Impact of generalized Fourier's law and Fick's law for MHD flow of Ag–H_2O and TiO_2–H_2O nanomaterials

Received 14 December 2018
Revised 20 March 2019
26 April 2019
Accepted 21 May 2019

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Abstract

Purpose – The purpose of this paper is to investigate the effect of inclined magnetic field, variable viscosity and Cattaneo–Christov heat and mass flux theories on the steady MHD free convective boundary layer flow of viscous, incompressible and electrically conducting water-driven silver and titanium-oxide nanofluids over a vertical stretching sheet.

Design/methodology/approach – The boundary layer equations of momentum, energy and nanoparticle concentration are partial differential equations in nature, which are reduced to nonlinear ordinary differential equations by means of similarity transformations. The resulting nonlinear equations are solved analytically by means of optimal homotopy analysis method.

Findings – Assessments with numerical results are performed and are found to be in an excellent agreement. Numerical results of the skin friction factor, the local Nusselt number and the local Sherwood number are obtained through tables. The effects of various physical parameters on the velocity, temperature and nanoparticles fraction are incorporated through graphs. The study analyzes the efficiency of heat transfer of nanofluids in cooling plants and rubber sheets.

Originality/value – No research works have been conducted to evaluate the effects of various physical phenomena on the copper and titanium nanofluids flow.

Keywords Heat and mass transfer, OHAM, Inclined magnetic field, Ag and TiO_2 nanoparticles, Cattaneo–Christov model

Paper type Research paper

Nomenclature

u, v	components of velocity in x and y directions (m/s)	C	nanoparticles volume fraction
x	coordinate along the stretching sheet (m)	D_B	Brownian diffusion coefficient (m^2/s)
y	distance normal to the stretching sheet (m)	D_T	thermophoresis diffusion coefficient (m^2/s)
u_w	stretching sheet velocity (m/s)	B_0	magnetic field strength (A/m)
C_f	skin friction coefficient	M	magnetic parameter
c_p	specific heat at constant pressure (N/m^2)	N_b	Brownian motion parameter
		N_t	thermophoresis parameter
		Re	Reynolds's number

Multidiscipline Modeling in Materials and Structures
Vol. 15 No. 6, 2019
pp. 1075-1099
© Emerald Publishing Limited
1573-6105
DOI 10.1108/MMMS-12-2018-0216

Journal of Statistics & Management Systems
ISSN 0972-0510 (Print), ISSN 2169-0014 (Online)
Vol. 22 (2019), No. 7, pp. 1349–1364
DOI : 10.1080/09720510.2019.1618519

Taylor & Francis
Taylor & Francis Group

An enhanced energy efficient routing protocol for VANET using special cross over in genetic algorithm

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Abstract

Wireless networks are gaining popularity now a days. A Vehicular Ad-hoc network that is able to configure all network devices, which means all devices work as host and as a router in network. For conveying all information only nodes help to each other. Vehicular ad hoc networks mostly formed temporary and comes in less infrastructure networks. Performance unit reduces caused by unstable channel position and network connection and mobility and

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International Journal of Modern Physics B
Vol. 33 (2019) 1950307 (20 pages)

DOI: 10.1142/S0217979219503077

Magnetohydrodynamic three-dimensional boundary layer flow and heat transfer of water-driven copper and alumina nanoparticles induced by convective conditions

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Received 26 March 2019
Revised 15 August 2019
Accepted 30 August 2019
Published 7 November 2019

This work examines the magnetohydrodynamic (MHD) three-dimensional (3D) flow comprising Cu and Al_2O_3 water-based nanofluids. The effects of heat and mass transfer with the effects of nanoparticles are carried out in the existence of thermal radiation and convective heat and mass transfer boundary conditions. By applying the proper similarity transformations the partial differential equations describing velocity, temperature and nanoparticle volume fraction (NVF) are transformed to a system of nonlinear ordinary differential equations (NODE). An optimal homotopy analysis technique is applied to evaluate the analytical solutions. The influences of pertinent parameters on the velocity, temperature and NVF are displayed in graphical and tabular forms. Calculations of Nusselt number, skin friction coefficients and the local Sherwood number are evaluated via tables. An excellent comparison has also been made with the previously-published literature.

Keywords: Nanofluids; heat and mass transfer; MHD; exponentially stretching surface; OHAM.

PACS numbers: 44.05.+c, 44.20.+b, 45.10.-b

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Available online at www.sciencedirect.com

ScienceDirect

Journal of Ocean Engineering and Science 4 (2019) 85–99

www.elsevier.com/locate/joes

Original Article

An efficient analytical technique for fractional partial differential equations occurring in ion acoustic waves in plasma

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Received 21 November 2018; received in revised form 22 January 2019; accepted 23 January 2019
Available online 24 January 2019

Abstract

In this work, we apply an efficient analytical algorithm namely homotopy perturbation Sumudu transform method (HPSTM) to find the exact and approximate solutions of linear and nonlinear time-fractional regularized long wave (RLW) equations. The RLW equations describe the nature of ion acoustic waves in plasma and shallow water waves in oceans. The derived results are very significant and imperative for explaining various physical phenomenons. The suggested method basically demonstrates how two efficient techniques, the Sumudu transform scheme and the homotopy perturbation technique can be integrated and applied to find exact and approximate solutions of linear and nonlinear time-fractional RLW equations. The nonlinear expressions can be simply managed by application of He's polynomials. The result shows that the HPSTM is very powerful, efficient, and simple and it eliminates the round-off errors. It has been observed that the proposed technique can be widely employed to examine other real world problems.

Keywords: Sumudu transform scheme; Homotopy perturbation technique; RLW equations; Ion acoustic wave; Shallow water waves in oceans.

1. Introduction

Over the last decades, fractional differential equations have been investigated due to their wide uses in the field of science and engineering. Several phenomenon's in material science, viscoelasticity, electromagnetics, electrochemistry, acoustics and plasma physics are characterized by fractional partial differential equations. Numerical solutions of fractional differential equations are of significant interest. There is no method that gives an exact solution for fractional differential equation. Approximate solutions can only be obtaining by applying series solution methods or linearization [1–6].

There exist various methodologies that deal with the approximate solutions of fractional differential equations of physical problems, called perturbation methods. These methods have some limitations. Since many nonlinear physical systems have no small parameters. So, small parameters are the basic requirement for approximate solution which shows complication sometimes. In many cases, unsuitable choices of small parameter introduce serious effects in the solutions. There exists an analytical approach, which does not need a small parameter in the equation. In past decades, researchers developed some new methods which are very simple in implementation and cost effective. These methods solve nonlinear fractional differential equations very precisely and effectively. The developed methods known as iterative techniques like homotopy analysis technique, Adomian decomposition scheme, homotopy perturbation technique, Laplace decomposition scheme, variational iteration approach, Tanh scheme, Backlund transformation technique, etc. [7–14].

Recently, homotopy perturbation Sumudu transform method (HPSTM) have been suggested by Singh et al. [15] for

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https://doi.org/10.1016/j.joes.2019.01.003