ARTIFICIAL NEURAL NETWORKS, 2

Proceedings of the 1992 International Conference on Artificial Neural Networks (ICANN-92)
Brighton, United Kingdom, 4-7 September, 1992

Edited by

Igor ALEKSANDER
Department of Electrical and Electronic Engineering
Imperial College of Science Technology and Medicine
London, United Kingdom

and

John TAYLOR
Department of Mathematics
King's College London
London, United Kingdom

Volume 1

1992

NORTH-HOLLAND
AMSTERDAM • LONDON • NEW YORK • TOKYO
Table of Contents
VOLUME 1

Plenaries

Artificial Neural Networks: Models, Paradigms or Methods?
T. Kohonen 3

From Single Neuron to Cognition
J. G. Taylor 11

Capturing Consciousness in Neural Systems
I. Aleksander 17

Associative-memory models of the Cerebellum
P. Kanerva 23

Analogue Neural VLSI: Issues, Trends and Pulses
A. F. Murray 35

Why are Neural Networks so Wide?
S. Judd 45

Combining Two Methods of Recognizing Hand-printed Digits
G. E. Hinton, C.K.J. Williams, M.D. Revow 53

Neurocontrol: Where it is Going and Why it is crucial
P.J. Werbos 61

Conference Papers

Learning Theory 1
Organizer: H.J. Kappen

Learning Rules, Stochastic Processes, and Local Minima
(Invited paper)
B. Kappen, T. Heskes 71

The Final Prediction Error Criterion for MLP Models
A. Varfis 79

Imposing A Generalisation Strategy on Artificial Neural Networks
G.D. Tattersall, G.E. Lee 83

A Self-organized Locally Tuned Network for Coarse Coding
G. Deco, J. Ebmeyer 87
Reaching the Generalization Maximum of Back-Propagation Networks
W. Schoner

On Systematically Diluted Hopfield Networks
K.-R. Müller

Global Performance of Learning Rules
T. M. Heskes, E.T.P. Slijpen

Generalization of Back-Propagation Based on Tellegens Theorem
G. Tyma

Computational Limitations on Training Sigmoid Neural Networks
K.-U. Höffgen

Network Topology, Training Set Size and Generalization Ability in MLP's Project
P. Burrascano

Temporal Knowledge in Locations of Activations in a Self-Organizing Map
J. Kangas

Unsupervised Symmetry Detection: A Network which Learns from Single Examples
W. Konen, C. von der Malsburg

A Learning Threshold Algorithm for Binary Linear Codes
A. Esposito, S. Rampone, R. Tagliaferri

The Use of an Adaptive Distance Measure in Generalizing Pattern Learning
G. Scheler

On Bounded-depth Threshold Circuits for Pattern Functions
A. Albrecht

The Bearable Lightness of Being: Reducing the Number of Weights in Backpropagation Networks
S. Santini

A Reinforcement Learning Algorithm for Networks of Units with Two Stochastic Levels
D. Kontoravdis, A. Likas, A. Štafylopatis

Learning Theory 2
Organizer: L.B. Almeida

Adaptive Decorrelation (Invited Paper)
L.B. Almeida, F.M. Silva

Training Window Neurons Through the Solution of Linear Equations
M. Muselli

Sequential Learning of Two-layer Networks with the Incomplete Upstart Algorithm
M. Muselli
An Ordering Theorem that Allows for Ordering Changes
E.A. Ferrán

A Complexity Metric and Benchmark Set for Learning Continuous Functions
R.W. Green, C.M. DeAngelis

Symmetries of General Feedforward Neural Networks and Equivalent Classification Tasks
P. DeWilde, A.M.C.-L. Ho

Unsupervised Hebbian Learning and the Shape of the Neuron Activation Function
J.L. Shapiro, A. Prügel-Bennet

Ockham's Nets: Self-Adaptive Minimal Neural Networks
G.D. Kendall, T.J. Hall

The Generalisation Ability of Dilute Attractor Neural Networks
C. Campbell

Attractor Structure of Constrained Neural Networks at Finite Temperature
C. Campbell

How to Remember the Future: Temporal Asymmetry in Mechanisms of Synaptic Change
O. Holland, M. Snaith

PCA in Fully Parallel Neural Networks
E. Oja, H. Ogawa, J. Wangwiwattana

Study on Minimal Net Size, Convergence Behaviour and Generalization Ability of Heterogeneous Backpropagation Network
J. Kamruzzaman, Y. Kumagai, H. Hikita

A New Geometric Approach to the Design of Neural Associative Memory
J. Dehaene, J. Vandewalle

The Howl-effect in Dynamic-network Learning
C. Thornton

A Theory of Over-Learning
H. Ogawa, K. Yamasaki

Deterministic Nets and Learning 3
Organizer: E.R. Caianiello

Do all Neurons Know Algebra?
(Invited Paper)
E.R. Caianiello

On the Capacity of n-h-1 Networks with Sigmoidal Functions
M. Yamasaki, A. Sakurai

Improving Generalization Performance by Nonconvergent Model Selection Methods
W. Finnoff, F. Hergert, H.G. Zimmermann
On the Capacity of n-h-s Networks
A. Sakurai, M. Yamasaki

A Signal Sharing Scheme for Unifying Computation and Learning Phases of Recurrent Networks
I. Kumazawa

Assigning Two Modes of Computation to Cells of a Formal Neural Network for Unsupervised Learning of Sequences
B. Gas, R. Natowicz

A Connectionist Model Constrained by an Optical Implementation
F. Alexandre, F. Guyot

Cascade LLM Networks
E. Littmann, H. Riuer

Reinforcement Learning and Subtasks
T. Wengerek, H. Ritter

Designing Neural Networks Using Structured Genetic Algorithm
D. Dasgupta, D.R. McGregor

M-RCE: A Self Configuring ANN with Rule-extraction Capabilities
N. Tschichold-Gürman, M. Ghazvini, D. Diez

Learning A-posteriori Probabilities with Multi-layer Perceptron Classifiers
M.J.J. Holt

The Connections of Large Perceptrons
W. Wiegerinck, T. Coolen

Stable States, Transitions and Convergence in Kohonen Self-organising Maps
D.A. Critchley

Structural Adaption of Boolean Higher Order Neurons: Classification with Parsimonious Topologies for Superior Generalization
G. Fahner, N. Goerke, R. Eckmiller

A Learning by Reinforcement Model from the Neurobiological Outlook
F.J. Vico, F. Sandoval

When a Bird in a Bush is Worth Two in the Hand
O. Holland, M. Snaith

Information Retrieval in Sparse Associative Memories
M. Ceccarelli, A. Petrosino

Neuromathematics 1
Organizer: S-I. Amari

Learning Curves, Generalization Errors and Information Criteria
(Invited Paper)
S-I. Amari
Gibbs Distribution Theory of Adaptive N-Tuple Networks
S.P. Luttrel

Autogenerative Nodal Memory Model (ANM) - A Mathematical Analysis of Autogenerated Internal Content
F.A. Monaco

Characteristic Properties of Stable Recurrent Higher Order Neural Networks
A. Bischoff, B. Schürmann, J. Maruhn, J. Reinhardt

Layer Based Neural Network Formalization
E. Fiesler, H.J. Caulfield

Phase Space Dynamics of Neural Nets
U. Ramacher, M. Wesseling

A Neural Network Model for the Generation of Epileptic Foci
A. Adamopoulos, P.A. Anninos

Looking at Hopfield-type Associative Memory Through Eigenvalues Analysis and SVD
S. Skoneczny

Non-Euclidean Cellular Automata and Neural Nets
K. Melkas, K. Kaski

The Effect of Correlated Inputs on Discrete Kohonen Networks
K. Ishida, Y. Matsumoto, N. Okino

On the Role of Time-varying Recurrent Synapses on the Properties of Neural Maps
A.C.R. Da Silva Fihlo

Stability of Asymmetric Networks and Dale's Law
H.G. Barrow

Eigenvalues and Eigenvectors for Compartmentally Modeled Unbranched Neurons
A.J. Klaassen

Attractor Learning of Recurrent Neural Networks
K. Gouhara, H. Takase, Y. Uchikawa, K. Iwata

Association Dynamics of Cross-Coupled Hopfield Nets with Many-to-Many Mapping Internetworks
S. Ozawa, K. Tsutsumi, H. Matsumoto

Prediction of Chaos in Non-autonomous Systems by a Neural Network
I. Grabec
Neuromathematics 2
Organizer: A. Babloyantz

From the single Neuron to the Cortical Networks - A Coherent Model of EEG
*(Invited Paper)*
A. Babloyantz

Boltzmann Machines with Finite Alphabet
J. Shawe-Taylor, J. Zernovnik

A New Global Optimization Method: "Rolling-Stone Scheme" and Its Application to Supervised Learning of Multi-layer Perceptrons
J. Chao, W. Ratanasuwon, S. Tsuji

Cytoskeleton as Feedback Control System in Neuron
D. Koruga, M. Andjelkovic, S. Jankovic, S. Hameroff

Equilibrium and Turbulent Solutions to Recurrent Neural Fields in $R^2$
C.B. Price, P. Wambacq, A. Oosterlinck

Approximating Functions and Predicting Time Series with Multi-Sigmoidal Basis Functions
M. Benaim, L. Tomasini

Back Propagation in a Clifford Algebra
J.K. Pearson, D.L. Bisset

A Novel Architecture of High Order Associative Memory with Reduced Cross Talk
Y. Kumagai, J. Kamruzzaman, Y. Maruyama, H. Hikita

Geometric Methods and Generalisation in Feedforward Networks
J. Mitchell

Discovering Nonlinear Dependences in the Output of Feed-forward Networks
A. Sperduti, A. Starita

The Bottleneck of the Bidirectional Associative Memory and Its Generalizations
H. Englisch, M. Herrmann

Automatic Gain Control by a Basic Neural Circuit
H.G. Barrow, J.M.L. Budd

Combinatorial Optimization by Random Neural Network Model Application to the Independent Set Problem
F. Pekergin

Global Behaviour in Asymmetric Continuous Neural Networks
J.-L. Gouzé

Capacity and Spurious Memory of Associative Memory Using a Non-Monotonic Neuron Model
S. Yoshizawa, M. Morita, S. Amari

Extraction of the Prototypes Encoded in chaotic Attractor
A. Yu. Loskutov, V. M. Tereshko
Sensorimotor Control
Organizer: R. Eckmiller

Model-Based Training Method for Neural Controllers
_T. Hrycej_

Rule Extraction for BNN Neural Network-based Fuzzy Control System by
Self-Learning
_D.A. Linkens, J. Nie_

Counterpropagation Network-Based Fuzzy Controllers: Explicit Representation and
Self-Construction of Rule-Bases
_J. Nie, D.A. Linkens_

Minimum-Motor-Command-Change Trajectories Predicted by Cascade Neural Network
Using a 17-Muscle Arm Model
_M. Dornay, M. Kawato, Y. Uno, R. Suzuki_

Control of a Paraplegic Patient Model by Neuroprosthetic Networks
_J. Beckmann, WJ. Daunicht, V. Hämberg_

A General Approach to Learning of Task Sequences
_F.E. Lauria, M. Sette_

A Neurocontroller Based on A Learning Boolean Network
_F. Bini Verona, F. E. Lauria_

A Neural Network Study on the Role of Efference Copy Feedback in the Generation
of the Collicular Motor Map
_K.P. Krommenhoek, A.J. van Opstal, C.C.A.M. Gielen, J.A.M. van Gisbergen_

SOBoS - A Self-Organizing Body Schema
_P. Morasso, V. Sanguineti_

Voluntary Motor Control Using Biologically Plausible Neural Networks with
Application to Advanced Biologically Inspired Robots
_M.P. Norman, M.J. Denham_

Vision 1
Organizer: K. Fukushima

An Improved Learning Algorithm for the Neocognitron
_(Invited Paper)_
_K. Fukushima, N. Wake_

A Dynamical Multiparticle Model for Early Vision
_M. Bengtsson_

Relaxation in 4D State Space - A Competitive Network Approach to Object-related
Velocity Vector-field Correction
_H. Glünder, A. Lehmann_
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance of Hopfield ANN in Simulating Human Optical Illusions:</td>
<td>513</td>
</tr>
<tr>
<td>The Muller-Lyer Paradigm</td>
<td></td>
</tr>
<tr>
<td>E. Ventouras, C. Papageorgiou, N.K. Uzunoglu, A. Rabavilas, C. Stefanis</td>
<td></td>
</tr>
<tr>
<td>Bionocular Vergence Control and Depth Reconstruction Using a Phase Method</td>
<td>517</td>
</tr>
<tr>
<td>W.M. Theimer, H.A. Mallot</td>
<td></td>
</tr>
<tr>
<td>An Incremental Neural Classifier of Configurations of Active</td>
<td>521</td>
</tr>
<tr>
<td>Orientation-specific Line Detectors</td>
<td></td>
</tr>
<tr>
<td>A.P. Azcarraga, B. Amy</td>
<td></td>
</tr>
<tr>
<td>A Precategorial Network Model for Line and Edge Detection and</td>
<td>525</td>
</tr>
<tr>
<td>Texture Segregation</td>
<td></td>
</tr>
<tr>
<td>M.M. Van Hulle, T. Tollenaere</td>
<td></td>
</tr>
<tr>
<td>Nonlinear Programming Neural Network Application to Image Filtering</td>
<td>529</td>
</tr>
<tr>
<td>A. Dzienninski, S. Skoneczny</td>
<td></td>
</tr>
<tr>
<td>A Parallel Translation of the Waltz Algorithm for Analyzing Line-</td>
<td>533</td>
</tr>
<tr>
<td>drawings</td>
<td></td>
</tr>
<tr>
<td>T. Tambouratzis</td>
<td></td>
</tr>
<tr>
<td>The Economy/Performance Issue in Harmony Theory Networks</td>
<td>537</td>
</tr>
<tr>
<td>T. Tambouratzis</td>
<td></td>
</tr>
<tr>
<td>Optical Flow Estimation Algorithm for Neural Networks</td>
<td>541</td>
</tr>
<tr>
<td>T. Watanabe, Y. Isobe</td>
<td></td>
</tr>
<tr>
<td>Image Recognition with a Cooperation of Symbolic Inference and</td>
<td>545</td>
</tr>
<tr>
<td>Neural Networks</td>
<td></td>
</tr>
<tr>
<td>N. Sakurai, T. Omori</td>
<td></td>
</tr>
<tr>
<td>Parallel Distributed Switching with Gating Lattices</td>
<td>549</td>
</tr>
<tr>
<td>E.O. Postma, H. J. van den Herik, P.T.W. Hudson</td>
<td></td>
</tr>
<tr>
<td>Self-organization of Binocular Receptive Fields</td>
<td>553</td>
</tr>
<tr>
<td>M. Andres, H. Mallot, G.-J. Giefing</td>
<td></td>
</tr>
<tr>
<td>Discovering Textures with a Metric Based on Image Structure</td>
<td>557</td>
</tr>
<tr>
<td>G. Smith, J. Austin</td>
<td></td>
</tr>
<tr>
<td>Interaction of 3-D Illusory Object with Binocular Viewing</td>
<td>561</td>
</tr>
<tr>
<td>M. Idesawa</td>
<td></td>
</tr>
<tr>
<td>An Efficient Neural Architecture Implementing the Boundary Contour System</td>
<td>565</td>
</tr>
<tr>
<td>E. Ardizzone, A. Chella, G. Compagno, R. Pirrone</td>
<td></td>
</tr>
</tbody>
</table>

**Robotics and Control**

**Organizer: I. Aleksander**

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Neural Architecture for Concurrent Generation of Configuration</td>
<td>571</td>
</tr>
<tr>
<td>Space Trajectory</td>
<td></td>
</tr>
<tr>
<td>S. Bhattacharya, A. Ghosal</td>
<td></td>
</tr>
<tr>
<td>A Neural Network Model for Trajectory Formation of Arm Movement by</td>
<td>575</td>
</tr>
<tr>
<td>Using Forward and Inverse Dynamics Models</td>
<td></td>
</tr>
<tr>
<td>Y. Wada, M. Kawato</td>
<td></td>
</tr>
</tbody>
</table>
Self-organizing Neural Network Application to Technical Process Parameters Estimation
E. Govekar, E. Susic, P. Muzic, I. Grabec

High-precision Robot Control: The Nested Network
A. Jansen, P.P. van der Smagt, F.C.A. Groen

Building Maps for Path-planning and Navigation Using Learning Classification of External Sensor Data
A. Kurz

A Neural Network for Collision-free Path Planning
H. Meng, P.D. Picton

Receptive Fields for CMAC. An Efficient Approach
W.S. Mischo

Extending the Adaptive Heuristic Critic and Q-learning: From Facts to Implication
O. Holland, M. Snaith

Neural Networks for Optimal Control of Nonlinear Stochastic Systems
T. Parisini, R. Zoppoli

Control of Time-delay Systems Using Reinforcement Learning
T. Langlois, S. Canu

A Neuro-controlled Autonomous Robot That Can Capture a Moving Object
K. Tanaka, M. Shimizu, K. Tsuchiya

Node Allocation and Topographical Encoding (NATE) for Inverse Kinematics of a Redundant Robot Arm - Learning without a Teacher
J. Hakala, H.W. Werntges, J.R. Beerhold, R. Eckmiller

Adaptive State Space Quantisation: Adding and Removing Neurons
B.J.A. Kröse, J.W.M. van Dam

Weightless Systems
Organizer: I. Aleksander

An Automata-theoretic Assessment of the Cognitive debate
(Invited Paper)
I. Aleksander

Adaptive Reward-penalty for Probabilistic Logic Nodes
R.S. Neville, T.J. Stonham

A Modular Weightless Neural Network System
R.J. Mitchell, P.R. Minchinton, J.P. Brooker, J.M. Bishop

Auto-Associative Digital Neural Network for Grey Level Data
J.M. Bishop, R.J. Mitchell, P.R. Minchinton
Implementing Hard Self-organization Tasks Using Logical Neural Networks
G. Tambouratzis, T.J. Stonham

A Cascadable 2048-Neuron VLSI Artificial Neural Network with On-Board Learning
T. Hui, P. Morgan, K. Gurney, H. Bolouri

The Use of Encoded Outputs and Reinforcement Training in pRAM Nets
Y. Guan, T.G. Clarkson, J.G. Taylor, D. Gorse

The Hysteretic Neuron - A Model with Energy for Learning
P.J.L. Adeodato, C.G. Fernandes

Turing Machine Simulation by Logical Neural Networks
W.R. de Oliveira, T.B. Ludermir

SOFT - A Boolean Self-organising Feature Extractor
A. de Carvalho, M.C. Fairhurst, D.L. Bisset

A Lazy Learning Approach to the Training of GSN Neural Networks
A. de Carvalho, M.C. Fairhurst, D.L. Bisset

Optimum Selection of Class Vectors
M.T. Brown, J. Austin

Bounding the Alphabet Size of Fixed Weight Block Codes
R. Beale

A Rapid Coding Methodology Utilising A Distributed Associative Memory
R. Beale

Hybrid Systems For Robot Planning
Organizer: P. Morasso

Hybrid Systems For Robot Planning
(Invited Paper)
P. Morasso, G. Vercelli, R. Zaccaria

On the Problem of Connectionist Production Systems - Models and Their Implementation
N.K. Kasabov, S. Shishkov

Competitive Learning in Classifier Feature Maps
N.R. Ball

Theory and Experiments in Connectionist AI: A Tightly-coupled Hybrid System
A. Giacometti, B. Amy, A. Grumbach

Generation of Symbolic Rules in Back-Propagation Networks
T. Denoeux

Learning Fuzzy Control Rules with a Fuzzy Neural Network
F. d'Alché-Buc, V. Andrés, J.-P. Nadal
Local Abduction and Prediction of Unit Clauses in Symmetric Hopfield Networks
P.M.V. Lima 721

Semantic Transparency, Brain Monitoring and the Definition of Hybrid Systems
J.G. Wallace, R. Silberstein, K. Bluff 727

Detecting Structures in Natural Language Using Neural Net and Rules
C. Lyon, R. Frank 731

Knowledge Acquisition with Self-Organizing Neural Networks
A. Ultsch 735

A Hybrid Method of Hidden Markov Model and Neural Network Classifier for On-line Handwritten Character Recognition
S.-B. Cho, J.H. Kim 741

A New Hybrid Approach to Robot Vision
F. Callari, A. Chella, S. Gaglio, R. Pirrone 745

Approximate Reasoning with Hybrid Connectionist Logic Programming Systems
N.K. Kasabov, S.H. Petkov 749

A Symbolic/Subsymbolic Interface for Variable Instantiation
R. Stark 753

A Rule-based Network Architecture
J. Hollatz, V. Tresp 757

Speech / Vision 2
Organizer: F. Fallside

Issues in Speech Recognition Using Neural Networks (Invited Paper)
F. Fallside 765

Improving Rejection in Neural Network Classifiers: An Application to Isolated Word Recognition
R. Gemello, F. Mana 775

Integration of Neural Networks and Hidden Markov Models for Continuous Speech Recognition
Z. Zhao 779

Task Decomposition Through A Modular Connectionist Architecture:
A Talker Identification System
Y. Bennani, P. Gallinari 783

Classification and Reproduction of Time Sequences
W. Simantzik, R.W. Brause 787

Self-organizing Map in Acoustic Analysis and On-line Visual Imaging of Voice and Articulation
P. Utela, J. Kangas, L. Leinonen 791
Diphone Synthesis Using a Neural Network
G.C. Cawley, P.D. Noakes

An Attempt to Recognise Structural Aberrations in Chromosomes Using a Neural Network System
M. Turner, J. Austin, N. Allinson, P. Thompson

Automatic Feature Selection by Self-organization
A. Visa

Neural Networks for Low-level Image Processing
D.T. Pham, E.J. Bayro-Corrochano

Application of Optic Flow of a Neural Network Based on the Kullback Entropy
J.F. Boyce, S.R. Protheroe, J.F. Haddon

Algebraic Methods for Learning in Stochastic Syntactic Neural Networks
S.M. Lucas

Learning to recognize 3D-Hand Postures from Perspective Pixel Images
A. Meyering, H. Ritter

A Neural Network Hierarchy for Data and Knowledge Controlled Selective Visual Attention
H.-M. Grob, E. Koerner, H.-J. Boehme, T. Pomierski

Neural Net Vector Quantizer for DCT Coding of Speech
R. Kunchev, L. Veleva

Shape, Position and Size Invariant Visual Pattern Recognition Based on Principles of Neocognitron and Perceptron
C. Neubauer