The IEEE 1st International Conference on Neural Networks - A First-Hand Account

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The IEEE 1st International Conference on Neural Networks (ICNN) was held from June 20-24 in San Diego. The conference highlighted demonstrations of the increasingly visible and exciting neural network technology, including pattern recognition of such complex patterns as faces and written Japanese characters. Neural nets were also used for representing high-level structures such as financial investments.

Conference presenters included both well-known people in AI and relative "unknowns," who had spent years developing neural net approaches and were just now reaping the rewards of their work. Invited speakers and session chairmen included Teuvo Kohonen, Stephen Grossberg, Bart Kosko, Shun-ichi Amari, James Anderson, John Hopfield, Kunihiko Fukushima, Carver Mead, Robert Hecht-Nielson, David Rumelhart, Terrence Sejnowski, Bernard Widrow, and many other figures from the fields of AI and parallel processing. Only 800 persons were originally expected at the conference, but actual attendence was over 1500.

This recent conference was a landmark in the growing field of adaptive neural network systems. Although the neural network (NN) approach has aspects in common with other parallel processing systems, a distinguishing feature of neural nets is that the interconnection between the NN units are designed to emulate the interconnections found between neurons in the brain. The neural network is "trained" to distinguish patterns, and can commonly operate with partial or distorted input. This is seen as one of the major advantages of NN systems for practical applications, as compared with the difficulty of pattern recognition using traditional (e.g., template matching) systems. Also, when some of the units from the "trained" system are removed, the output of the system is degraded - but not totally destroyed. This yields an advantage in terms of creating "ruggedized" systems which are highly fault-tolerant.

A soon-to-be-published issue of Computer will be exclusively devoted to neural networks and will feature the work presented at this conference. During the meeting, the International Neural Network Society was formed, and a journal for the field will begin soon. As these resources are available, or soon to become available, this article is devoted to a personal assessment of the conference and of the emerging field.

The rest of this article looks at the conference - and the emerging neural network research area - from three points of view. The first point of view does not compare neural nets with expert systems per se. Rather it contrasts the introduction (or more properly, explosion) of the neural network research domain with the introduction and advance of expert systems technologies in the previous decade. The second view assesses the potential for growth in the field, and the third aspect of this article looks at the demands that neural network research places on the researchers.

Throughout the conference, comparisons between the neural net "new paradigm" with the "traditional" expert system approaches were commonplace. A few presenters explicitly compared the performance capabilities of specific neural nets with the performance of specific expert systems on the same or similar tasks. However, many of the comments were much more general. There seemed to be a strong feeling that neural nets were the new "hot opportunity," and that they would be in the latter part of the 80's what expert systems were in the late 70's and early 80's. Interestingly enough, the very similarity that the participants felt between the two fields has led to attitudes and actions that have made the introduction of neural network approaches distinct from the earlier introduciton of expert systems.

First, since expert systems have proved to be commercially successful, and a competitive market in expert systems technology has been established, there was a sense of "rushing" to get on the neural networks "bandwagon." This feeling seemed evident throughout the academic, industrial, and government (both DoD and Non-DoD) groups of participants at the conference. Secondly, there was a sense of cynicism mixed in with the very real expectation of useful results from developing neural network technologies. Most of the attendees were veterans of many computer science/AI conferences, and had seen the explosion of "hype" about expert systems a few years earlier. Thus, the same degree of hype, applied to the newly emerging science and technology of neural network systems, evoked a cynical comparision to the "publicity versus reality" experiences of previous years.

Nevertheless, the expectations for strong applications potential were very much in evidence. The facility with which NN processes can handle demanding pattern recognition tasks has led to some impressive demonstrations. As an example, the results of NETTALK (text-to-speech generation, by Terrence Sejnowski and Charlie Rosenberg) have been very effective in showing how a neural network system "learns."

Neural network applications were also demonstrated by TRW, General Dynamics, Verac, TI, and other companies. Further, several companies are creating and agressively marketing the neural net equivalent of expert system "shells." These companies include Hecht-Nielson Neurocomputer Corporation ("Defining an industry"), Neuraltech, Inc. ("The foundation of knowledge processing"), Neuronics ("Setting standards and breaking limits"), Nestor Inc. ("Learning systems - the next generation"), Adaptics ("Adaptive solutions for tomorrow's problems - today"), and SAIC (No buzz-phrase for SAIC, just product description).

In addition to the presented papers and the exhibits of soft- and hardware, there was a panel presented by NSF and several major DoD funding agencies, during which representatives from each organization specified funding opportunities with their respective agencies for neural net

research and prototype applications devleopment. The total value of program opportunities explicitly described was on the order of ten million dollars. Since these programs had to have been authorized before the conference, and since the response to NN technology was so strong, it is possible that even greater opportunities for funded research will be available. Also, the above figure does not include the independent investment of resources by industry. Many major corporate laboratories are either beginning or intensifying their reserch in distributed parallel processing and adaptive neural networks. A key point here is that the investment of resources in NN research seems to be both more rapid and more intensive than the steps taken years ago to invest in expert systems technology.

The final point which I'd like to make is a personal assessment of the nature of neural net research, and the demands which it will make on the talents and training of researchers. The leaders of the neural network research field are characterized by an unusual combination of both depth and breadth in their scientific knowledge. They are well trained in mathematics, and generally have substantial knowledge of one or more of the physical and/or biological sciences in addition to their knowledge of computer science and AI. Teuvo Kohunen's work, as an example, forms part of the core theoretical underpinning for neural network models. His texts, as well as those of many others in the field, require substantial knowledge of linear algebra. Stephen Grossberg and others use differential equations to describe models of neural net systems. J.J. Hopfield's model uses a formal isomorphism between neural net systems and systems which can be described using statistical thermodynamics. And these represent just the genesis of the field! It is unlikely the the work in neural networks will become any less conceptually and mathematically demanding. I believe that it is likely that those who will be most successful in this field will be those who can bring to bear the skills provided by a strong training in mathematics and the physical sciences.

The field of adaptive neural networks, although young, is growing rapidly. There are high expectations - and pressures - for successful applications. The demand on researchers is unusual in terms of requiring depth of mathematical and scientific background. However, the opportunities for both fundamental and practical advances are great, and the next several years of research will probably be exceptionally interesting.

TUTORIAL ARTICLE

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THE INTERNATIONAL NEURAL NETWORK SOCIETY

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