recognition of more complex patterns in the pulses.

In "Programming Parallel Computers Using Energy Minimization Algorithms," S.D. Simmes presented evidence that energy minimization algorithms (for example, neural net algorithms) are very well suited to decomposition for solution on multiprocessors. Current simulations on uniprocessors exhibit very poor performance, suggesting that "real" problems will yield to neural techniques only when hardware accelerators are available. A multiprocessor approach may mitigate the need for special-purpose hardware.

Bart Kosko, in "Adaptive Inference in Fuzzy Knowledge Networks," reported on the combination of neural-network expert systems into a single large system without the performance degradation attendant on a conventional match-select-act architecture.

In "Representing Conceptual Structures in a Neural Network," Dave Touretzky of CMU reported on a two-level associative retrieval system that corrects partially incorrect key specifications. It uses a connectionist-based frame-like knowledge representation approach. Inheritance is not a part of the frame system. Instead, microfeatures are explicitly encoded to handle exceptions to captured regularities in the knowledge.

Judith Styles, in "Detection of Favorited Patterns in the Temporal Structure of Nerve Cell Connections," presented evidence that favored patterns do exist and can be correlated to sensory input in animals. A favored pattern is a temporal sequence within a neuron's spike train that occurs more often than would be expected if the neuron's output were random. Patterns were found in the cortex of a monkey expecting food that were not present while the animal was eating (or not expecting food).

Deborah Walters of the State University of New York at Buffalo reported a project that found that biological networks tend to use representations that fall in the middle of the variable representation space. In other words, many neurons are neither fully "on" nor fully "off." This is in contrast to the representation used in most artificial neural network models. Walters suggested the devising of a theoretical framework for variable representation in artificial neural network models that would be more closely aligned with biology.

In "Self-Organization of Stable Category Recognition Codes for Analog Input Patterns," Gail Carpenter and Stephen Grossberg of Boston University presented the results of a government-sponsored project in which automatic classification of 20 different shapes was done under conditions of scaling, rotation, and noise.

**Plenary sessions**

Several luminaries in the field presented longer invited papers in the evening sessions. One of Caltech professor Carver Mead's messages was "Bad news: we must learn how to design analog VLSI systems." He was referring to his belief that the most efficient way to implement neural networks in hardware is to make the neurons out of analog circuits rather than digital ones. He also pointed out a fact important to the long-term future of neural network research: The cortex is basically a two-dimensional structure. It is roughly one meter x one meter x one millimeter, with most of the thickness composed of white matter, I.e., of wiring. Knowing this simplifies somewhat the technology needed to wire up something similar to the cortex, although it will still be many years before as many processing elements and as many connections as the cortex has can be put into an artificial neural network.

Bernard Widrow put the research discussed at the conference into a historical perspective by presenting some work done in the mid-1960's, including some work on a connectionist approach to speech recognition. The results he showed were almost too good and the reports he referenced seemed almost too contemporary, raising the question of how much progress has really been made in the last 20 years.

Representatives of several government agencies—including DARPA, NSF, the Office of Naval Research, the Air Force Office of Scientific Research, and the Air Force Wright Aeronautics Laboratory—described work they are interested in supporting and told the plenary session attendees how to apply for funds.

**Vendor exhibits**

About 20 vendors were represented at the conference, in booths ranging from the large and elaborate to the small and simple. Hecht-Nielsen Neurocomputer Corporation exemplified the large exhibitor—they demonstrated several applications of their IBM PC/AT coprocessor board and software designed to support neural network paradigms. At the other end of the scale, a university was giving away copies of a simulator for the Apple Macintosh.

---

**Attention readers!**

**Save the reputation of your colleagues!**

Rumor has it that design and test engineers, technical staff, and even management have no opinions, no sense of humor, and nothing to complain about. We at *D&T* just couldn't believe that, so we started a department called "D&T Forum" to give those silent types a chance to change their reputation. We even agreed to withhold the names of contributors to prevent undue embarrassment.

So far, only two brave souls have ventured forth. Could it be that the rumor was true?

There's still time to renew our faith in you. Send humor—cartoons, jokes, parodies, etc.—opinions, or beefs to D&T Forum, IEEE Design & Test, 10662 Los Vaqueros Cir., Los Alamitos, CA 90720.