A novel efficient two-phase algorithm for training interpolation radial basis function networks

Huan H.X., Hien D.T.T., Huynh H.T.

Faculty of Information Technology, College of Technology, Vietnam National University, Hanoi, Viet Nam; Faculty of Electronics and Telecommunications, College of Technology, Vietnam National University, Hanoi, Viet Nam; Department of Electrical and Computer Engineering, Laval University, Que., Canada

Abstract: Interpolation radial basis function (RBF) networks have been widely used in various applications. The output layer weights are usually determined by minimizing the sum-of-squares error or by directly solving interpolation equations. When the number of interpolation nodes is large, these methods are time consuming, difficult to control the balance between the convergence rate and the generality, and difficult to reach a high accuracy. In this paper, we propose a two-phase algorithm for training interpolation RBF networks with bell-shaped basis functions. In the first phase, the width parameters of basis functions are determined by taking into account the tradeoff between the error and the convergence rate. Then, the output layer weights are determined by finding the fixed point of a given contraction transformation. The running time of this new algorithm is relatively short and the balance between the convergence rate and the generality is easily controlled by adjusting the involved parameters, while the error is made as small as desired. Also, its running time can be further enhanced thanks to the possibility to parallelize the proposed algorithm. Finally, its efficiency is illustrated by simulations.

Author Keywords: Contraction transformation; Fixed point; Output weights; Radial basis functions; Width parameters

Index Keywords: Contraction transformation; Fixed point; Output weights; Width parameters; Algorithms; Computer simulation; Errors; Interpolation; Problem solving; Radial basis function networks

Year: 2007

Source title: Signal Processing

Volume: 87

Issue: 11

Page : 2708-2717

Link: Scorpus Link

Correspondence Address: Huynh, H.T.; Faculty of Electronics and Telecommunications, College of Technology, Vietnam National University, Hanoi, Viet Nam; email: huynh@gel.ulaval.ca

ISSN: 1651684

CODEN: SPROD

DOI: 10.1016/j.sigpro.2007.05.001

Language of Original Document: English

Abbreviated Source Title: Signal Processing

Document Type: Article

Source: Scopus

Authors with affiliations:

1. Huan, H.X., Faculty of Information Technology, College of Technology, Vietnam National University, Hanoi, Viet Nam
2. Hien, D.T.T., Faculty of Information Technology, College of Technology, Vietnam National University, Hanoi, Viet Nam
3. Huynh, H.T., Faculty of Electronics and Telecommunications, College of Technology, Vietnam National University, Hanoi, Viet Nam, Department of Electrical and Computer Engineering, Laval University, Que., Canada

References:

1. Broomhead, D.S., Lowe, D., Multivariable functional interpolation and adaptive networks (1988) Complex Syst., 2, pp. 321-355
2. Haykin, S., (1999) Neural Networks: A Comprehensive Foundation. second ed., , Prentice-Hall Inc., Englewood Cliffs, NJ
3. Looney, C.G., (1997) Pattern Recognition Using Neural Networks: Theory and Algorithm for Engineers and Scientist, , Oxford University Press, New York
4. Schwenker, F., Kesler, H.A., Palm, G., Three learning phases for radial-basis-function networks (2001) Neural Networks, 14 (4-5), pp. 439-458
5. Hartman, E.J., Keeler, J.D., Kowalski, J.M., Layered neural networks with Gaussian hidden units as universal approximations (1990) Neural Comput., 2 (2), pp. 210-215
6. Park, J., Sandberg, I.W., Approximation and radial-basis-function networks (1993) Neural Comput., 5 (3), pp. 305-316
7. Poggio, T., Girosi, F., Networks for approximating and learning (1990) IEEE Proc., 78 (9), pp. 1481-1497
8. Bianchini, M., Frasconi, P., Gori, M., Learning without local minima in radial basis function networks (1995) IEEE Trans. Neural Networks, 6 (3), pp. 749-756
9. Michelli, C., Interpolation of scattered data: distance matrices and conditionally positive definite functions (1986) Constr. Approx., 2, pp. 11-22
10. Collatz, L., (1966) Functional Analysis and Numerical Mathematics, , Academic Press, New York
11. Mitchell, T.M., (1997) Machine Learning, , McGraw-Hill, New York
12. (1995) Fundamental of Artificial Neural Networks, , Mousoun, MIT Press, Cambridge, MA