

FAST COMPUTATIONAL APPROACH TO THE LEVENBERG-MARQUARDT ALGORITHM FOR TRAINING FEEDFORWARD NEURAL NETWORKS

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Submitted: 19th October 2022; Accepted: 15th February 2023.

Abstract

This paper presents a parallel approach to the Levenberg-Marquardt algorithm (LM). The use of the Levenberg-Marquardt algorithm to train neural networks is associated with significant computational complexity, and thus computation time. As a result, when the neural network has a big number of weights, the algorithm becomes practically ineffective. This article presents a new parallel approach to the computations in Levenberg-Marquardt neural network learning algorithm. The proposed solution is based on vector instructions to effectively reduce the high computational time of this algorithm. The new approach was tested on several examples involving the problems of classification and function approximation, and next it was compared with a classical computational method. The article presents in detail the idea of parallel neural network computations and shows the obtained acceleration for different problems.

Keywords: feed-forward neural network, neural network learning algorithm, Levenberg-Marquardt algorithm, QR decomposition, Givens rotation.

1 Introduction

Currently, artificial intelligence (AI) is widely used both in science research and in industry. Among the issues of artificial intelligence, neural networks (NN) deserve special attention. Continuously many researchers pub-

lish a lot of scientific papers about artificial intelligence [1, 2], especially about neural networks e.g. [3, 4, 5, 6, 7, 8, 9, 10, 11]. There are more and more advanced AI solutions and methods that are willingly used in industry and various products. Important areas of neural networks applications are health care and

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Machine Learning-Based Modelling in Atomic Layer Deposition Processes Oluwatobi Adeleke, Sina

Karimzadeh, Tien-Chien Jen, 2023-12-15 While thin film technology has benefited greatly from artificial intelligence AI and machine learning ML techniques there is still much to be learned from a full scale exploration of these technologies in atomic layer deposition ALD This book provides in depth information regarding the application of ML based modeling techniques in thin film technology as a standalone approach and integrated with the classical simulation and modeling methods It is the first of its kind to present detailed information regarding approaches in ML based modeling optimization and prediction of the behaviors and characteristics of ALD for improved process quality control and discovery of new materials As such this book fills significant knowledge gaps in the existing resources as it provides extensive information on ML and its applications in film thin technology Offers an in depth overview of the fundamentals of thin film technology state of the art computational simulation approaches in ALD ML techniques algorithms applications and challenges Establishes the need for and significance of ML applications in ALD while introducing integration approaches for ML techniques with computation simulation approaches Explores the application of key techniques in ML such as predictive analysis classification techniques feature engineering image processing capability and microstructural analysis of deep learning algorithms and generative model benefits in ALD Helps readers gain a holistic understanding of the exciting applications of ML based solutions to ALD problems and apply them to real world issues Aimed at materials scientists and engineers this book fills significant knowledge gaps in existing resources as it provides extensive information on ML and its applications in film thin technology It also opens space for future intensive research and intriguing opportunities for ML enhanced ALD processes which scale from academic to industrial applications *Valorization of Biomass to Value-Added Commodities* Michael O.

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industrial control and communications systems It also facilitates the use of intelligent systems such as neural networks fuzzy systems and evolutionary methods in terms of a hierarchical structure that makes factory control and supervision more efficient by addressing the needs of all production components Enhancing its value this fully updated collection presents research and global trends as published in the IEEE Transactions on Industrial Electronics Journal one of the largest and most respected publications in the field As intelligent systems continue to replace and sometimes outperform human intelligence in decision making processes they have made substantial contributions to the solution of very complex problems As a result the field of computational intelligence has branched out in several directions For instance artificial neural networks can learn how to classify patterns such as images or sequences of events and effectively model complex nonlinear systems Simple and easy to implement fuzzy systems can be applied to successful modeling and system control Illustrating how these and other tools help engineers model nonlinear system behavior determine and evaluate system parameters and ensure overall system control Intelligent Systems Addresses various aspects of neural networks and fuzzy systems Focuses on system optimization covering new techniques such as evolutionary methods swarm and ant colony optimizations Discusses several applications that deal with methods of computational intelligence Other volumes in the set Fundamentals of Industrial Electronics Power Electronics and Motor Drives Control and Mechatronics Industrial Communication Systems

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you can load your own data into the workspace With MATLAB is possible to solve three different kinds of time series problems In the first type of time series problem you would like to predict future values of a time series y_t from past values of that time series and past values of a second time series x_t This form of prediction is called nonlinear autoregressive network with exogenous external input or NARX In the second type of time series problem there is only one series involved The future values of a time series y_t are predicted only from past values of that series This form of prediction is called nonlinear autoregressive or NAR The third time series problem is similar to the first type in that two series are involved an input series predictors x_t and an output series responses y_t Here you want to predict values of y_t from previous values of x_t but without knowledge of previous values of y_t This book develops methods for time series forecasting using neural networks across MATLAB

Neural Information Processing Chu Kiong Loo, Yap Keem Siah, Kok Wai Wong, Andrew Teoh Beng Jin, Kaizhu Huang, 2014-10-20 The three volume set LNCS 8834 LNCS 8835 and LNCS 8836 constitutes the proceedings of the 20th International Conference on Neural Information Processing ICONIP 2014 held in Kuching Malaysia in November 2014 The 231 full papers presented were carefully reviewed and selected from 375 submissions The selected papers cover major topics of theoretical research empirical study and applications of neural information processing research The 3 volumes represent topical sections containing articles on cognitive science neural networks and learning systems theory and design applications kernel and statistical methods evolutionary computation and hybrid intelligent systems signal and image processing and special sessions intelligent systems for supporting decision making processes theories and applications cognitive robotics and learning systems for social network and web mining

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