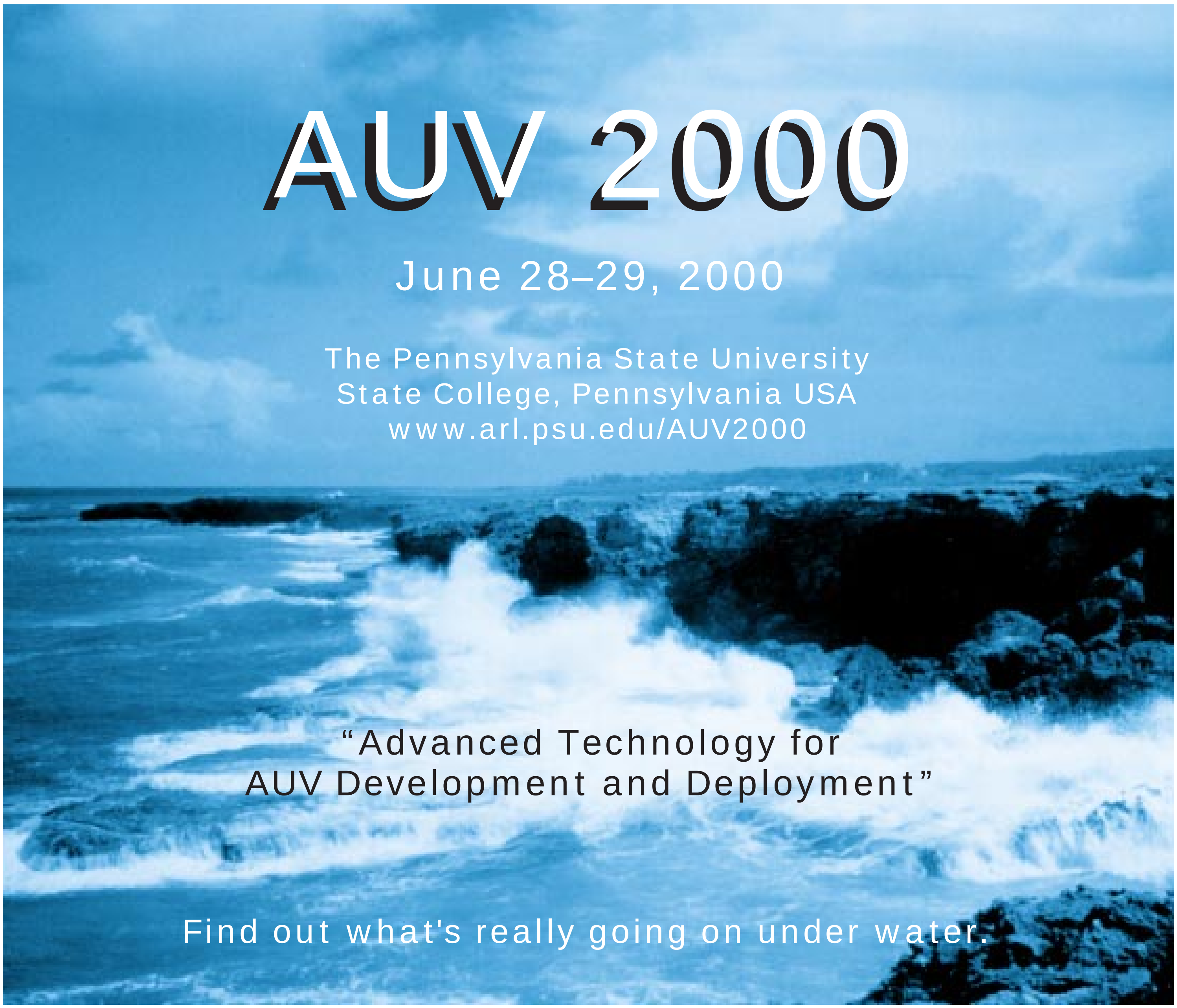

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President's Message

To All OES Members –

Welcome to the Oceanic Engineering Society in 2000!

1999 was a very good year for the OES with a quite successful OCEANS '99 MTS/IEEE Conference in Seattle, Washington, under the General Chairmanship of Dr. Robert Spindel. Bob has been active in both the OES and MTS for many years, having also chaired OCEANS'89, another outstanding meeting in the OCEANS Conference series.

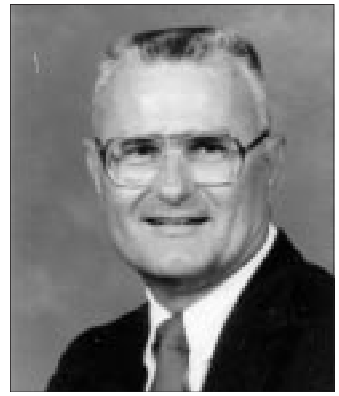
Some of you may be wondering why you're still getting the hard copy version of the OES Newsletter. I had previously announced that the Winter 1999 issue was the last OES Newsletter to be printed hard copy, and that all Newsletters from the 2000 Spring issue forward would be Web based for electronic access by OES members. Since that announcement, I have had opportunities to speak to many members, and the message came through loud and clear that they felt that it's a bit premature to do away with the hard copy version totally. The members strongly supported the move to electronic delivery of the Newsletter, but were not supportive of that being the only Newsletter medium. Therefore, for the foreseeable future, the OES will continue to publish the Newsletter in both hard copy form as well as the Web based electronic version, with the hard copy version delivered to all OES members, and electronic notification of the Web publication to those OES members for whom we have email addresses.

At OCEANS'99 MTS/IEEE I also announced that the OES was going to archive our intellectual property on CDROM. Current plans are for all issues of the Journal of Oceanic Engineering and most of the Proceedings of the OCEANS Conferences to be archived and retrievable via an industry standard search engine. The Proceedings and the early Journals, from inception through 1995, will be in shadowed PDF form, while the Journals from 1996 through 1999 will be in SGML tagged form. IEEE Corporate is acting on OES's behalf in contract negotiations, since other societies either already have or soon will undertake the same archiving process with their intellectual property, and could possibly use the same contractor services. The cost of this OES CD Archive Set will be nominal for OES members, and scaled up appropriately for non-OES and non-IEEE members. Also, I have been promised that the CD Set will be available for purchase at OCEANS '00 MTS/IEEE in Providence, RI in September 2000.

IEEE has also opened up the XPLORE electronic publishing archive to IEEE society member use. The later OES Journals are also in that data base in SGML tagged form. To keep the OES costs for the CDROM project above, as well as later additions to XPLORE, in a responsible range, data bases and other previously developed archives will be utilized in both of these projects.

Don't forget… The OES has two conferences coming up in the near future.

- UT'00 – Tokyo, Japan - May 23-26, 2000 – *http://underwater.iis.u-tokyo.ac.jp/ut00/*



Glen WIlliams

And

- OCEANS'00 MTS/IEEE – Providence, RI – September 11-14, 2000 – *http://www.OCEANS2000.com*

To all OES student members – Check the OCEANS'00 Web Site in June or so for additional information about some new student activities planned for Providence…

I will end on a recruiting note… The OES needs some more volunteers… We have an awfully good group to work with, but we also have a lot of opportunities for members to get involved and give something back to their profession. If you have any questions about our activities, either on a professional level or an administrative level, please contact me at *g-williams@tamu.edu*, or 979.845.5485.

Glen N. Williams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For Immediate Release

March 27, 2000

Contact: J. Spargo and Associates, Fairfax, VA, 703.631.6200, 1.800.564.4220, email: oceans@jspargo.com, Web Page: www.Oceans2000.com.

Providence Rhode Island Will Host Oceans 2000 MTS/IEEE September 11-14, 2000. Highlights of what's going on and what's to come

Providence, Rhode Island: Oceans 2000 MTS/IEEE, the premier ocean science and technology gathering will take place September 11-14, 2000 at the Rhode Island Convention Center located in the heart of downtown Providence, RI. Providence is a great place for an Oceans Show because there are so many customers located within 1-2 hours driving distance and it's such an easy city to navigate. It can be accessed by the new and very modern TF Green International Airport that is just 20 minutes from the convention center and the "show hotels". One can access Providence from New York and Boston by train, automobile or plane. Boston is just a 1 hour drive to the Northeast and New York is about three hours driving time to the Southwest.

Oceans 2000 MTS/IEEE will bring together the scientific community and the business community under one roof for three and one half days to explore ways to build equipment that will enable scientists to do their job of data gathering easier, less costly and overall more effective. Scientists and engineers will have an opportunity to catch up with the trends and advances in oceanographic and environmental research techniques and technologies.

Providence boasts a spectacular extravaganza, Water Fire which will be lighted by special Oceans 2000 MTS/IEEE sponsors. It is an artistic display of gigantic torches which are located in the center of Providence. These will be ignited with great fanfare during an evening ceremony to open the show.

Oceans 2000 MTS/IEEE Technical Chairman and IEEE OES Chairman, Claude Brancart, announced today that his committee expects to receive well over 400 abstracts for technical and scientific papers to be presented during the three days of the conference. "I am extremely impressed by the technical and scientific content of these abstracts. Never before have we seen such innovative ideas and cutting edge scientific accomplishments at this stage of the process." Session topics include, advanced marine technology, communications and navigation, underwater acoustics, ocean monitoring systems, marine resources, signal processing and information processing, ocean and coastal engineering, and marine policy, education and business. The technical committee will be reviewing and rating these abstracts during April with author acceptance notifications going out soon thereafter. Deadlines for final papers is July 14, 2000. Brancart would like as many papers to be submitted electronically as possible.

According to Fred Maltz, Tutorial Chairman, "the tutorials will be offered on Monday, September 11, 2000. Some of the topics that will be covered in the tutorials include Ocean Acoustics, Marine Law, Technology Management, Systems Engineering, Acoustic Signal Processing, and Marine Cable Design". There will be parallel sessions in both morning and afternoon. The morning sessions will be from 8:00 A.M. to 12:00 noon, with afternoon sessions starting at 1:00 P.M. and ending at 5:00 P.M. Registration information will be available in the official Oceans 2000 MTS/IEEE Advance Program; at the show web page, *www.Oceans2000.com* and in the IEEE/OES Newsletter.

The Plenary Session on Tuesday, September 12 will feature Dr. John Sirmalis, Technical Director of the US Naval Undersea Warfare Center in Newport RI. "We are also extremely honored to announce that Rear Admiral Richard D. West, Oceanographer of the Navy will outline the R&D program that the US navy will undertake in the next 1,5 and 10 years to continue to delve the depths of the worlds oceans to protect human life and to understand oceanographic processes at the same time," said Jack Heller, Oceans 2000 co-chairman during the March monthly planning meeting. Additional Plenary speakers are expected to lock-in during the next few months.

Exhibits are filling in nicely with 150 companies committed as of March 19 and many more are on the way - an early indicator of the type of enthusiasm that is prevalent in the industry today. This year the organizing committee is offering some welcome changes to enhance the interaction between Exhibitors and Conference Attendees. Among the changes is the first time ever Exhibitors Showcase. Exhibitors often do not have enough time in a trade show format to demonstrate a product or explain a new version of a product in great detail. The Exhibitors Show case provides a great venue to do just that. The sessions will be from 20-40 minutes depending on how many abstracts are accepted. There will be one technical track all three days filled with presentations by company personnel on new technologies and products. "We've had a great response to this new idea and we're looking forward to seeing what transpires"' commented Bob Lobecker, Exhibits Chairman. Speakers will have to submit final technical papers that will be included in the show proceedings. Another exhibitor enhancement will be that all coffee breaks will be held in the exhibit hall. This will give the attendees an opportunity to visit the trade show floor at least twice a day. Exhibitors will also be provided free passes for their clients to visit the exhibit hall at any time during the show.

For more information about, exhibits, abstract and technical paper details, registration, hotel accommodations, travel plans, tourist attractions in the RI/MA/CT region, please feel free to contact the show organizers, J. Spargo and Associates at 1.800.564.4220 and check out the web page at *www. Oceans2000.com*.

Ferial El-Hawary

Ferial El-Hawary, Canadian Atlantic Chapter Chairperson, Recipient of Two IEEE Honors

Ferial El-Hawary has earned the THE 1999 RAB ACHIEVEMENT AWARD, "For Sustained Achievement in Promoting IEEE Interest in the Oceanic Engineering Community in Atlantic Canada."

Also, Ferial has received a Congratulations Letter from Bruce Eisenstein, 2000 IEEE/ President on her selection as recipient of the IEEE THIRD MILLENNIUM MEDAL, which stated: "This award honours IEEE Members for Their Outstanding Contributions in Their Respective Areas of Activity"

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BH Engineering Systems Limited
P. O. Box 25041, Halifax, NS
B3M 4H4, Canada

Chapter Coordinators Retreat

The IEEE held a Chapter Coordinators Retreat in New Orleans 7-9 February 2000. This was a first time event in bringing the Chapter Coordinators from the Societies and the Regions together. 26 Societies and 6 Regional representatives attended the retreat. It was a great success and all who attended were in favor of continuing the program.

One of the things that was of importance to all who attended was defining the purposes of Chapters and the requirements for a Chapter. The TAB Bylaws define a chapter as "A Chapter is a technical subunit of one or more Sections, or a Regional Council, constituted by a minimum of 12 members of a Society ....concerned to represent and fulfill the needs of the members and the mission of IEEE". Further, "A Chapter is a technically-oriented organizational unit formed to promote the interests of Section Members in a specific technical area associated with one or more of the IEEE Societies."

A minimum of 12 members of a Society are required to form a Chapter and they must hold two meetings a year as a minimum.

The first part of the retreat focused on Chapter "Best Practices". Several of the larger societies reported on the things their chapters were doing that enhanced their meetings and maintained the interest of the members in participating in the chapter activities. This session offered many activities that could be used by all societies. Two of the must successful ideas were recognition of individuals and chapters. Several of the societies had practice of giving awards on an annual basis to members of the chapter in recognition of their work and support to the chapter. They also gave awards to the Outstanding Chapter of the Year at their annual meetings. Many of the chapters cited the Distinguished Lecturer program as a big draw for attendance at meetings. A common theme was to have some "activity" for the members of the chapter to participate in during the year.

It was interesting to note that the societies with the most active chapters were the larger societies that had large numbers of members in a given city or area. The smaller societies had fewer chapters and less chapter activities. Also chapters that are in areas with a large academic population are stronger than those in industrial areas. This is certainly true in the case of the Oceanic Engineering Society. Our two most active chapters, Tokyo and Norway, are associated with universities. Another common thread was to have chapters where two technical societies can interchange meetings. This is the case in Seattle where the Seattle chapter regularly holds meetings with the Marine Technology Section.

The Retreat also dealt with the problem of forming chapters and maintaining interest. Another common thread to all societies was that you needed inspired leadership. You need persons who are interesting in organizing and holding meetings. No matter how much the AdCom may want chapters, unless you can find a dedicated leader in an area, you cannot form and run a successful chapter. This also relates to the problem of few members with a common interest in a given region. As an example, we have considered forming a chapter in the Gulf of Mexico area for several years. We recently did a survey of membership in the Alabama, Mississippi, and Louisiana area. We found that we had approximately 40 OES members. However, they were scattered over a wide geographic region. We had members in the Gulfport/Biloxi area, in the New Orleans area, and in the Shreveport area. There was no central place where meetings could be held with less than an hour to an hour and a half drive for the members. Further, while all were members of the OES, they did not a have a common work interest. The mem-

Norman D. Miller

bers in the Biloxi area were oriented towards the Navy Oceanographic offices at Stennis, the members in the Shreveport area were oriented towards U.S. Army Corps of Engineers river projects, while those members in the New Orleans area were oriented towards the offshore oil industry. This presents a challenge in providing speakers at a meeting that would draw members.

The Retreat did provide a lot of resources for all of the Coordinators that attended the meeting. All were amazed at how much work IEEE has done in promoting chapters and yet somewhat dismayed at how little of the information available has been disseminated to those on the working level that need it.

In the wrap-up session of the retreat all of the working groups came up with a common need - A Chapter Leadership Manual! This will be a focus for the coming year.

Submitted by,

Norman D. Miller
IEEE/OES Chapter Coordinator

A Short Overview of Neural Network and Information Processing Trends in Oceans Technology

by V. William Porto

Raw data can be filtered, aggregated, transformed, visualized, and correlated. However, data by itself is of no real value. For data to be of value it must first be interpreted. Interpretation/analysis is a necessary but insufficient condition for conveying information. The interpretation must impact the behavior of the end user for the data to be truly useful. This forms the underlying basis of all information processing systems: utilize data collected from a variety of sources to piece together a view of the world which enables an end user to make enlightened decisions with respect to this environment.

Information processing (IP) systems take various forms, many of which combine technology from several scientific fields. Within the past decade we have seen IP systems incorporate the latest technological advances in artificial neural networks (ANNs), fuzzy logic, and genetic algorithms/evolutionary computation. Artificial neural networks are perhaps the most well publicized technology of this group, with application areas ranging from control systems, pattern recognition/classification, and modeling systems to fault diagnosis and adaptive filtering. The ocean sciences have benefited significantly from these technologies as they have provided new solutions to difficult and previously (computationally) intractable problems. This article highlights neural network and information processing efforts in oceans technology over the past decade, and presents some predictions about future developments in this dynamically changing arena.

Artificial neural networks: what are they and why are they useful?

Artificial neural networks are mathematical models originally designed to mimic aspects of how we believe the brain works. Neural networks are parallel processing structures consisting of non-linear processing elements interconnected by fixed or variable weights. Computation nodes typically sum N weighted inputs and pass the result through a nonlinear function. Data flows through this series of non-linear transformations (e.g., sigmoid), in one or more stages in an assigned topology. Neural network topologies can be structured to generate arbitrarily complex decision regions for stimulus-response pairs, hence they are perfectly suited for mapping input-output relationships. They provide the ability to construct complex, adaptive nonlinear filters that in many cases outperform linear discriminant functions. Linear discriminant mapping functions were previously designed and used because of their mathematical tractability.

One of the significant advantages of neural networks lies in their parallel distributed processing structures. Rather than performing a programmed set of instructions sequentially as in a traditional Von Neumann type computer, neural network nodal functions can be evaluated simultaneously, thereby gaining enormous increases in processing speed. Although software representations of actual neural networks are typically used, special purpose neural-processor boards have also recently become available.

The benefits of using artificial neural networks to solve real-world problems extend beyond the high computational rates provided by their massive parallelism. Neural network classifiers are non-parametric and make weak or no assumptions about the probabilistic properties of the underlying distributions of the data. Traditional detector/classifiers require assumptions concerning the data distributions and may undergo a degradation in performance when these assumptions are violated. Thus, neural network classifiers are more robust when distributions of the data are generated by nonlinear processes and are strongly non-Gaussian.

Neural network paradigms can be divided into two basic categories: supervised learning and unsupervised learning structures. In a supervised learning paradigm, the input data is associated with some output criterion in a one-to-one mapping, with this mapping known *a priori*. This mapping is learned by the network in the training phase and thus similar inputs are associated with the various desired output classes. Input vectors may consist of frequency components, pixel values, transform coefficients, or any other features considered important. Complex decision regions are typically formed using hyperplane decision boundaries or kernel-function nodes that form overlapping receptive fields.

Unsupervised learning paradigms form decision regions based on whether or not an input exemplar is sufficiently similar to the exemplars previously learned. No training supervision is needed, eliminating the need for *a priori* input-output pair associations. Various metrics can be utilized for determination of goodness of fit. If the similarity measure exceeds a threshold, a new class of exemplars is created and this process is then repeated for each new input exemplar. These network topologies are often used for clustering data and are quite useful where knowledge of unknown associations existing between input exemplars is needed.

Finally, neural networks must be trained prior to use. Training a neural network effectively synthesizes a set of rules from a body of training exemplars. During the training phase, the neural network encodes the necessary transformation, mapping a desired set of input features to specific output features. Applicable training methods are a function of the characteristics of the neural topology and nodal functions.

Application of Artificial Neural Networks in the Ocean Sciences

There are a wide variety of areas in which artificial neural networks have been applied to problems in the ocean sciences. These include pattern recognition, optimal control, adaptive filtering, inversion, target tracking, and general purpose modeling, among many other imaginative applications.

Optimal Control

Modern control theory has scored impressive gains in the comparatively few years of its existence. Improvements have been made in conventional optimal control, as well as many forms of adaptive control, pole-placement using state-variable feedback, control of multi-input/multi-output systems by entire eigenstructure assignment, and Kalman filtering. As powerful as the theory has become, it still has its limitations. These are often felt when dealing with time varying systems, such as those encountered in navigating an autonomous underwater vehicle. Nonlinear environments can pose significant difficulties. Systems designed by optimal control theory are not always robust with respect to parameter variation or changes in the form of the input relative to that of the original design. To be truly useful, a navigation controller must learn and encode control changes through a variety of environments while also learning new state inputs and required corrections. Conventional controllers and expert systems often have difficulty in dealing with these nonlinear environments.

Neural networks offer a distinctly different approach to optimal control. Because they are robust, they are particularly well suited to controlling systems in dynamic non-linear environments. Neural networks also offer the ability to design nonlinear controllers without requiring complex system models. Several testbed environments have been developed to assist in developing robust controllers [1][5]. Tracking errors are typically used in a feedback loop wherein the ANN learns the appropriate responses to the input stimuli. In one of these systems, a neural-controller environment (SIGNAL) has been created to specifically assist in development of a variety of marine vessel control loops [1]. This testbed can be used to design a number of control systems ranging from navigation to ballast stabilization systems. It is currently being used to design autonomous subsea robot controllers since it can utilize real-time probes and learn in-situ.

Other control applications include depth controllers for UUVs [2], current prediction in shallow water environments [3], and adaptive heave compensation [4]. More recently, an ANN has been used to synthesize a robust velocity control system for a Remotely Operated Vehicle (ROV). Researchers Pollini and Nasuti [6] incorporated a feedback linearization controller (FBLC) in conjunction with a neural network. Mixed pattern batch learning was used together with linearized output nodes to greatly increase the convergence rates and facilitate on-line learning. Though the use of linearized activation functions makes this approach similar to standard adaptive controllers, the use of multiple, redundant neurons in the topology makes the system performance much more robust.

Pattern Recognition, Classification, and Detection

One of the largest and most successful application areas involves the use of ANNs for pattern recognition, classification and detection. The goal of pattern recognition and classification is that of assigning each separate input pattern to one of a finite number of output classes. Input elements represent measurements of selected features that are used to distinguish between the various output classes. These input patterns form a multi-dimensional feature space, with the job of the classifier being to partition this space into decision regions indicative of the class to which each input pattern belongs. Quite a variety of marine classification/detection problems have been attacked and solved through the use of ANNs.

One early study incorporated an ANN to obtain a low false alarm rate in a passive sonar transient detection and classification system. Researchers at GTE Government Systems [7] used a two-stage approach wherein a transient processing chain is used to detect and classify short duration transients together with a tonal processing chain to handle longer duration transient signals. Power spectral estimates with two separate pre-processing stages generated the input features to the ANNs. A false alarm rate of 5×10^{-6} was achieved with a standard transient data test set. The ANNs were trained in the presence of additive noise. Results show that all of the incorrect classifications (in this test set) were due to missed detections. It is noteworthy to mention that the learning mechanism can be adjusted to minimize type 1 or type 2 errors (false positive, false negative) as required by the application.

ANNs have been used to interpolate seafloor sediments where only sparse measurements are available. Caiti and Parisini [8] were able to design a neural network that was able to generate a continuous mapping of various sediment properties as a function of the three-dimensional position of the sediment measurements. Radial-basis function (RBF) node topologies were used instead of the often-used multi-layer perceptron (MLP) structures. RBF structures are well suited to this application. RBFs form smooth mappings and do not rely on the specifics of the measurement system or physical properties, hence measurements from a variety of sensors can even be utilized simultaneously. Results of this study show the network was able to generate predictions with very low mean square error (with their data sets).

More recently, neural networks were used to classify marine sediments using measurements from a sub-bottom profile model [12]. The goal of this research was to accurately classify the topmost layer in a heterogeneous sediment profile. A two stage feature extraction method was combined with a RBF network classifier. Raw acoustic signals are poorly suited for use as input features to a classifier because useful information is buried within their structure. Feature extractors were designed using wavelet packet analysis, eigen analysis, and a non-linear component based upon distances between desired class prototypes and the input vectors. All of these features were passed through a discriminant factor analysis tool to obtain the final input vector for the ANN. Results using computer simulated data are quite promising. Statistical results show that relatively high classification rates can be achieved via this approach, potentially eliminating the need for costly and tedious direct sediment sampling.

Other ocean related classification/ detection problems tackled with neural networks include automatic object recognition systems using synthetic pattern imagery [9], pollutant induced tissue changes in fish livers [10], plankton recognition [10], and seafloor imagery [11]. Multi-layer perceptron topologies are often used in these studies due to their ease of training.

Buried object detection using ANN techniques has also studied recently. Researchers in Italy exploited object resonances induced by an active sonar ping [13]. A classify-before-detect strategy was employed as it takes advantage of the microstructure in acoustic signatures. Both Maximum Likelihood Estimator (MLE) and Multivariate Gaussian Classifier (MVG) approaches were studied with time-frequency features used as inputs to the ANN. Efforts focused on training an ANN on the low frequency components of the parametric sonar signal. Instead of utilizing a traditional Euclidean distance metric, a Mahalanobis distance metric and a Bayesian distance metric were used in the MVG and MLE classifiers, respectively. Analysis of ROC curves illustrate the capability of this classify-before-detect technique to handle signals with low signal-to-reverberation ratios.

Adaptive Filtering

Neural networks have also been quite fruitful in ocean applications where optimal adaptive filters must be designed. In a paper by El-Hawary and Li [14], an ANN was designed and used to filter and classify a series of sinusoidal signals at different SNR levels (ranging from 0.1dB to 100dB). A feed-forward two hidden layer perceptron architecture was trained, and results compared to a standard linear prediction filter (LP). Their research showed that they were able to obtain results that are equal to or better than the LPC in all of the test cases. Importantly, they note that it is only necessary to train the ANN once with a clean signal whereas the LP filter must estimate the parameters for each set of signalS for a given order *p*. This is a prime example of the advantages of the inherent non-linear mapping properties of the ANN when compared to standard statistical (i.e., linear) techniques.

A related approach to designing non-linear filters was shown by Gomes and Barroso [15]. Radial basis function neural networks were used for blind adaptive equalization in a set of acoustic receivers. Blind equalization attempts to reduce inter-symbol interference and channel fading. There are many standard approaches to this problem, but each makes performance limiting assumptions regarding the underlying noise and transmission distortions. RBF networks were used in an unsupervised learning mode to cluster the input data. The performance of the RBF networks to solve this problem was evaluated using both simulated and real world data sets. Results show that the network is tolerant of significant errors in the placement of cluster centers, but may be limited to problems of low to moderate dimension. They note that other ANN topologies (e.g., recurrent networks) may alleviate the need for a large number of nodes in the network (which often leads to brittle classifiers).

Data Inversion

An interesting approach to inverting geophysical data incorporates the use of neural networks to learn topographic mappings. Ocean acoustic tomography involves estimating sound velocity profiles (and temperature, salinity, etc.) by inversion of travel times of sound from source(s) to receiver(s). Neural networks can be used to generate the inverse mapping of the sound velocity profiles [16], [17], [18]. Gan [17] used such an approach to solve the inverse problem. In his study, a parabolic equation (PE) model was used in the forward problem. A feed-forward MLP network was presented as a method capable of recognizing (2-dimensional) sound velocity profiles.

In a similar approach, Stephan [16] utilized a multi-layer perceptron to learn the mappings between sound-speed environments and arrival time patterns. A ray-tracing model with varied degrees of additive noise was used to generate the input data. The MLP technique produced errors (min, max, and mean) which were lower than the traditional linear approach based upon canonical decomposition of sound velocity profiles in triangular kernels. As expected, results using the neural methodology were most impressive as the differences from linear profile regions increase. In addition, the ANN method was better at rejecting estimation errors in the presence of noise when compared to the linear method. This approach was extended later [18] and proven robust on a larger simulated data set from the North-Atlantic environment.

Research by Terre, Golenzer, and Solaiman employed both MLPs and Hopfield networks to track and identify ray acoustic arrivals [20]. A temporal series of arrivals was generated by tracking resolved peaks. Outputs of a ray-tracing model were processed together with peak time series to identify the arrival times. In addition to results which were favorable to traditional methods, significant improvements in processing speed were also realized. When compared to a Bayesian method, the neural system required less than ten percent of the time to process a Megapixel image.

Target Tracking

Target tracking is another area in which ANNs have been quite useful. A group of researchers at NUSC developed a system which utilized five individual feed-forward networks trained to provide estimates of contact state variables given time series measurements [19]. Traditional target tracking methods (i.e., Extended Kalman filtering (EKF)) all make limiting assumptions, typically reducing to and solving the problem as a linearized dynamical system. In environments of poor observability, or when non-linear kinematic relationships between the observer and the contact exist (i.e., real-world systems), stability is a major concern. The series of five ANNs was able to learn the underlying dynamical system models throughout a range of observability conditions. When compared with traditional statistical methods, the ANNs demonstrated high levels of tracking accuracy using both azimuth bearing and range measurements, as well as in highly non-linear conical bearings-only problems.

Modeling

Since neural networks can map arbitrary input-output associations, they are perfectly suited for modeling virtually any number of dynamical systems. One such problem is generating an interpolative/extrapolative model of ocean data wherein the number of observations (i.e., salinity) is sparse or irregularly spaced. ANNs can be trained to learn optimal meshes of these data. Neural meshing of a geographical space relative to oceanographic data has been performed by Sarzeaud et al. using Kohonen self-organizing networks[21]. The nodes in the network were adapted by successively comparing the location of each datum and moving the closest node and its neighboring nodes toward this location.. Sarzeaud et al. were able to generate efficient neural meshes on a hydrological database of the North-East Atlantic, and point to the inherent capabilities of this method to generate meshes for a wide variety of data.

An auditory periphery neural model was designed by Dubrovsky and Rimskaya-Korsakova to detect and identify small objects via sonar [22]. Their neural model is based upon the auditory mechanisms in dolphins. Since the dynamic ranges of the neuron models were smaller than that of the signal sources, networks with different sensitivity thresholds combined with short-time adaptation mechanisms were used. Analysis of simulated echoes (of varying intensity) with three frequency channels was performed. Clustering of these multidimensional echo vectors (projected onto a plane) show excellent separation, with distinct boundary regions. This bionically inspired system was able to utilize highlights in weak echoes and was demonstrated to be quite effective in the classification of a variety of short impulsive echo types.

Chaotic modeling of radar backscattering from an ocean surface has also been performed via the use of neural networks. In a study by Haykin and Leung [23], radar backscatter (sea clutter) was modeled using radial basis function networks. This research used radar data to demonstrate the applicability of chaos theory for modeling sea clutter. A finite-dimensional deterministic model was developed using a RBF network as a predictor of the next value of the dynamical process. After the network was trained, it was shown to follow the sea clutter waveform closely. Importantly, through the use of their RBF models, the authors make the case that radar backscatter from the ocean surface may not be a stochastic process. Instead, they showed that a chaotic model learned by the RBF is not only plausible but also fits actual real-world data.

Neural networks have also been used to generate wind vectors from scatterometer data. Models developed by Mejia et al. utilized a multi-layer feed-forward network to learn the geophysical relationships between active microwave radar (transmitted and received via satellite) data and wind directions. Scatterometers are used to calculate the normalized radar cross section of the ocean surface. Their neural model mapped the transfer function of an ERS-1 scatterometer using over 30,000 wind vector pairs taken from North Atlantic ocean surveys. Subsequent testing produced results which outperform the previous statistical models, although in its current form the neural model's dynamic range is smaller.

Other Interesting Application Areas

Neural networks have been used in a variety of ways to estimate image texture. In most of these studies, the network is used to make decisions on features extracted from imagery. Bourgeois and Walker [25], used a neural network to directly model image texture from sidescan sonar imagery. The task involved identification of homogeneous textures in an image. Standard image processing techniques (e.g., Fourier transforms, fractal modeling, etc.) often provide inadequate results. Many problems are due to the underlying assumptions made together with the fact that these techniques often discard data. Sub-image pixel data was used directly as inputs mapped to a set of desired image texture outputs. Results indicate the capability of multi-layer perceptrons to recognize input sequences even in the presence of significant amounts of random noise.

Segmentation of sidescan imagery has also been performed using a hybrid neural network approach. Research by the Deep Submergence Laboratory at Woods Hole Oceanographic Institution used a Markov random field model combined with a MLP to learn the distribution of observations from seafloor sidescan images[26]. Most seafloor acoustic imagery segmentation procedures rely on models that do not sufficiently take into account the spatial relationships of adjacent image regions. The authors' neural network approach provides a non-parametric alternative to learn the probability contribution of each observation (pixels in an image set).

Another interesting application area involves using neural networks for fault diagnosis. In one study, a non-linear process model was designed to describe a set of fault types for a rudder control system [27]. A rudder-control system was monitored by an integral neural network fault-detection and identification model (FDI). The supervisory system is extended with an online learning, neural estimated fault model, and was continuously updated by differences between the actual system and the model state. A radial basis network generated accurate estimates of and feedback to the non-linear fault function, and was shown to potentially handle unanticipated faults (faults which were not previously modeled).

Looking into the Future

The aforementioned applications of neural networks to ocean science problems only hints at the potential for these techniques. Research in the past decade has proven the capability and utility of ANNs to solve a large number of problems. Previous techniques to solve many marine problems relied on linearization of the problem space (since linear models are easy to study) and mathematical models with limiting assumptions (i.e., Gaussian noise) because they were mathematically tractable. However, real-world environments are often highly non-linear. The ease in which neural networks can be designed and implemented makes them the obvious choice for numerous applications. Now that the groundwork has been laid and numerous ANN design toolsets have become available, we will see an expansion of their usage as they replace older, conventional methods. A long-standing concern that neural network solutions are difficult to analyze will be overshadowed by the fact that they provide proven, simple, and robust solutions in addition to performance advantages (e.g., computational speed and increased accuracy).

Predictions for the future include imbedded neural network systems which implement online *in-situ* learning instead of using weights fixed from previous training sessions. These will be important in navigation control, prediction of target dynamics, as well as for pattern recognition. Fault diagnosis and prediction is another upcoming area. Imagine an online neural system which can predict incipient failure of a hydraulic pump or propeller driveshaft with sufficient time to make necessary repairs. Models of marine life interactions, environmental pollution dynamics, and shallow-water surveillance are other promising areas ripe for the application of ANNs.

It is important to note that ANNs are only one tool in a multifaceted toolbox. In the future we will see ANNs integrated into hybrid systems. By combining the useful properties of neural networks together with evolutionary computation, fuzzy logic, and new visualization tools, ocean scientists will be able to solve many previously intractable problems. Future IP systems will depend on integration of several of these advanced tools to better solve problems. The inherent and unique capabilities of each tool will be exploited instead of relying on a singular technology to solve the entire problem.

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Mr. Porto has been involved in the OES for the past 10 years and currently serves as IEEE OES Technology Committee Chairman for Neural Networks and Information Processing. He did his undergraduate and graduate work (B.A and M.A) in mathematics and applied mathematics at the University of California at San Diego. He has worked in such areas as optimal sensor control, multi-hypothesis multi-sensor target tracking, sensor fusion, and transient signal processing. More recently he has concentrated his efforts in the field of computational intelligence (neural networks, fuzzy logic, and evolutionary computation). Mr. Porto has published over a number of papers in refereed journals and conferences. He is currently Vice President of Natural Selection, Inc. in La Jolla, California.

Mr. Porto has served on the Office of Naval Research advisory panel for neural networks, and is a charter officer of the Evolutionary Programming Society. He was on the organizing committees for the 1988 and 1989 IJCNN conferences, served as tutorials co-chair for OCEANS’ 95, and more recently was general chairman of the 1998 Conference on Evolutionary Programming. Mr. Porto is a member of the editorial board for the IOP/Oxford Press Handbooks for Neural Computation and Evolutionary Computation and is an associate editor for the IEEE Transactions on Evolutionary Computation.

Joseph Vadus Receives French Legion of Merit Award

Last year, the President of France approved the selection of Joseph R. Vadus for the French National award of, “Chevalier de “Odre National du Merite.” On January 20, 2000, Consul General, M. Alain de Kehgel of the Embassy of France in Washington D.C., presented him with the silver and blue cross of the Knight of the French National Order of Merit at a reception-award ceremony, with many friends from the Washington area in attendance. The award recognized his valuable contributions to U.S.–France cooperation for over 20 years. He was most appreciative and acknowledged his wife Gloria’s contributions. In 1973, while at NOAA serving as manager of technology in the Manned Undersea Science and Technology Office, he began interacting with France’s National Center for Exploration of the Ocean (CNEXO), now called IFREMER, by sharing technology and engaging in cooperative activities with undersea vehicles and underwater habitats. From 1980 through 1995, Vadus served as U.S. Program Leader for Marine Technology in the U.S.-France Cooperation in Oceanography. He provided sustained leadership in cooperation on Marine Technology including joint projects with undersea vehicles, ROV’s, AUV’s, oceanographic equipment, telemetry, OTEC, and fisheries technology. His main French counterparts over these years were Capt. Dominique Girard, M. Guy Herrouin and M. Jean Jarry.

Joseph Vadus, Vice President IEEE/OES Technical Activities, recipient of France’s National Award, with Dr. Thomas Wiener, IEEE/OES Treasurer at Reception-Award Ceremony held at France’s Consul General’s home in Bethesda, MD.

In 1985, one of six projects in the marine technology program with co-leader Jean Jarry, evaluation of deep submergence survey systems viz., Woods Hole Argo System (headed by Robert Ballard) and France’s SAR System (headed by Jean Louis Michel) resulted in successful evaluation, and the spectacular discovery of RMS TITANIC. This was but one of the many cooperative projects in the Marine Technology Program. Vadus retired from NOAA in 1996. He is consultant to SEA TECHNOLOGY for International Programs, and is President of his consulting firm, Global Ocean Inc., Potomac, MD.

Who's Who in the OES

Paul A. Rosenstrach

Paul A. Rosenstrach runs the Autonomous Systems Program Area of the the Charles Stark Draper Laboratory's Special Operations and Land Robotics Directorate. His programs focus on autonomous vehicle systems, sensor payloads, guidance, navigation and control, and electronics packaging technology.

Mr. Rosenstrach began his technical career as a member of the Surface Ship Sonar and Sonar Trainers sections at Raytheon Corporation's Submarine Signal Division after earning a Bachelor of Engineering degree in Electrical Engineering from the State University of New York at Stony Brook. At Raytheon, Mr. Rosenstrach developed modular sonar system architectures and acoustic signature synthesis techniques. During his tenure at Raytheon, Mr. Rosenstrach completed graduate studies at the University of Rhode Island, earning his Master of Science in Electrical Engineering in 1989.

Mr. Rosenstrach joined The Charles Stark Draper Laboratory as a Staff Engineer in the Sensor Section in 1990 where he developed sonar signal processing algorithms for autonomous undersea vehicle applications including navigation and mine detection.

In 1992 Mr. Rosenstrach joined the Defense Advanced Research Projects Agency's Maritime Systems Technology Office, serving as a Program Manager until 1995. There he managed sonar processing automation programs including the Full Spectrum Acoustic Sonar Test Bed and Ship Systems Automation. As a result of these programs, reliable full-spectrum acoustic contact management in high traffic environments was demonstrated to be feasible. Mr. Rosenstrach received the Office of the Secretary of Defense Award for Excellence in recognition of his achievements while at DARPA.

Mr. Rosenstrach returned to Draper Laboratory in 1995 as Systems Engineer responsible for Ocean Systems programs and as Technical Director for several autonomous vehicle and air acoustic signal processing programs.

An avid sailor, Mr. Rosesnstrach feels fortunate that his career has remained close to the ocean and is grateful for the chance to serve the Oceanic Engineering Society as a member of the Administrative Council.

UPCOMING CONFERENCES

Unmanned Underwater Vehicles (UUV) Symposium
April 24-27, 2000
Newport, Rhode Island

Information: Monica L. Silva
Conference Coordinator
+1 401 849-8900 x303
+1 401 848 0638 (fax)
email: msilva@amaltd.com

OTC2000 - Offshore Technology Conference
May 1-4, 2000
Houston, Texas

SPE, P.O. Box 833868
Richardson, TX 75083 (fax)
website: http://www.otcnet.org

Underwater Technology 2000 UT '00
May 23-26, 2000
The New Sanno Hotel Tokyo, Japan

UDT Europe - Undersea Defense Technology
June 27-29
Conference and Exhibition, Nexus Media
+44 (0) 1322 660070
+44 (0) 1322 661257
email: UDT@nexusmedia.co.uk

AUV 2000 - Advanced Technology for AUV Development & Deployment
June 28-29, 2000
ARL
Penn State
P.O. Box 30
State College, Pa.

5TH European Conference on Underwater Acoustics ESCPE
July 10-13, 2000
Lyon, France

OCEANS 2000 MTS/IEEE Conference & Exhibition
September 11-14, 2000
Providence, Rhode Island

Techno Oceans 2000 Exhibition & Conference
November 9-11
Kobe, Japan

+81 78 303 7516
+81 78 302 1870 (fax)
email: info-kcva@exd.city.kobe.jp

Signal and Image Processing Conference
November 19-23, 2000
Las Vegas, Nevada

CEU COURSE DIRECTORY NOW ON THE IEEE WEB

Piscataway, NJ 15 March 2000 - Planning your professional development requirements for this year? It's time to freshen up your skills for either short-term or long-term goals. Help is as close as the IEEE website at *http://www.ieee.org/organizations/eab/ceucourselist.htm.*

A list of courses offering Continuing Education Units (CEUs), as well as contact information, can now be found on the IEEE website. Listed by date, the courses run the gamut from Advanced Induction Motor Production through XML Technologies.

1999 IEEE President Kenneth R. Laker has stated: "Engineers who desire to remain competitive in the job market must maintain professional vitality throughout the course of their careers. However, no individual can maintain professional vitality without continuing his/her education, especially in the contemporary job market."

Course developers: To list your CEU offering or offer CEUs at your educational program, please contact Sharon Strock, Projects Administrator, at *s.strock@ieee.org*.

PROFESSIONAL CAREER TIME LINE

By Stu Levy & Ed Podell,
Co-Chairmen, Philadelphia Section, IEEE

Today is the first day of the rest of your career! Are you drifting along, letting random events or others determine your career path? Are you bored, stagnating? Do you feel ill-prepared to compete in our changing world?

YES? Then it's time today to take charge of your career...because how you plan and manage your career will determine whether it is exciting, challenging, and growing — or dull, routine, and uncertain.

To help you set your goals, the American Institute of Aeronautics and Astronautics' (AIAA) Career Enhancement Committee created this Professional Career Time Line. It supplies a checklist of helpful actions for assuring greater success during every phase of your career.

The Time Line begins two years prior to your college graduation and continues through your retirement. It suggests measures you should take through each phase of your career to keep it vibrant. Please reflect on each phase, set your goals, and frequently re-evaluate yourself to keep your career plan current.

Throughout Your Career

- Assess yourself to define specific goals. Periodically check, reassess, extend, or modify goals.
- Keep your resume current.
- Remain active in a professional society that represents your discipline, such as the IEEE
- Establish and maintain professional contacts.
- Write, publish, and present your own work at technical meetings.
- Stay abreast of new developments in your field by subscribing to appropriate periodicals, attending workshops and seminars, and traveling to international and national conferences when feasible.
- Pursue additional formal education and on-the-job training to remain competitive in an increasingly complex work world.
- Maintain an appropriate balance among family, career, community, and recreation.
- Manage money wisely and make intelligent purchases. Periodically seek professional advice about financial planning matters.
- Sustain good physical and mental fitness.
- Enhance organizational and interpersonal skills, including communication, interviewing, and networking.
- Remain adaptable to all changes (technological, social, etc.) implemented in the world of work.

Six stages in your career time line follow. Start wherever you are: student to retiree.

1. Completing College

College Junior to Graduation
Career Phase: Student
Typical Age: 20-22

Take advantage of co-op opportunities and internships. Work while in school in a career-related field.

- Participate in an IEEE Student Paper Competition to learn how to prepare and present technical papers.
- Decide on graduate school, or seek employment after graduation.
- Prepare your resume.
- Research potential employers in your chosen field.
- Develop tentative goals. Make career-path decisions (e.g. industry vs. government vs. R&D vs. design vs. manufacturing vs. teaching etc.).
- Prepare for the FE (EIT) Exam. Take it during your senior year.
- Make a realistic and valid first-job choice based upon your career interests.

2. First Job

Grad. to 3 Yrs in Work Force
Career Phase: New Engineer/Scientist in Training
Typical Age: 22-25

Upgrade from IEEE Student Member to Member.

- Adjust to routines of the work environment.
- Apply textbook knowledge to real life situations.
- Learn the company ropes. Become an effective contributor to the team.
- Learn to perform under pressure. Accomplish tasks effectively and on time.
- Obtain advanced degree (technical discipline or MBA).
- Start preparing for the state professional engineering license, if available, in your field of discipline.

- Develop a mentor or sponsor relationship.
- Enhance your technical competency. Subscribe to periodicals, technical journals, etc.
- Present papers on your work (participate in local mini-symposia, national young professional paper sessions, etc.)

3. Early Career

3 Yrs to 10 Yrs in Work Force
Career Phase: Young Professional
Typical Age: 25-32

Focus on your technical specialty, or move toward being a generalist.

- Continue developing technical skills and credentials.
- Gain exposure to management and other disciplines.
- Review your options. Consider changing your career, job, employer, etc.). Make enhancements to your progress.
- Seek out and accept higher levels of responsibility. Learn to make effective decisions.
- Keep up-to-date on advancements in your discipline.
- Obtain state engineering license.
- Assume a leadership role at the local, regional, or national level of the IEEE.
- Apply for membership on an IEEE technical committee.
- Begin preparing for a senior leadership role.
- Transition from being reactive to proactive in your career decisions.
- Continue upgrading your leadership role in the IEEE.
- Consider after-hours graduate programs in your specialty.

4. Mid-Career

10 Yrs to 22 Yrs in Work Force
Career Phase: Senior Professional (Technical or Supervisory)
Typical Age: 32-52

Make career path decision; i.e., remain in a technical area or move into management.

- Stay technically up-to-date in your chosen specialty.
- If moving into management, hone your management and human resources skills.
- Apply for full leadership role on an IEEE technical committee.
- Continue to take on additional areas of responsibility or assignments.
- Apply for Senior Member in the IEEE.
- Become a mentor or sponsor.
- Achieve national recognition. Assume professional leadership roles.
- Continue upgrading your leadership role in the IEEE.
- Begin retirement planning.

5. Late Career

22 Yrs to 40 Yrs in Work Force
Career Phase: Recognized Expert
Typical Age: 52-Retirement

Continue professional leadership progression by obtaining assignments (or jobs) with increasing responsibility and authority.

- Stay technically up-to-date.
- Continue mentoring and providing guidance to younger professionals.
- Represent your organization outside the workplace. Achieve national or international recognition.
- Diversify your skills or develop hobbies that could lead to a second career or added income upon retirement.
- Teach at a college or university, or start your own consulting practice.
- Continue retirement planning.

6. Retirement

40+ Yrs in Work Force Career Phase: Expert Emeritus
Typical Age: 60+

Implement your retirement plans.

- Replace required compulsory activity with desired leisure wants.
- Consider opportunities for part-time work, consulting, or a second career.
- Use accumulated experience and wisdom on behalf of others in various senior roles.
- Make meaningful use of your time.
- Find new sources of professional and personal satisfaction.
- Remain active in the IEEE: maintain professional contacts.
- Tutor precollege students in math, science, or engineering.

This Time Line is a product of the AIAA Career Enhancement Committee. It is the compilation of information and experiences of individual members. The information is intended as general guidelines for technical professionals, and should be tailored to individual situations. The opinions expressed do not necessarily represent those of the AIAA or the IEEE.

The IEEE Year In Review: 1999

Dan Senese, IEEE Executive Director, presented “The IEEE Year in Review: 1999" at the IEEE Board of Directors meeting series in New Orleans, Louisiana, U.S.A. on Friday, 11 February. He has made the entire presentation available on the IEEE website at *www. ieee.org/about/review/index.htm*. Check out this site for an interesting overview of IEEE goals and accomplishments.

REMINDER: If your Section has not yet submitted 1999 meeting and financial activity and current officers, please do so as soon as possible. The rebates will not be available for reports received after 30 November 2000. Write to sec-rebate@ieee.org *or call +1 732 562 5564 with questions.*

Spectrum Online

Beginning 1 March 2000 IEEE Members will benefit from a completely redesigned IEEE Spectrum Online, at www.spectrum.ieee.org/. The improved Spectrum Online uses the capabilities of the web to deliver content beyond what is available in print. New features exclusive to the online version include:

- Daily Science and Technology News provided by Reuters, the international news service.
- News is archived for 30 days.
- Weekly Web Sights, reports on new, compelling websites of special interest to the science and technology communities.
- Weekly Newslog identifies and summarizes key science and technology events for the prior week.

Spectrum Online will be available free to the general public for a special six-week trial from 1 March through 12 April 2000.

IEEE GOLD Calls All Section Officers!

The RAB GOLD Committee is calling all Section officers to identify and appoint a GOLD member in your Section as its GOLD Representative in 2000. Including a GOLD member on your Section's leadership team opens opportunities for your Section to draw upon the talents of younger IEEE members and helps them develop the leadership skills needed for your Section's future.

Forming a GOLD Affinity Group is simple - signatures of six IEEE Members, other than Students, who are members of the Section, are necessary for formation. For additional details and the petition form, go to the Section/Chapter Support web site: *www.ieee.org/ra/scs*, then select the link for "Entity Formations".

Information regarding funding for GOLD and submittal form is available on the GOLD web site at *www.ieee.org /organizations/rab/gold/programs. html*.

Many IEEE Sections have GOLD activities underway and we want to know about it! The GOLD Committee distributes an electronic quarterly newsletter and we want to include your Section's GOLD program and highlight the members involved. Visit the GOLD web site at *www.ieee.org/gold*, or send a message to .

Half-Year Memberships Begin 1 March

Are you planning a membership development activity for your Section? Are you looking to attract new members? Membership applications received by the IEEE, including technical Society memberships, as of 1 March 2000 will be processed on a "half year" basis with dues at half of the regular annual rate.

Those who join after 1 March will become members through 31 December 2000 and will receive all publications from the time their applications are entered into the database.

Keep An Eye On This Site?

A great new web page has been created for IEEE volunteers! Accessible directly from the IEEE home page at *www.ieee.org*, the Volunteer Resources link leads to a "table of contents" of volunteer related links. This new site, helpful now, is also in the process of being fine-tuned for maximum usefulness. So use it now and keep it in mind as a resource for information in the future.

In addition to information that is important to all volunteers, the IEEE Volunteer Resources page targets specific groups of volunteers, including those writing articles/creating content and publishing, or those involved in Societies, Sections, Chapters, Students, Conferences, Standards, Professional Development, and Entity Activities. For information, contact Jayne Cerone, telephone +1 732 562 3908 or email *j.cerone@ieee.org*.

Financial Information For IEEE Geographic Units

As an IEEE officer, you may have questions about the functions and responsibilities of the Treasurer's position as well as IEEE financial rules and regulations. In order to answer the most questions in one handy format, the IEEE Regional Activities department has created a handbook for Treasurers.

The Treasurer's Handbook contains important financial information for Geographic Units, covering subjects such as required reports, funding, insurance, banking, record retention and more. Contact data for the appropriate IEEE staff is included next to each subject matter in the handbook in case additional information is needed. Hard copies of the Treasurer's Handbook will be mailed to new Treasurers for the year 2000. It can also be found on the web at *www.ieee.org/ra/scs*. Select the link for either "What's New" or "Required Reporting" to bring you to the Treasurer's Handbook.

Rebate Reminder

The deadline for the required annual reports necessary to obtain an IEEE Section rebate is 22 February 2000. The reports due are: meeting activity in 1999, financial activity for 1999 and a list of current officers. If submitted by the deadline, an additional 10% of the rebate will be added to the total. Packages with forms and information have been mailed to the appropriate Section officers and should have arrived by the time you read this article. All forms and information are also available the web site *www.ieee.org/ra/scs*. Select the link "Required Reporting". Inquiries can be sent to IEEE Regional Activities, Section/Chapter Support, email sec-rebate@ieee.org.

IEEE Launches New Online Store & Catalog

The IEEE has taken a major leap forward in its ongoing objective to "do business electronically" with the launch of the new IEEE Online Store & Catalog. The site went live 28 Dec, at *www.ieee.org/ieeestore*. The definitive source for IEEE products, the Store is fully searchable and sells IEEE books, conference proceedings, subscriptions, Standards, mixed-media products and merchandise in a secure environment. It includes such value-added e-commerce features as shopping lists and a help desk. A kickoff promotion offers a free IEEE shirt with every book purchase. For more information, contact Terry Burns, Sales & Marketing, at *t.burns@ieee.org*.