

## Subject Index

**A**

Adaptive filtering 124  
 Adaptive networks 761  
 Adaptive resonance 653, 695  
 Adaptive signal processing 29  
 Aerospace 314  
 ALVIS 20  
 Analog implementation 384, 568, 618,  
 671, 678, 687, 695, 703, 712, 739,  
 748, 761, 769, 777  
 Anatomy 477  
 Annealing 91, 149, 594, 602  
 Aperture problem 468  
 Approximation 29  
 Architecture, programmable 712  
 Association rules 511  
 Associative learning 419  
 Associative memory 65, 459, 527, 586  
 Attention model 610  
 Attractor/repellor dynamics 20, 91, 634  
 Attractors, periodic 459  
 Auditory processing 366, 662  
 Autonomous devices, neural control of  
 577  
 Autonomous navigation 305

**B**

Backgammon 99  
 Backpropagation learning, improving  
 107  
 Backpropagation network 99, 177, 272,  
 340  
 Backpropagation, acceleration of  
 learning 224  
 Backpropagation, comparisons 206  
 Backpropagation, generalization 224  
 Backpropagation, non-gradient descent  
 678  
 Backpropagation, recurrent 149  
 Barn Owl 366  
 Basins of attraction 264  
 Bayesian estimation 332, 502, 594

Biased regression 177  
 Bifurcation 402, 459  
 Biological model 419, 459  
 Birdsong learning 795  
 Boltzmann machines 511, 602, 626,  
 748  
 Boltzmann perceptron network 116  
 Border patterns 160

**C**

Capacity 81, 586  
 Center-surround cells 186  
 Central pattern generators 384, 545  
 Cerebellar Model Articulation Controller  
 29  
 Cerebellum 410  
 Chaos 527, 568  
 Chaotic time series 57  
 Character recognition 40, 323, 332,  
 340, 728  
 Classical conditioning 195  
 Classification of phonemes 206, 215  
 Classification of signals 281  
 Classification, soft 116  
 Classifier systems 49  
 Cluster analysis 643  
 CMAC model 29  
 Cochlear model 662  
 Cognitive models 553  
 Color vision 297  
 Combinatorial optimization 91  
 Comparison training 99  
 Compartmental model 485, 802  
 Competitive activation 626  
 Competitive learning 739  
 Computational completeness 494  
 Computer games 99  
 Conjugate gradient techniques 40  
 Connectionist glue 215  
 Consonant recognition 215  
 Constrained networks 687  
 Constraining generalization 107

## Subject Index

Constraint satisfaction 602  
 Constraints on gradient 2  
 Content addressable memory 149, 695  
 Content-addressable memory 511  
 Contiguity 73  
 Continuous time dynamics 653  
 Control 20  
 Control systems 314, 348  
 Control theory 356, 410  
 Control, distributed 577  
 Control, motor 366  
 Convergence 149  
 Cooperative learning 232  
 Cooperative network 297  
 Cortical receptive field 11  
 Covariance storage 394  
 CPG 384  
 Critical temperatures 91  
 Crossover 49

**D**

Database analysis 256  
 DCPS 626  
 Delay-differential equations 568  
 Dendrite 477  
 Differential-Hebbian 195  
 Diffusion-enhancement layer 289  
 Digital implementation 728  
 Distributed control 577  
 Distributed memory 527, 586  
 Distributed representation 626  
 Divided attention 610  
 Dynamical systems theory 459  
 Dynamics 356

**E**

Ear model 224  
 Efficiency 29  
 Eigenfunction analysis 375  
 Electrical cochlea 662  
 Electrolocation 436

Electronic receptors 785  
 Electrophysiology 477  
 Energy landscapes 626  
 Energy minimization 519  
 Error, weighted metric 206  
 Expert systems 99, 248, 256  
 Exploratory behavior 436

**F**

Feature detection 11  
 Feed-forward networks 81, 332  
 Feedback network 305, 769  
 Filtering 687  
 Finite-element method 436  
 Finite-state grammars 643  
 Fish, electric 436  
 Formant transitions 240  
 Fractals 527  
 Frame systems 618

**G**

Gain control 720  
 Gallium Arsenide 695  
 Gaussian sources 116  
 Generalization 2, 29, 81, 107, 160  
 Genetic algorithms 49  
 Global maxima 602  
 Gnathonemus Petersii 436  
 Gradient estimation 141  
 Gradient techniques 40  
 Graph bipartitioning 91  
 Graph matching 618  
 Grouping, spatio-temporal and long-range 289

**H**

Hall effect transistors 785  
 Handwriting analysis 340  
 Handwritten digit recognition 323

## Subject Index

- Haptic sensors 785  
 Hardware adaptation heuristic 777  
 Hardware classifier 739  
 Hashing functions 29  
 Hebb rule 468  
 Hebb synapse 375  
 Hebbian learning 11, 769  
 Hebbian learning, incremental 511  
 Hermisenda visual-vestibular network 419  
 Heterogeneous information integration 206  
 Heterogeneous neural network 577  
 Hidden Markov models 796  
 Hidden units, choosing 11, 177  
 Hidden units, optimal 519  
 Hierarchical organization 618  
 Hippocampus 394, 610  
 Hopfield networks 91, 264  
 Hopfield networks, continuous 634  
 Human performance model 2  
 Hyperacuity 444  
 Hypothesis testing 256
- I**
- Image coding 11  
 Image compression 264  
 Image recognition 728  
 Image representation 297  
 Image restoration 594  
 Importance sampling 272  
 Impulse networks 678  
 Incremental Hebbian learning 511  
 Incremental learning 40, 215  
 Induction of rules 2  
 Inference 256, 527, 545  
 Infomax principle 186  
 Information-theoretic measures 57, 186, 256  
 Inhibition 703  
 Inhibitory search 20  
 Insect, artificial 577
- Intermodality integration 610  
 Internal noise network 560  
 Internal representation 206  
 Inverse kinematics 20  
 Ising spin system 451, 560  
 Isotropy in neural structures 794
- K**
- Kalman filter learning 133  
 Kanji, handwritten 332  
 Karhunen-Loeve transform 11  
 Kinematics 20, 348  
 Knowledge engineering 248  
 Kohonen networks 728, 739
- L**
- Layered networks 186  
 Learning by selection 264  
 Learning deterministic categorization 2  
 Learning from expert examples 99  
 Learning, associative 419  
 Learning, birdsong 795  
 Learning, competitive 739  
 Learning, cooperative 232  
 Learning, Hebbian 11, 769  
 Learning, higher order correlation 459  
 Learning, incremental 40, 215  
 Learning, Kalman filter 133  
 Learning, neuron 169  
 Learning, offline 678  
 Learning, PAC 81  
 Learning, parallel 40  
 Learning, perceptron 73  
 Learning, reinforcement 141  
 Learning, sigma-pi 348  
 Learning, simple techniques 602  
 Learning, stochastic 748  
 Learning, supervised 2, 73  
 Learning, unsupervised 11, 375, 468, 728  
 Least squares regression 65

## Subject Index

Lesion studies 577  
 Limit cycles 402  
 Line-search techniques 40  
 Linear networks 65  
 Local connectivity 65, 553  
 Local minima 65  
 Localist networks 545  
 Locomotion, neural control of 577  
 Long-term potentiation/depression 394  
 Lumped parameter model 419

**M**

Magnetic field sensors 785  
 Majority function 160  
 Maps, neural 366, 444, 802  
 Markov models 502, 511, 796  
 Matrix inversion 141  
 Maximum information preservation  
   principle 186  
 Mean field annealing 594  
 Mechanoreceptors 802  
 Membrane model 678  
 Memory, associative 65, 459, 527, 586  
 Memory, content addressable 149, 695  
 Memory, distributed 527, 586  
 Memory, long-term 394  
 Memory, reconstructive 527  
 Mental imagery 348  
 Metastability 264, 560  
 Microfeatures 553  
 Minimal networks 2, 177, 519  
 Monte Carlo simulation 272  
 Motion, apparent long-range 289  
 Motor control 366  
 Multi-resolution hierarchy 29  
 Multilayer networks 81, 272, 494  
 Multiple-access communications 272  
 MURPHY 348  
 Mutation 49  
 Mutual information 186

**N**

Natural language 527, 537, 545  
 Nearest neighbor network 560  
 Network analysis 626  
 Network architecture 57, 169  
 Network design 215  
 Network dynamics 402  
 Network initialization 206  
 Network modularity 215  
 Network performance analysis 281  
 Network simplification 107  
 Network training 494  
 Network, reducing free parameters 107  
 Neural development 375  
 Neural maps 366, 444, 802  
 Neurobiology 195, 436, 794  
 Neuron model 485, 678, 802  
 Neuron, limited interconnection 777  
 Neurons, real 802  
 Noise removal 124  
 Noise, internal 560  
 Noise, non-gaussian 124  
 Nonlinear dynamics 568  
 Nonlinear signal processing 124  
 NP-completeness 494

**O**

Object recognition 618  
 Ocular dominance column 451  
 Ocular dominance columns 375  
 Odor recognition 402  
 Offline learning 678  
 Olfactory bulb 402, 459  
 Optimal estimation 410  
 Optimal model 57  
 Optimization techniques 40  
 Optimization, constrained 618  
 Optimum multi-user demodulation 272  
 Orientation column 451  
 Oscillation 568  
 Oscillation modes 402  
 Oscillator, controlled neuron 560

## Subject Index

Oscillators, nonlinearly coupled 402  
 Oscillatory attractors 610  
 Oscillatory circuits 384

**P**

PAC learning 81  
 Pacemaker 577, 610  
 Parallel learning 40  
 Parallel parsing 537  
 Parity 73  
 Pattern recognition 2, 81, 314, 459  
 Pattern recognition, temporal 643  
 Pavlovian conditioning 419  
 Perceptron architecture 777  
 Perceptron learning 73  
 Perceptual grouping 289  
 Perceptual organization 618  
 Periodic attractors 459  
 Perturbation analysis 91  
 Phase transitions 451, 610  
 Phase-locked loop network 610  
 Phoneme classification 206, 215, 224  
 Phonemic symbol production 232  
 Photoreceptor 720  
 Physiological network 419  
 Plasticity 394  
 Potts spin system 451  
 Prediction 586  
 Principal components 65, 375  
 Probability of convergence 511  
 Pseudo-Newton method 141  
 Pulse coding 195  
 Pulse-firing 671

**R**

Radar target identification 281  
 Real world application 305  
 Receptive field 477  
 Receptor array 444  
 Receptors 802  
 Recognition, model-based 618

Recurrent analog network 459  
 Recurrent backpropagation 149  
 Recurrent inhibition 560  
 Recurrent multilayer perceptron 502  
 Recurrent network 149, 256, 305, 643  
 Recursion 527  
 Reinforcement learning 141  
 Relaxation 91  
 Relaxation neurodynamics 264  
 Relevance assessment 107  
 Representation, determining 73  
 Representation, distributed 626  
 Representation, internal 206  
 Representation, invariant 289  
 Representation, temporal 240  
 Retina 477  
 Retinal bipolar cell 720  
 Retinotopic organization 451  
 Rhythmic activity 384  
 Road following 305  
 ROBIN 545  
 Robotic control 20, 141, 305, 348, 356  
 Role binding 545  
 Routing switches 712  
 Rule induction 2, 107, 256

**S**

Saddle points 65  
 Scaling 160  
 Schema processing 602  
 Search techniques 20, 602  
 Self organizing structure 57, 728  
 Sensory filtering 410  
 Sensory motor control 366  
 Sensory processing 695  
 Sensory representation 444  
 Sensory systems 802  
 Sensory-motor learning/control 348  
 Sequential processing 502, 653  
 Shunting inhibition 477  
 Shunting neural networks 695  
 Sigma-pi learning 348

## Subject Index

- Signal detection 248  
 Signature activation 545  
 Signature verification 340  
 Simulated annealing 91, 149, 594, 602  
 Simulation, biological 485  
 Single-layer networks 99  
 Skeleton networks 107  
 Smooth surface interpolation 687  
 Soft classification 116  
 Solar flare forecasting 248  
 Spacecraft, attitude 314  
 Speech recognition 215, 240, 502, 796  
 Speech recognition, speaker-independent 224  
 Speech synthesis 232  
 SPICE simulation 662  
 Spin glasses 264  
 Spread pattern information 232  
 Spread-spectrum 272  
 Spreading activation 553  
 Stability analysis 568  
 Star identification 314  
 State representation 653  
 State trajectories 149  
 Stereo vision 11  
 Stochastic learning 748  
 Stochastic models 502  
 Stochastic networks 141  
 Stochastic relaxation 594  
 Structured models 553  
 Sub-space classification 728  
 Supervised learning 2, 73  
 Surface interpolation 594  
 Syllable recognition 240  
 Symmetry 73  
 Symmetry in neural structures 794  
 Synapses, analog 739  
 SYREN 240  
 System identification 57, 653

**T**

Tactile sensors 785

- Target identification 281  
 Temperature, local model 169  
 Temporal correlation 186  
 Temporal derivatives 195  
 Temporal difference methods 195  
 Temporal representation 240  
 Temporal windows 356  
 TheoNet 248  
 Threshold synapse 769  
 Time delay network 215, 568  
 Timeseries prediction 29  
 Transfer functions, programmable 712  
 Transition functions 653  
 Transmission line modeling 662  
 Tuning curve 444, 468

**U**

- Unified submodule network 560  
 Unsupervised learning 11, 375, 468, 728

**V**

- Vapnik Chervonenkis dimension 81  
 Vector field programming 459  
 Vector quantization 11, 264  
 Velocity filters 356  
 Vestibulo-ocular reflex 410  
 Vision, color 297  
 Vision, early 289, 687  
 Visual cortex 375, 468  
 Visual motion 468, 477  
 Visual perception 305  
 Visualization techniques 626  
 VLSI implementation 323, 384, 568, 618, 671, 678, 687, 695, 703, 712, 728, 739, 748, 761, 769, 777  
 Voltage sensitive dye neurophysiology 720

**Subject Index****W**

Weber's law 720  
Weight decay 40, 177  
Weight search constraints 177  
Winner-take-all networks 626, 634,  
703, 728  
Word sense disambiguation 545

**X**

XOR problem 133

