Analytical Solution for Telegraph Equation by Modified of Sumudu Transform "Elzaki Transform"

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Abstract

In this work modified of Sumudu transform [10,11,12] which is called Elzaki transform method (new integral transform) is considered to solve general linear telegraph equation, this method is a powerful tool for solving differential equations and integral equations [1, 2, 3, 4, 5]. Using modified of Sumudu transform or Elzaki transform, it is possible to find the exact solution of telegraph equation. This method is more efficient and easier to handle as compare to the Sumudu transform method and variational iteration method. To illustrate the ability of the method some examples are provided.

Keywords: modified of Sumudu transform- Elzaki transform - Telegraph equation - Partial Derivatives

1. Introduction

Telegraph equations appear in the propagation of electrical signals along a telegraph line, digital image processing, telecommunication, signals and systems.
The general linear telegraph equation is

$$U_{tt} + aU_t + bU = c^2 U_{xx} \tag{1}$$

With the initial conditions:

$$U(x,0) = \alpha \quad , \quad U_t(x,0) = \beta \tag{2}$$

Where α , β are functions of x.

The basic definitions of modified of Sumudu transform or Elzaki transform is defined as follows [1, 2].

Elzaki transform of the function $f(t)$ is

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Beginning Partial Differential Equations Peter V. O'Neil,2014-05-07 A broad introduction to PDEs with an emphasis on specialized topics and applications occurring in a variety of fields Featuring a thoroughly revised presentation of topics Beginning Partial Differential Equations Third Edition provides a challenging yet accessible combination of techniques applications and introductory theory on the subjectof partial differential equations The new edition offers nonstandard coverageon material including Burger s equation the telegraph equation damped wavemotion and the use of characteristics to solve nonhomogeneous problems The Third Edition is organized around four themes methods of solution for initial boundary value problems applications of partial differential equations existence and properties of solutions and the use of software to experiment with graphics and carry out computations With a primary focus on wave and diffusion processes Beginning Partial Differential Equations Third Edition also includes Proofs of theorems incorporated within the topical presentation such as the existence of a solution for the Dirichlet problem The incorporation of MapleTM to perform computations and experiments Unusual applications such as Poe s pendulum Advanced topical coverage of special functions such as Bessel Legendre polynomials and spherical harmonics Fourier and Laplace transform techniques to solve important problems Beginning of Partial Differential Equations Third Edition is an ideal textbook for upper undergraduate and first year graduate level courses in analysis and applied mathematics science and engineering Fractional-order Modeling of Nuclear Reactor: From Subdiffusive Neutron Transport to Control-oriented Models Vishwesh Vyawahare,Paluri S. V. Nataraj,2018-02-03 This book addresses the topic of fractional order modeling of nuclear reactors Approaching neutron transport in the reactor core as anomalous diffusion specifically subdiffusion it starts with the development of fractional order neutron telegraph equations Using a systematic approach the book then examines the development and analysis of various fractional order models representing nuclear reactor dynamics ultimately leading to the fractional order linear and nonlinear control oriented models The book utilizes the mathematical tool of fractional calculus the calculus of derivatives and integrals with arbitrary non integer orders real or complex which has recently been found to provide a more compact and realistic representation to the dynamics of diverse physical systems Including extensive simulation results and discussing important issues related to the fractional order modeling of nuclear reactors the book offers a valuable resource for students and researchers working in the areas of fractional order modeling and control and nuclear reactor modeling New Insights into High-Energy Processes on the Sun and Their Geospace Consequences Xiangliang Kong,Jing Liu,Gang Li,2025-02-21 The Sun releases an enormous amount of energy during explosive solar activities such as solar flares and coronal mass ejections The solar corona can be heated up to tens of millions of degrees and a large number of charged particles can be accelerated to nearly the speed of light Heated plasmas and high energy particles increase solar radiations across the whole electromagnetic spectrum from radio to gamma ray wavelengths which can have a profound effect on the

Earth s upper atmosphere immediately after about eight minutes These create additional ionization and heating in the Earth s upper atmosphere leading to radio blackout GNSS signal interferences and tracking loss increased drag on spacecraft etc Recent studies have demonstrated that the effects can extend to the Earth s magnetosphere via electrodynamic coupling When the high energy particles propagate through the interplanetary medium and arrive at the vicinity of the Earth known as solar energetic particle SEP events they can pose hazardous radiation threats to astronauts and spacecraft electronics in space **Delay Ordinary and Partial Differential Equations** Andrei D. Polyanin,Vsevolod G. Sorokin,Alexei I. Zhurov,2023-08-28 Delay Ordinary and Partial Differential Equations is devoted to linear and nonlinear ordinary and partial differential equations with constant and variable delay It considers qualitative features of delay differential equations and formulates typical problem statements Exact approximate analytical and numerical methods for solving such equations are described including the method of steps methods of integral transformations method of regular expansion in a small parameter method of matched asymptotic expansions iteration type methods Adomian decomposition method collocation method Galerkin type projection methods Euler and Runge Kutta methods shooting method method of lines finite difference methods for PDEs methods of generalized and functional separation of variables method of functional constraints method of generating equations and more The presentation of the theoretical material is accompanied by examples of the practical application of methods to obtain the desired solutions Exact solutions are constructed for many nonlinear delay reaction diffusion and wave type PDEs that depend on one or more arbitrary functions A review is given of the most common mathematical models with delay used in population theory biology medicine economics and other applications The book contains much new material previously unpublished in monographs It is intended for a broad audience of scientists university professors and graduate and postgraduate students specializing in applied and computational mathematics mathematical physics mechanics control theory biology medicine chemical technology ecology economics and other disciplines Individual sections of the book and examples are suitable for lecture courses on applied mathematics mathematical physics and differential equations for delivering special courses and for practical training **Advances in Mathematical Modelling, Applied Analysis and Computation** Jagdev Singh,George A. Anastassiou,Dumitru Baleanu,Carlo Cattani,Devendra Kumar,2022-10-13 This book is a valuable source for graduate students and researchers and provides a comprehensive introduction to recent theories and applications of mathematical modeling and numerical simulation It includes selected peer reviewed papers presented at the 4th International Conference on Mathematical Modelling Applied Analysis and Computation ICMMAAC 2021 held at JECRC University Jaipur India during August 5 7 2021 The book is focused on mathematical modeling of various problems arising in science and engineering and new efficient numerical approaches for solving linear nonlinear problems and rigorous mathematical theories which can be used to analyze different kinds of mathematical models Applications of mathematical methods in physics chemistry biology mechanical engineering civil engineering computer science social science and finance are presented **Introduction to Random Signals and Applied Kalman Filtering with Matlab Exercises and Solutions** Robert Grover Brown,Patrick Y. C. Hwang,1997 In this updated edition the main thrust is on applied Kalman filtering Chapters 1 3 provide a minimal background in random process theory and the response of linear systems to random inputs The following chapter is devoted to Wiener filtering and the remainder of the text deals with various facets of Kalman filtering with emphasis on applications Starred problems at the end of each chapter are computer exercises The authors believe that programming the equations and analyzing the results of specific examples is the best way to obtain the insight that is essential in engineering work Journal of Engineering Education ,2001 **Practical Design of Ships and Mobile Units** Marinus Willem Cornelis Oosterveld,S. G. Tan,1998 These proceedings contain the papers presented at the 7th International Symposium on Practical Design of Ships and Mobile Units The symposium was held at the Congress Centre in The Hague The Netherlands on 20 25 September 1998 The overall aim of PRADS conferences is to advance the design of ships and mobile marine structures through the exchange of knowledge and the promotion of discussions on relevant topics in the fields of naval architecture and marine and offshore engineering Greater international co operation of this kind can help improve design and production methods and so increase the efficiency economy and safety of ships and mobile units The main themes of this symposium are design synthesis production ship hydromechanics ship structures and materials and offshore engineering Some topics which attracted many papers were design loads design for ultimate strength impact of safety and environment grounding and collision resistance and flow seakeeping fatigue considerations and propulsor and propulsion systems *Cornell University Courses of Study* Cornell University,2002 Probability and Random Processes Donald G. 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Polking,1995 **Signals and Systems Laboratory with MATLAB** Alex Palamides,Anastasia Veloni,2010-08-13 Developed as a textbook for the laboratory part of the course Signals and Systems this book introduces students to theory through analytical examples implemented in Matlab code Thus every theoretical equation is accompanied by the corresponding code implementation Instead of using big M Files or author written functions with comments the commands are executed one by one at the Matlab command line and the results dong with comments are given side by side in two or three column tables This is very helpful and popular to students in Electrical Engineering since the nature of this course includes detailed mathematical derivations and demands a strong mathematical background

Solving ODEs with MATLAB L. F. Shampine,I. Gladwell,S. Thompson,2003-04-28 This concise text first published in 2003 is for a one semester course for upper level undergraduates and beginning graduate students in engineering science and mathematics and can also serve as a quick reference for professionals The major topics in ordinary differential equations initial value problems boundary value problems and delay differential equations are usually taught in three separate semester long courses This single book provides a sound treatment of all three in fewer than 300 pages Each chapter begins with a discussion of the facts of life for the problem mainly by means of examples Numerical methods for the problem are then developed but only those methods most widely used The treatment of each method is brief and technical issues are minimized but all the issues important in practice and for understanding the codes are discussed The last part of each chapter is a tutorial that shows how to solve problems by means of small but realistic examples Calculus and Differential Equations with MATLAB Pramote Dechaumphai,2016-06-30 Calculus and Differential Equations with MATLAB presents a clear easy to understand on how to use MATLAB to solve calculus and differential equation problems The book contains eleven chapters with essential materials that are taught in calculus and differential equation courses These include Limits differentiation and integration Taylor maclaurin and other infinite series Ordinary differential equations Laplace and Fourier transforms Partial differential equations Numerical and finite element methods Special functions error gamma beta Bessel Airy Legendre etc Exact solutions are derived before showing MATLAB commands to provide the same solutions Numerical methods are used to obtain approximate solutions when exact solutions are not available The book contains a large number of examples and homework problems to demonstrate the capability of symbolic mathematics in MATLAB for solving calculus and differential equation problems Applied Numerical Methods Using MATLAB Won Y. Yang,Wenwu Cao,Jaekwon Kim,Kyung W. Park,Ho-Hyun Park,Jingon Joung,Jong-Suk Ro,Han L. Lee,Cheol-Ho Hong,Taeho Im,2020-05-12 This new edition provides an updated approach for students engineers and researchers to apply numerical methods for solving problems using MATLAB This accessible book makes use of MATLAB software to teach the fundamental concepts for applying numerical methods to solve practical engineering and or science problems It presents programs in a complete form so that readers can run them instantly with no programming skill allowing them to focus on understanding the mathematical manipulation process and making interpretations of the results Applied Numerical Methods Using MATLAB Second Edition begins with an introduction to MATLAB usage and computational errors covering everything from input output of data to various kinds of computing errors and on to parameter sharing and passing and more The system of linear equations is covered next followed by a chapter on the interpolation by Lagrange polynomial The next sections look at interpolation and curve fitting nonlinear equations numerical differentiation integration ordinary differential equations and optimization Numerous methods such as the Simpson Euler Heun Runge kutta Golden Search Nelder Mead and more are all covered in those chapters The eighth chapter provides readers with matrices and Eigenvalues and Eigenvectors The book finishes with a complete overview of differential equations Provides examples and problems of solving electronic circuits and neural networks Includes new sections on adaptive filters recursive least squares estimation Bairstow s method for a polynomial equation and more Explains Mixed Integer Linear Programing MILP and DOA Direction of Arrival estimation with eigenvectors Aimed at students who do not like and or do not have time to derive and prove mathematical results Applied Numerical Methods Using MATLAB Second Edition is an excellent text for students who wish to develop their problem solving capability without being involved in details about the MATLAB codes It will also be useful to those who want to delve deeper into understanding underlying algorithms and equations Introduction to Numerical Ordinary and Partial Differential Equations Using MATLAB Alexander Stanoyevitch,2011-10-14 *Periodic Solutions of Nonlinear Telegraph Equations* J. Mawhin,1976

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