

Handbook of Neural Network Signal Processing

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Handbook of Neural Network Signal Processing

Yu Hen Hu and Jeng-Neng Hwang, Editors

CRC Press, Boca Raton. 2001.

408 pp. Price: \$129.95 (hardcover) ISBN: 0849323592.

Neural Networks have found application in solving a wide variety of signal processing problems. *Handbook of Neural Network Signal Processing* edited by Hu and Hwang aptly demonstrates the effectiveness and wide scope of the neural network paradigm for signal processing. The editors have brought together many leading experts in the neural network and signal processing fields to cover a wide variety of topics and recent developments. While many texts exist describing neural network algorithms, this book is unique in its solid coverage of neural network concepts, approaches to signal processing problems, and applications. The book consists of three parts. The first part of the book describes the various neural network paradigms. The different neural network approaches are described clearly and recent developments outlined. The second part of the book covers neural network approaches to some important signal processing problems. The final part of the book examines some successful neural network based applications and systems.

The book begins with an introductory chapter by Hu and Hwang. This chapter is well written and familiarizes the reader with the basic concepts on which the remainder of the book is built. This chapter begins with neural network architectures and theory such as the McCulloch and Pitts' neuron, Multi-Layer Perceptrons, Radial Basis Networks, Competitive Learning Networks, Committee Machines, and Support Vector Machines. Code written for MATLAB is available for download from the publisher to allow readers to experiment with the various types of neural network, and useful references to publicly available software are given. The remainder of the chapter provides background on the various problems to signal processing examined by the book and concludes with an overview of the material in each chapter.

Chapter 2 is written by Manry, Chandrasekaran, and Hsieh and describes signal processing using Multi-Layer Perceptrons (MLPs). A major consideration when implementing MLPs is how to choose the best network topology and estimate the error on unseen test data based on the performance on training data. Efficient algorithms are presented in this chapter to train MLPs as well as estimate the optimal topology of a MLP for any particular problem and bound the error expected for new test data. The algorithms presented are tested by designing and training a MLP to estimate mechanical loads on a helicopter during flight based on cockpit measurements.

In Chap. 3, Andrew Back describes Radial Basis Function (RBF) networks and presents recent advances. The chapter begins with an overview of RBF networks and then describes the theoretical capabilities. Like MLPs, RBF networks have been shown to be able to approximate any smooth nonlinear function to any desired degree of accuracy when enough neurons are used. Algorithms are presented to train RBF networks and select the most effective number of hidden units. Finally, an indication of the capabilities of RBF networks is given by examining a number of real-world applications.

In the next chapter Müller, Mika, Rätsch, Tsuda, and Schölkopf present the theory of Kernel-Based Algorithms. After describing the Vapnik-Chervonekis Theory and kernel feature spaces, the chapter moves on to

supervised and unsupervised learning using Support Vector Machines (SVMs), Kernel Fisher Discriminants, and Kernel Principal Component Analysis. The choice of kernel for particular applications is examined and the chapter concludes with some applications of this class of algorithm to signal processing.

Chapter 5 is written by Volker Tresp and presents the theory behind committee machines. By merging the results of many classifiers, a committee machine can achieve performances exceeding any of its component classifiers. Tresp examines the various methods for constructing committee machines and presents in detail two examples, the Mixture of Experts and the Bayesian Committee Machine.

Jose Principe has contributed the first chapter in part two of the book. This chapter looks at how Dynamic Neural Networks can be applied to the problem of optimal signal processing. The chapter begins by formulating the problem in terms of the more general problem of function approximation and then examines how the uniform approximation properties of Dynamic Neural Networks allow them to be applied to this problem. The chapter concludes by presenting a class of generalized delay operators for optimal filtering.

Scott Douglas presents the difficult problem of Blind Source Separation and Blind Signal Deconvolution in Chap. 7. This chapter covers the basic theory, recent advances, and important applications in a manner that is both clear and interesting. The chapter concludes with a discussion of open issues.

In Chap. 8 Konstantinos Diamantaras examines various neural network architectures designed to perform Principal Component Analysis (PCA). The basic theory is presented as well as application examples and the benefits and disadvantages of the various approaches. The neural network models are then expanded to perform nonlinear PCA and applications such as blind image separation are showcased.

Chapter 9 is written by Liao, Moody, and Wu and examines the problem of predicting a complex time series using neural networks. The chapter starts with an overview of the problem and traditional approaches. The authors then describe how the time delay neural networks and recurrent neural networks have been developed to solve this problem. Recent research is presented showing how committee machines and regularization schemes for recurrent networks can improve the accuracy of the results obtained. Finally, a case study involving the prediction of economic indicators using the proposed methods is studied in detail.

The final part of the book deals with real-world application of neural networks in signal processing. The first topic considered is speech recognition. Shigeru Katagiri describes the fundamentals of the speech recognition problem before examining four approaches that remain the subject of continued research. Generalized Probabilistic Descent is examined before sections on recurrent neural networks and Support Vector Machines. The chapter concludes with a discussion of signal separation theory, essential to developing speech recognition technologies to function in noisy general environments.

Chapter 11 was contributed by Muneesawang, Wong, Lay, and Guan and describes a successful application of a radial basis function network to the problem of content-based image retrieval.

In Chap. 12, Adali, Wang, and Li look at various applications of neural networks to the field of biomedical image analysis. The chapter begins by examining the methods by which neural networks may be used for image characterization. This field is concerned with identifying and measuring different tissue types and structures in medical imagery. The second half of the

chapter describes the problem of computer-aided diagnosis and examines neural network approaches to identifying tumors in x-ray imagery. In each section, real-world applications and results are shown to validate the theory presented.

The final chapter in the book was contributed by Taur, Kung, and Lin and introduces a decision-based neural network with application to pattern classification. The decision-based network merges concepts from modular neural networks and fuzzy logic. Numerous applications from image processing are also examined.

This book is an excellent resource for anyone interested in neural networks, both in general and the applications to signal processing. The book covers both basic theory and advanced concepts and so will be useful to the experienced and inexperienced researcher alike. The division of the book into methods, problems, and applications seems to work well and the fact that most chapters are well stocked with application examples helps greatly to understand the material. Most applications in the book revolve around image processing, however, there is sufficient material on signal

separation and speech recognition to interest acousticians. In addition, much of the material in the first part of the book is relevant to many applications.

The fact that the editors have brought together many experienced researchers in the field means that most chapters are easy to read and yet the mathematical fundamentals of the methods, problems, and applications are well covered. The breadth and depth of the material covered in this book has made it difficult to adequately describe each chapter in this review. In conclusion, the label of "Handbook" as referred to in the title seems well deserved, as I would recommend this book to anyone interested in neural networks.

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BOOKS RECEIVED

Computational Atmospheric Acoustics. Erik M. Salomons. Kluwer Academic, Boston, 2001. 348 pp. \$109.00 *hc.* ISBN 0792371616.

Inverse Problems and Inverse Scattering of Plane Waves. Dilip N. Ghosh Roy and L. S. Couchman. Academic Press, New York, 2001. 320 pp. \$75.00 *hc.* ISBN 0122818652.

Acoustic Characterization of Contrast Agents for Medical Ultrasound Imaging. Lars Hoff. Kluwer Academic, Dordrecht, The Netherlands, 2001. 230 pp. \$74.00 *hc.* ISBN 1402001444.

Auditory Sound Transmission: An Autobiographical Perspective. Jozel J. Zwislocki. Erlbaum, Hillsdale, NJ, 2002. 419 pp. \$99.95 *hc.* ISBN 0805806792.

Higher Order Numerical Methods for Transient Wave Equations. Gary C. Cohen. Springer, New York, 2001. 348 pp. \$69.95 *hc.* ISBN 354041598X.

Transient Aeroelasticity of Spherical Bodies. A. G. Gorshkov and D. V. Tarlakovskii. Springer, New York, 2001. 250 pp. \$99.00 *hc.* ISBN 3540421513.

Environmental Urban Noise. Amando Garcia, Editor. Wit, Boston, 2001. 225 pp. \$136.00 *hc.* ISBN 1853127523.

Duct Aeroacoustics: From Technological Applications to the Flute. Sylvia Dequand. Technische Universiteit-Eindhoven, Eindhoven, 2000. 203 pp. Price not available. ISBN 90-386-1889-1 *pb.*

Design of Knock Sensors and Piezoaccelerometers. Alexander A. Bazhenov and Valery I. Yarovikov. Futurepast, Inc., Arlington, VA, 2002. 176 pp. \$115.00 *hc.* ISBN 0971046409.

The Intelligent Ear. Reinier Plomp. Erlbaum, Hillsdale, NJ, 2001. 174 pp. \$39.95 *hc.* ISBN 0805838678.

Listening to Nineteenth-Century America. Mark M. Smith. University of North Carolina Press, Chapel Hill, NC, 2001. 368 pp. \$55.00 *hc.* (\$19.95 *pb.*). ISBN 080782657X *hc.* (0807849820 *pb.*).

The Virtual Score: Representation, Retrieval, Restoration. Walter B. Hewlett and Eleanor Selfridge-Field, Editors. MIT Press, Cambridge, MA, 2001. 291 pp. \$28.00 *pb.* ISBN 0262582090.

Advanced Signal Processing Handbook. Stergios Stergiopoulos, Editor. CRC Press, New York, 2000. 752 pp. \$99.95 *hc.* ISBN 0849336910.

Statistical Quality Control. M. Jeya Chandra. CRC Press, Boca Raton, FL, 2001. 284 pp. \$89.95 *hc.* ISBN 0849323479.

Handbook of Multisensor Data Fusion. David L. Hall and James Llinas, Editors. CRC Press, Boca Raton, FL, 2001. 568 pp. \$159.95 *hc.* ISBN 0849323797.

Continuous Signals and Systems with MATLAB. Taan S. Elali and Mohammad A. Karim. CRC Press, Boca Raton, FL, 2001. 544 pp. \$89.95 *hc.* ISBN 0849303214.

Filter Design with Time Domain Mask Constraints: Theory and Applications. Ba-Ngu Vo, Antonio Cantoni, and Kok Lay Teo. Kluwer Academic, Boston, 2001. 350 pp. \$136.00 *hc.* ISBN 0792371380.

Handbook of Neural Network Signal Processing. Yu Hen Hu and Jeng-Neng Hwang, Editors. CRC Press, New York, 2001. 408 pp. \$129.95 *hc.* ISBN 0849323592.

Wavelets in Signal and Image Analysis: From Theory to Practice. Arthur A. Petrosian and Francois G. Meyer, Editors. Kluwer Academic, Dordrecht, The Netherlands, 2001. 543 pp. \$143.00 *hc.* ISBN 1402000537.