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RESEARCH ARTICLE

Elliptical shaped wide slot monopole patch antenna with crossed shaped parasitic element for WLAN, Wi-MAX, and UWB application

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Abstract

This paper illustrates the design and performance of microstrip feed elliptical shaped patch antenna having crossed shaped parasitic element. The overall size of antenna is 40 mm × 40 mm × 1.59 mm. For optimization of the performance of antenna, CST Microwave studio 2014 simulator is used while antenna is tested with available facilities under laboratory conditions. Proposed antenna provides triple impedance bandwidth extended between frequency ranges of 2.28-2.62 GHz, 2.70-3.96 GHz, and 5.1-6.29 GHz with flat gain (close to 3-5 dBi) in the desired frequency range. Good circular polarization conditions are realized at frequency 5.90 GHz for different sets of elevation and azimuth angles with maximum axial ratio bandwidth close to 600 MHz at the same frequency. The SAR values at desired frequencies are much lower than those for specified frequencies of modern communication systems. This antenna may be a useful structure for 'Wi-Fi, WLAN, Wi-MAX communication bands and lower and median UWB bands.

KEYWORDS

bandwidth, circular polarization, gain, parasitic element, SAR

1 | INTRODUCTION

In modern wireless communication systems, multiband antennas have their crucial role.[1,2] IEEE 802.11 and IEEE 802.16 standards allocated 2.4/5.2/5.8 GHz as WLAN bands and 2.5/3.5/5.5-GHz as Wi-MAX bands, respectively. These bands have wide applications in smart phones, hand hold computers, and various wireless portable devices. Designing of circularly polarized multiband monopole planar antennas covering all these bands and having desired characteristics such as low profile, compact size, omni-directional pattern, and small SAR value is a challenging task.[3-5] Various antenna designs have been reported by researchers to minimize the instinctive limitations of planar patch structure.[6-13] Dual band multistrip monopole patch antenna with modified ground was designed by Kaur et al[6] for WLAN/IMT/BLUETOOTH/Wi-MAX applications. Behera et al[7] applied triple U-slots in the radiating patch to attain WLAN and Wi-MAX communication. Compact radiator patch structure was proposed by Sun et al[8] which covered all the bands of WLAN. Ring slotted circularly polarized U-shaped printed monopole antenna was proposed by Jangid et al[9] for various wireless applications. A dual layer circular patch structure was reported by Chen and Liu[10] for WLAN and Wi-MAX applications. The parasitic patch was strongly coupled with lower patch with the help of slots located in the lower patch. Sharma and Gangwar[11] reported a low profile cylindrical dielectric resonator for wireless application.[11] Cheong et al[12] reported a novel CPW structure with three fractal S-shaped patches for WLAN and Wi-MAX applications. It was found that the number of resonance is directly proportional to the number of fractal s-shape patches. A square spiral patch antenna was presented by Beigi et al[13] for multiband operations. In this communication, various frequency resonances were obtained by using square spiral patch with two L-shape strips. All these reported antennas[6-13] have wide physical size and do not show circular polarization.

The main aspire of this communication is to provide a compact planar design which has multi band performance with concurrent advancement in gain and axial bandwidth. It is a realized fact that circular polarization can be easily achieved with an elliptical design in comparison to conventional rectangular or circular configuration. In this investigation, design and performance of an elliptical patch structure having a crossed shaped parasitic element with defected ground structure is discussed. This crossed shaped parasitic element is placed just on upper side of the patch to revamp the electric field without disturbing the radiation performance of

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

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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.

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

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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

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Original Article

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

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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 meth ods have some limitations. Since many nonlinear physic systems have no small parameters. So, small parameters the basic requirement for approximate solution which sho complication sometimes. In many cases, unsuitable choi of small parameter introduce serious effects in the soluti There exists an analytical approach, which does not ne small parameter in the equation. In past decades, researc developed some new methods which are very simple in plementation and cost effective. These methods solve no ear fractional differential equations very precisely and tively. The developed methods known as iterative techn like homotopy analysis technique, Adomian decompo scheme, homotopy perturbation technique, Laplace dec sition scheme, variational iteration approach, Tanh s Backlund transformation technique, etc. [7–14].

Recently, homotopy perturbation Sumudu tra method (HPSTM) have been suggested by Singh et al.

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