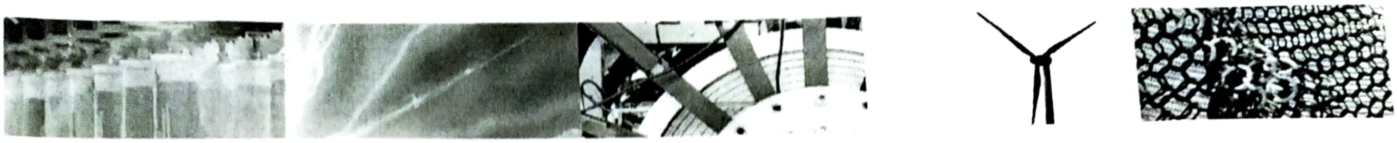

Research Article

SN

Analytical study for MHD flow of Williamson nanofluid with the effects of variable thickness, nonlinear thermal radiation and improved Fourier's and Fick's Laws

Sumit Gupta[1] · Devendra Kumar[2] · Jagdev Singh[3]

Received: 21 August 2019 / Accepted: 8 January 2020 / Published online: 18 February 2020

Abstract
The key aim of the present work is to analyze the magnetohydrodynamic 2D flow of Williamson type nanofluid. Heat and mass transfer impacts are carried out in the manifestation of nonlinear thermal radiation, Cattaneo–Christov heat and mass flux models and varying thicker surface. By applying the appropriate similarity transformations, the mathematical equations of velocity, temperature and volume fraction transform to NODEs. An analytical scheme is pragmatic to estimate the convergence solutions in terms of power series. The dimensionless velocity profile, temperature profile and nanoparticle volume fraction with the administrative physical aspects are depicted through graphs. It is evidently ostensible that the dimensionless velocity declines for the augmented index parameter and wall thickness while cumulative values of M and β, the horizontal fluid velocity decreases. Temperature specie upsurges with rising of $Nb, Nt, n, \beta, R_d, \theta_w$ and M. Consequently demotes with the higher values of Pr and De_1. Nanoparticle volumetric specie escalates with the growing effects of Nt, while it diminishes with Nb, Sc and De_2. Comparison is the key procedure for validation our results with the earlier literature.

Keywords Williamson nanofluid · Nonlinear thermal radiation · Variable thickness · HAM · Cattaneo–Christov heat/mass fluxes

1 Introduction

Nanofluids is the name discovered by Choi [1] to interpret this novel class of nanoparticles based fluids that demonstrates thermal inheritances higher-up to those of their base fluids. Due to their small size usually less than 100 nm, nanoparticles fluidize simply in the base fluid and as a result, clogging and erosion in channels are no longer a problem. These particles carry only a few thousand atoms and own properties that are substantially differ from their original materials. Recently there have been several advancements which have made the nanofluids more stable and ready for use. Nanofluids find potential applications in electronic devices as they have higher denser chips with compact design which makes heat dissipation difficult, heat pipes in the computer devices to improve heat dissipation, industrial cooling uses resulting in excellent energy savings and emission reduction, for cooling nuclear systems, space and defense because of the restriction of space and heat exchangers to improve heat transfer rates, in fuel cell, Solar water heaters, chillers, domestic refrigerator and as lubricants in machining.

Nanofluids are not merely liquid–solid amalgams but are composed by dispersing nanometer-scale solid particles into

✉ Jagdev Singh, jagdevsinghrathore@gmail.com; Sumit Gupta, guptasumit.edu@gmail.com; Devendra Kumar, devendra.maths@gmail.com | [1]Department of Mathematics, Swami Keshvanand Institute of Technology, Management and Gramothan, Ramnagaria, Jaipur, Rajasthan 302017, India. [2]Department of Mathematics, University of Rajasthan, Jaipur, Rajasthan 302004, India. [3]Department of Mathematics, JECRC University, Jaipur, Rajasthan 303905, India.

JOURNAL OF NANO- AND ELECTRONIC PHYSICS
Vol. 12 No 1, 01008(4pp) (2020)

ЖУРНАЛ НАНО- ТА ЕЛЕКТРОННОЇ ФІЗИКИ
Том 12 № 1, 01008(4cc) (2020)

An Off-diagonal Feed Elliptical Patch Antenna with Ring Shaped Slot in Ground Plane for Microwave Imaging of Breast

S. Shekhawat[1,*], Pawan Kumar Jain[2], B.R. Sharma[2], V.K. Saxena[1], D. Bhatnagar[1]

[1] *Microwave Lab, Department of Physics, University of Rajasthan, Jaipur 302004, India*
[2] *Department of Physics, Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur 302017, India*

(Received 21 November 2019; revised manuscript received 15 February 2020; published online 25 February 2020)

Being planar and having many applications of microstrip patch antennas, nowadays these also have applications in biomedical field (for detection of cancer). As EM radiations are hazardous so direct experiments on human body and EM radiation are impossible. So this paper is focused on a breast model to detect the presence of tumor inside it along with antenna structure as a radiation source. HFSS simulation software is used for designing and simulation part. Antenna is resonating at 2.46 GHz in frequency range 2.41-2.5 GHz of ISM band suitable for medical purpose. Two models, one of which has microstrip patch antennas along with breast model without tumor and the other with tumor, are designed and simulated, and their radiation properties are compared. For cancer detection near E-field results are important, so near E-field plots for both models are shown in this paper. The differences in these results of two models can be used to diagnose tumor.

Keywords: MIS, Diagnostic of Breast Tumor, Patch antenna.

PACS number: 52.70.Gw

DOI: 10.21272/jnep.12(1).01008

1. INTRODUCTION

Breast cancer is the most threatening disease occurring in the lives of women, also leads to a large number of deaths. But it can be cured if it is diagnosed early. The screening of breast cancer is a key to successful cure. Modern methods used for the diagnosis and treatment of breast diseases are based on the action on the tissue from radiation of various types: laser, ultrasonic waves, high-frequency current, and others, and include x-ray mammography, MRI, ultrasound, etc. [1-3]. X-ray mammography is commonly used for early breast cancer diagnosis but has many errors. A number of published reports deliberate that it gives direct exposure of radiation to patient; and false results are also very common in this technique [4-6]. During recent scenario microwave imaging is finding place as one of the most promising techniques in diagnosis as well as screening of breast cancer. It has many advantages like the use of non-ionizing radiation, non-invasive, sensitive to tumors, and low in cost. The principle behind the diagnosis of tumor in microwave imaging system consists in differences in electrical properties (conductivity, permittivity or dielectric parameters) of healthy and cancerous tissues at microwave range [7, 8].

In microwave breast imaging (MBI), low power and low frequency signals (compared to X-ray mammography) are used to obtain for ordered breast scanning. In the imaging systems based on microwave, an antenna is a significant element to irradiate the body under test with microwaves which travel through the body and then are detected by the other antenna working as a receiver. The receiver antenna contains the reflected information from tumors which are recorded and analyzed using suitable signal processing technique to get three-dimensional images of body under test. Microstrip antenna is one of the suitable types of antennas for use in Microwave Imaging System (MIS) as they are compact, conformal, low cost, light, easily designed and ease to fabricate. Several research groups from all over the world are working in this field. The performance of double layer and single layer patch antennas is checked, and it is proved that single layer patch structure is better candidate to be used in microwave imaging of breast return loss [9]. The inset fed antenna structure as a rectangular microstrip patch antenna is used, and a simple 3*D* breast structure is modelled for better understanding of cancer detection model [10]. A novel Multi-Ring Slots Ultra-Wide-Band (MRS-UWB) patch antenna that can be used for breast tumor detection is presented [11]. For radar based microwave imaging wide slot double sided microstrip antenna with fork feed has been presented [12]. A review on various geometries of microstrip patch antenna using FR-4 substrate resonating at various frequencies for MIS is also discussed [13].

2. EXPERIMENTAL DETAILS

It is a big challenge for researchers to design a compact size, low profile broadband antenna which can be efficiently used for imaging human body. In this paper, an off-diagonal microstrip line fed elliptical shaped microstrip antenna is proposed for microwave imaging system and for further check of its performance in active imaging system. A simple 3D breast structure with and without tumor is also modelled to diagnose cancerous tissue. HFSS simulator is employed for simulations. Antenna is designed for ISM band allotted for biomedical application. The designed antenna is resonating at 2.46 GHz in free space which is kept below breast model, and simulated maximum volume current density and maximum electric field results have been analyzed for cancer diagnosis. Step by step discussion

* sumita10shekhawat@gmail.com

Assymetric Fed Compact Size Wide Slot Monopole Patch Antenna for S-band, X-band & Ku-band Application

Pawan Kumar Jain[1a], Braj Raj Sharma[2], K.G. Jangid[1], S. Shekhawat[1], Vijay Sharma[3], V.K.Saxena[1] and Deepak Bhatnagar[1]

[1]*Microwave Lab, Department of Physics, University of Rajasthan, Jaipur-302004(India)*
[2]*Department of Physics, SKIT M &G, Jaipur-302017(India)*
[3]*Department of Physics, Govt. Mahila Engg. Collge, Ajmer-305002 (India)*

[a]E-mail:pawan.hep@gmail.com

Abstract: This research article illustrates the design and performance of asymmetric microstrip feed compound shaped compact size wideslot monopole patch antenna. The overall size of antenna is 28 mm × 32 mm × 1.59 mm. Performance of antenna has been optimized by CST Microwave studio 2014 simulator. Proposed antenna provides triple impedance bandwidth in three different bands such as S-band, X-band and Ku-band which is extended between frequency ranges of 2.44-6.02 GHz, 7.23-12.54 GHz and 14.42-16.99 GHz with flat gain (close to 3-5 dBi).This antenna may be a useful structure for modern wireless communication systems.

Keywords: Assymetric feed, Wideslot Monopole, Bandwidth, Gain

INTRODUCTION

In recent year, compact microstrip patch antennas with multiband characteristics have much attention. Designing of S-X-Ku bands antennas wrapping low profile, compact size and asymeetric feed characteristics is a demanding tasks. Microstrip patch antenna working in S-X -Ku bands are incorporated in numerous applications, including mobile phones, WLAN & WI-Max bands applications, Wireless Medical Services, Broadcast Satellite Services (BSS), fixed satellite services (FSS) and weather forcasting [1-6]. Due to various splendid applications, many researchers have extreme interest in designing S-X-Ku bands antennas [7-9]. In this communication [7], a miniature planar patch antenna with ability to operate in frequency range of Ku and K bands applications is reported. The better antenna performance in higher bands is obtained using DGS technique. Microstrip feed line is manipulated through a proximity-fed technique. A very compact dual polarized microstrip patch antenna has been reported for Ku-band applications. The overall dimension of this porposed antenna is 15×15 mm and achieved 950 MHz bandwidth in Ku band with maximum gain of 7.6 dB [8]. A compact dual wideband semi-circular shape patch antenna is reported for Ku/K band applications. The gain of this antenna is low due to ringing resonating frequencies in lower operating band [9]. The proposed asymetric feeding structure is provided higher gain and wider impedance bandwidth. The CST Microwave Studio 2014 is utilized for the simulation analysis of antennas while antennas are tested by using Vector Network Analyzer (R&S-ZVA 40) & RF signal generator. The simulation analysis of proposed design is discussed in section 2. Discussion & conclusion are included in section 3 and section 4 respectively.

3rd International Conference on Condensed Matter and Applied Physics (ICC-2019)
AIP Conf. Proc. 2220, 140068-1–140068-4; https://doi.org/10.1063/5.0002063
Published by AIP Publishing. 978-0-7354-1976-6/$30.00