

Introduction to the “FUNN 2003” Special Issue of Natural Computing.

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We are very pleased to present to you this special issue of Natural Computing, with extended versions papers from the FUTURE of Neural Networks (FUNN) workshop held in conjunction with the 2003 ICALP conference in Eindhoven, The Netherlands.

The objective of this workshop was to assemble researchers working on state of the art in artificial neural network research and let them highlight their current research directions and collect their thoughts on what the future of neural networks is likely to be.

We enjoyed a full program, within the excellent organization provided by the ICALP organization: we would specifically like to thank Erik de Vink, Anne-Meta Oversteegen and Tijn Borghuis for their involvement in the organization of the workshop.

In this issue, there are five papers that are extended versions of papers presented at workshop. It is interesting to note that four out of five papers consider networks of artificial neurons that are much closer to real biological neurons than traditional neurons: so-called spiking or pulsed neural networks. The goal is to find advantages of spiking neural networks over traditional (sigmoidal) neural networks.

In the paper “Short Term Memory in Recurrent Networks of Spiking Neurons”, by Emmanuel Dauc, work on retention and tracking of objects in recurrent networks of spiking neurons is presented. The networks are composed of interacting inhibitory and excitatory populations, and for specific distributions of delays and weights, slow waves of synchronous activity promote fast adaptation of the network activity to input stimuli. The model then displays dynamic retention and normalization of presented stimuli, as well as target tracking. These properties of such interacting spiking neural networks are of interest for such diverse applications as modeling biological topologically or-



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ganized structures, and for robotic applications taking place in noisy environments where targets vary in size, speed and duration.

Laurent Perrinet presents work on learning over-complete dictionaries for efficiently encoding visual stimuli in "Finding Independent Components using spikes: a natural result of Hebbian learning in a sparse spike coding scheme" By deriving an over-complete dictionary using sparse spike coding, an encoding scheme is developed that is both compatible with biological constraints and with neuro-physiological observations. The paper is in particular concerned with the exploration of learning mechanisms that derive in an unsupervised manner an over-complete set of filters which provides a progressively sparser representation of the input.

Similarly, Markus Volkmer presents work that connects the fields of Time Frequency Analysis and spiking neural networks in "PNN model of SRTFs and population coding in auditory cortex". This link allows the author to show how a neural time-frequency signal representation can be considered as a signal-dependent overcomplete dictionary.

In the paper "The Evidence for Neural Information Processing with Precise Spike-times: A survey", by Sander Bohte, the evidence that has accumulated in neuroscience for the relevance of the timing of individual spikes is surveyed. The conclusion is that the common theme in experiments where such timing was found to be precise, the neural systems were operating in an environment that demanded (very) fast or very precise information processing, like the flies visual systems when performing complex movements, or the perception of auditory signals in cortex.

The final paper investigates a different route for applying networks of neural networks and let them behave more like cognitive systems. Olcay Kursun presents work on a method for automated data analysis and interpretation in "SINBAD Automation of Scientific Discovery: from Factor Analysis to Theory Synthesis" The SINBAD method is a novel computational method of nonlinear factor analysis based on the principle of maximization of mutual information among non-overlapping sources – extracts higher-order features of the data revealing hidden causal factors in the observed phenomena. The set of methods and procedures together make up the "Virtual Scientist" and provide an analytical and theory-building tool for uses in complex scientific problems characterized by multivariate and nonlinear relations.

In all, we believe these papers show that the field of neural networks is very much alive, and advances steadily to better explanation and understanding of the workings of biological neural systems. Moreover, the field also provides new and interesting tools for the application within Science.