# Neural Algorithm for Solving Differential Equations

HYUK LEE

*Department of Electrical Engineering, Polytechnic Institute of New York,
Brooklyn, New York 11201*

AND

IN SEOK KANG

*Department of Chemical Engineering, California Institute of Technology,
Pasadena, California 91125*

Finite difference equations are considered to solve differential equations numerically by utilizing minimization algorithms. Neural minimization algorithms for solving the finite difference equations are presented. Results of numerical simulation are described to demonstrate the method. Methods of implementing the algorithms are discussed. General features of the neural algorithms are discussed.  © 1990 Academic Press, Inc.

## I. INTRODUCTION

Numerical computation in many disciplines, such as physics, applied mathematics, electrical engineering, biochemistry, etc., has received a great deal of attention recently as a practical technique to understand complex phenomena that are almost impossible to treat analytically [1]. Supercomputers have been built to speed up the calculation. Furthermore, new computing algorithms based on the concept of concurrent processing have been developed and implemented by connecting a small number of processors.

Recently, highly parallel neural networks have been investigated extensively to solve complicated problems such as pattern recognition and combinatorial optimization [2]. Linear simultaneous equations also have been treated by applying neural networks [3]. Implementation of neural networks by utilizing volume holographic optical interconnections have proved to be promising [4].

One of the most general methods of solving differential equations is to use finite difference equations and to solve the algebraic equations [5]. The computational load for solving the difference equations increases very fast as the number of discrete points becomes large. Therefore, a highly parallel algorithm to solve the finite difference equations is essential when a complicated problem is encountered. In this paper, neural algorithms for minimization are utilized to develop highly parallel

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# Neural Algorithm For Solving Differential Equations

**Sebastian Brünink**

**Neural Algorithm For Solving Differential Equations:**

*Mathematical Methods in Dynamical Systems* S. Chakraverty,Subrat Kumar Jena,2023-05-19 The art of applying mathematics to real world dynamical problems such as structural dynamics fluid dynamics wave dynamics robot dynamics etc can be extremely challenging Various aspects of mathematical modelling that may include deterministic or uncertain fuzzy interval or stochastic scenarios along with integer or fractional order are vital to understanding these dynamical systems Mathematical Methods in Dynamical Systems offers problem solving techniques and includes different analytical semi analytical numerical and machine intelligence methods for finding exact and or approximate solutions of governing equations arising in dynamical systems It provides a singular source of computationally efficient methods to investigate these systems and includes coverage of various industrial applications in a simple yet comprehensive way    Advances in Mathematical Modelling, Applied Analysis and Computation Jagdev Singh,George A. Anastassiou,Dumitru Baleanu,Devendra Kumar,2024-03-28 This book gathers selected research articles presented in the 6th International Conference on Mathematical Modelling Applied Analysis and Computation ICMMAAC held at JECRC University Jaipur during August 3 5 2023 This book is focused on articles dealing with necessary theory and techniques in a balanced manner and contributes towards solving mathematical problems arising in physics engineering chemistry biological systems medicine networking system control systems environmental sciences social issues of current interest and more Annually held since 2018 the ICMMAAC conference aimed in particular to foster cooperation among practitioners and theoreticians in these fields This proceedings is an invaluable resource for researchers academicians and professionals associated or interested in current advances in different aspects of mathematical modelling computational algorithms and analysis necessary for handling real world problems    **Computational Science and Its Applications – ICCSA 2025 Workshops** Osvaldo Gervasi,Beniamino Murgante,Chiara Garau,Yeliz Karaca,Maria Noelia Faginas Lago,Francesco Scorza,Ana Cristina Braga,2025-08-07 The fourteen volume set LNCS 15886 15899 constitutes the papers of several workshops which were held in conjunction with the 25th International Conference on Computational Science and Its Applications ICCSA 2025 held in Istanbul Turkey during June 30 July 3 2025 The 362 full papers 37 short papers and 2 PHD showcase included in this book were carefully reviewed and selected from 1043 submissions In addition the conference consisted of 58 workshops focusing on very topical issues of importance to science technology and society from new mathematical approaches for solving complex computational systems to information and knowledge in the Internet of Things new statistical and optimization methods several Artificial Intelligence approaches sustainability issues smart cities and related technologies    Computation and Modeling for Fractional Order Systems Snehashish Chakraverty,Rajarama Mohan Jena,2024-02-20 Computation and Modeling for Fractional Order Systems provides readers with problem solving techniques for obtaining exact and or approximate solutions of governing equations arising in fractional dynamical systems presented using various analytical semi analytical and

numerical methods In this regard this book brings together contemporary and computationally efficient methods for investigating real world fractional order systems in one volume Fractional calculus has gained increasing popularity and relevance over the last few decades due to its well established applications in various fields of science and engineering It deals with the differential and integral operators with non integral powers Fractional differential equations are the pillar of various systems occurring in a wide range of science and engineering disciplines namely physics chemical engineering mathematical biology financial mathematics structural mechanics control theory circuit analysis and biomechanics among others The fractional derivative has also been used in various other physical problems such as frequency dependent damping behavior of structures motion of a plate in a Newtonian fluid PID controller for the control of dynamical systems and many others The mathematical models in electromagnetics rheology viscoelasticity electrochemistry control theory Brownian motion signal and image processing fluid dynamics financial mathematics and material science are well defined by fractional order differential equations Generally these physical models are demonstrated either by ordinary or partial differential equations However modeling these problems by fractional differential equations on the other hand can make the physics of the systems more feasible and practical in some cases In order to know the behavior of these systems we need to study the solutions of the governing fractional models The exact solution of fractional differential equations may not always be possible using known classical methods Generally the physical models occurring in nature comprise complex phenomena and it is sometimes challenging to obtain the solution both analytical and numerical of nonlinear differential equations of fractional order Various aspects of mathematical modeling that may include deterministic or uncertain viz fuzzy or interval or stochastic scenarios along with fractional order singular non singular kernels are important to understand the dynamical systems Computation and Modeling for Fractional Order Systems covers various types of fractional order models in deterministic and non deterministic scenarios Various analytical semi analytical numerical methods are applied for solving real life fractional order problems The comprehensive descriptions of different recently developed fractional singular non singular fractal fractional and discrete fractional operators along with computationally efficient methods are included for the reader to understand how these may be applied to real world systems and a wide variety of dynamical systems such as deterministic stochastic continuous and discrete are addressed by the authors of the book **Advances in Artificial Systems for Logistics Engineering** Zhengbing Hu,Qingying Zhang,Sergey Petoukhov,Matthew He,2022-04-28 The book comprises high quality refereed research papers presented at the Second International Conference on Artificial Intelligence and Logistics Engineering ICAILE2022 held in Kyiv Ukraine on February 20 22 2022 organized jointly by the National Technical University of Ukraine Igor Sikorsky Kyiv Polytechnic Institute Wuhan University of Technology Nanning University National Aviation University and the International Research Association of Modern Education and Computer Science The topics discussed in the book include state of the art papers in artificial intelligence and logistics engineering It is an excellent

source of references for researchers graduate students engineers management practitioners and undergraduate students interested in artificial intelligence and its applications in logistics engineering **Artificial Intelligence in Heat Transfer** J.P. Abraham,J.M. Gorman,2025-05-22 Artificial Intelligence in Heat Transfer shows how artificial intelligence AI tools and techniques such as artificial neural networks machine learning algorithms genetic algorithms etc provide practical benefits specific to thermal sciences It presents case studies involving heat and mass transfer multi objective optimization conjugate heat transfer nanofluids thermal radiation heat transfer through porous media metal foam and more Drawing on the collective expertise of leading researchers and experts in multiple fields the book provides an in depth understanding of the possibilities that emerge when these tools are applied to problems related to thermal sciences AI is an ever evolving discipline that has created new and groundbreaking opportunities to advance the mechanical engineering field particularly in the area of numerical heat transfer This volume Advances in Numerical Heat Transfer explores various ways AI is used in heat transfer to solve engineering problems This book will serve as an important resource for upper level undergraduate students researchers engineers and professionals equipping them with the knowledge and inspiration to push the boundaries of the thermal sciences through AI driven tools and techniques *Peter Carr Gedenkschrift: Research Advances In Mathematical Finance* Robert A Jarrow,Dilip B Madan,2023-11-10 This Gedenkschrift for Peter Carr our dear friend and colleague who suddenly left us on March 1 2022 was organized to honor the life and lasting contributions of Peter to Quantitative Finance A group of Peter s co authors and professional friends contributed chapters for this Gedenkschrift shortly after his passing The papers were received by September 15 2022 and some were presented at the Peter Carr Gedenkschrift Conference held at the Robert H Smith School of Business on November 11 2022 The contributed papers cover a wide range of topics corresponding to the vast range of Peter s interests Each paper represents new research results in recognition of Peter s scholarly activities The book serves as an important marker for the research knowledge existing at the time of the Gedenkschrift s publication on a number of topics within quantitative finance It reflects the diverse interactions between mathematics and finance and illustrates for those interested the breadth and depth of this development The book also presents a collection of tributes to Peter from family and friends including those made at his Memorial Service on March 19 2022 The result is hopefully a more complete testament to a personal and professional life well lived and unexpectedly cut short **An Introduction to Neural Network Methods for Differential Equations** Neha Yadav,Anupam Yadav,Manoj Kumar,2015-02-26 This book introduces a variety of neural network methods for solving differential equations arising in science and engineering The emphasis is placed on a deep understanding of the neural network techniques which has been presented in a mostly heuristic and intuitive manner This approach will enable the reader to understand the working efficiency and shortcomings of each neural network technique for solving differential equations The objective of this book is to provide the reader with a sound understanding of the foundations of neural

networks and a comprehensive introduction to neural network methods for solving differential equations together with recent developments in the techniques and their applications The book comprises four major sections Section I consists of a brief overview of differential equations and the relevant physical problems arising in science and engineering Section II illustrates the history of neural networks starting from their beginnings in the 1940s through to the renewed interest of the 1980s A general introduction to neural networks and learning technologies is presented in Section III This section also includes the description of the multilayer perceptron and its learning methods In Section IV the different neural network methods for solving differential equations are introduced including discussion of the most recent developments in the field Advanced students and researchers in mathematics computer science and various disciplines in science and engineering will find this book a valuable reference source **Solving Differential Equations With Deep Neural Networks (DNNs).** Jaysa Grafton,2022 Overall the goal of this project is to make use of the machine learning algorithm of deep neural networks DNNs to solve differential equations Specifically this project aims to solve two different second order differential equations Poisson and Ginzburg Landau equations Results for the Poisson equation show an accurate solution can be acquired using a single layer network with no activation function due to the linearity of the equation These results demonstrate that finding solutions to differential equations is possible through the use of deep neural networks For the Ginzburg Landau equation two different loss functions are utilized with adjustments being made to account for boundary conditions and derivatives Results indicate an accurate approximation for various mesh sizes i e coarse versus fine mesh and allow for the comparison of network architectures for each mesh size in order to determine the parameters necessary for an accurate solution **International Aerospace Abstracts** ,1996 **Intelligent Engineering Systems Through Artificial Neural Networks** ,1991 **Mathematical Reviews** ,2003 **Chinese Journal of Electronics** ,2004 *Physics Briefs* ,1991 **Manufacturing Engineering and Process II** Bale V. Reddy,2013-06-13 Selected peer reviewed papers from the ICMEP 2013 International Conference on Manufacturing Engineering and Process April 13 14 2013 Vancouver Canada **Intelligent Engineering Systems Through Artificial Neural Networks** Cihan H. Dagli,1995 As a follow up to the previous four volumes of Intelligent Engineering Systems Through Artificial Neural Networks by the same editor the present volume contains the edited versions of the technical presentations of ANNIE 95 held November 1995 in St Louis Missouri The 160 some contributions are grouped into six categories artificial neural network architectures including subsections on architectures and learning algorithms and training fuzzy neural networks and systems evolutionary programming pattern recognition adaptive control and smart engineering system design including bio medical engineering systems signal processing forecasting environmental applications machining and robotics process control monitoring and automated inspection and general engineering Includes bandw photographs diagrams and charts Annotation copyright by Book News Inc Portland OR **Parallel Architectures for Image Processing** Joydeep Ghosh,Colin G. Harrison,1990 **Artificial**

**Neural Networks for Engineers and Scientists** S. Chakraverty,Susmita Mall,2017-07-20 Differential equations play a vital role in the fields of engineering and science Problems in engineering and science can be modeled using ordinary or partial differential equations Analytical solutions of differential equations may not be obtained easily so numerical methods have been developed to handle them Machine intelligence methods such as Artificial Neural Networks ANN are being used to solve differential equations and these methods are presented in Artificial Neural Networks for Engineers and Scientists Solving Ordinary Differential Equations This book shows how computation of differential equation becomes faster once the ANN model is properly developed and applied      *Bulletin of the Polish Academy of Sciences* ,1983      *Ordinary Differential Equations* Mohan C. Joshi,2006 Ordinary Differential Equations Modern Perspective presents a unified and comprehensive treatment to a wide variety of topics including Initial Value Problems Boundary Value Problems Green s Function Stability Analysis and Coloured Theory using abstract formulation in the underlying spaces and hence amenable to the modern tools of linear and Nonlinear Analysis It brings clarity by displaying theoretical results with illustrative examples and graphics at appropriate places

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