Innovation and Application of ANN in Europe demonstrated by Kohonen Maps

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Extended Summary

One of the most important contributions to neural networks comes from Kohonen, Helsinki/Espoo, Finland, who had the idea of self-organizing maps in 1981. He verified his idea by an algorithm of which many applications make use up to now. The impetus for this idea came from biology, a field where the Europeans have always been very active at several research laboratories. The challenge was to model the self-organization found in the brain. Today one goal is the development of more sophisticated neurons which model the biological neurons more exactly. They should come to a better performance of neural nets with only few complex neurons instead of many simple ones.

A lot of application concepts arised from this idea: Kohonen himself applied it to speech recognition together with a japanese company, but the project did not overcome much more than the recognition of the numerals one to ten at that time. In the last years he is generating artificial music via self-organizing maps. A more promising application for self-organizing maps is process control and process monitoring. In this field Goser, Dortmund, made several proposals which concern parameter classification of semiconductor technologies, design of integrated circuits, and control of chemical processes. His graduates as Speckmann at Tuebingen broadened the field of applications. Ritter applied self-organizing maps to robotics. Germond, MANTRA center at Lausanne, introduced the neural concept into electric power systems.

At Dortmund we are working on a system which has to monitor the quality and the reliability of gears and electrical motors in equipments installed in coal mines. The results are promising and the probability to apply the system in the field is very high. A special feature of the system is that linguistic rules which are embedded in a fuzzy controller analyze the data of the self-organizing map in regard to life expectation of the gears. It seems that the fuzzy technique will introduce the technology of neural networks in a tandem mode. These technologies together with the genetic algorithms start to form the attractive field of computational intelligence. - Von Seelen, Bochum, develops a system with self-organizing maps that can monitor breaks and plugs in cars on this basis, too. Rueckert, Hamburg, and Ultsch, Marburg, try to combine the self-organizing map with an expert system instead of a fuzzy network, so that the total system exploits the advantages of both implicit and explicit rules.

Several research teams try to improve the theory of self-organizing maps, e.g. Cotrell, Paris, published important facts about the consistency of self-organisation, Tryba and Kanstein, Dortmund, are developing a new algorithm which bases on differential equations. Herault and Demartines, Grenoble, developed the vector quantization from the self-organizing concept. The vector quantization shows impressive results at the prediction of catastrophic failures. They also invented the interesting concept of separation of sources by simple neural networks which may find applications in hearing aids and noisy machineries.

A further effort aims to an implementation in hardware: Ramacher at Siemens, Munich, presented the Neural Computer Synapse which has a high flexibility and a remarkable high performance in regard to 10^8 CUPS (Connection Updates Per Second). Siemens AG is introducing Synapse I into the market now. - There are some activities about neural ASICs: Rueping, Dortmund, is representing the interesting concept BISOM in digital technique at which a simplified and adapted algorithm reduces the number of required transistors. Vittoz, Neuchatel, worked out an analog circuit for self-organizing maps which can be used in mobile and portable systems. Del Corso, Turino and Murray, Edinburgh, show that the pulse modulation techniques have decisive advantages for integration in analog technique.

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At the moment there are a lot of conferences in Europe in this field: ICANN, NeuroNimes, MicroNeuro, IWANN, ESANN, and several local workshops. Some conferences are strongly bound to roman and other to anglo-saxon regions. The high number of conferences does absolutely not relate to the number of industrial applications which are quite poor up to now. One reason for so many conferences comes from the role of universities which is far from industrial challenge: the promotion at universities needs papers which can be produced in the most easiest way on an innovative field and on conferences which need participants.

In conclusion we have to say that the industrial situation on the field of artificial neural networks is poor and difficult in Europe. One reason is that there are no or only little activities in the field of classical data processing in Europe. The strategy of many politicians is, however, that Europe gains a better position in a new technology as neuroinformatics, since in classical fields there are barely no chances for newcomers. There are a lot of soft applications of neural nets especially developed at application oriented laboratories as FhG (Seitzer, Hosticka), SICAN (Weinert) and IMS (Hoefflinger) in Germany. At the moment they concentrate their work on the electronic eye and on automotive applications. The academic work far from real economic pressure is overwhelming. We can only hope that the gap between academic and industrial world in Europe will diminish in future and the activity will grow on the industrial side, especially for our own interest to become more successfully in the important economical sector of information technologies.

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