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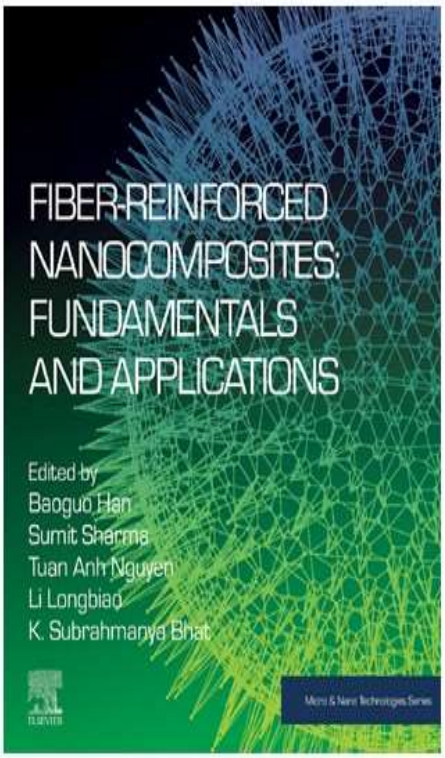


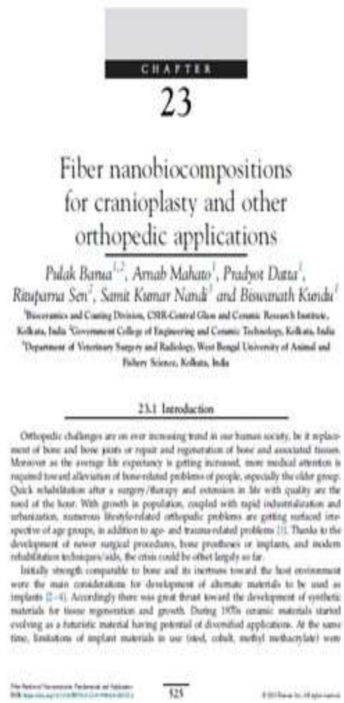

CHAPTER

23

Fiber nanobiocompositions for cranioplasty and other orthopedic applications

Pulak Barua[1,2], Arnab Mahato[1], Pradyot Datta[1], Rituparna Sen[2], Samit Kumar Nandi[3] and Biswanath Kundu[1]

[1]Bioceramics and Coating Division, CSIR-Central Glass and Ceramic Research Institute, Kolkata, India [2]Government College of Engineering and Ceramic Technology, Kolkata, India [3]Department of Veterinary Surgery and Radiology, West Bengal University of Animal and Fishery Science, Kolkata, India

23.1 Introduction

Orthopedic challenges are on ever increasing trend in our human society, be it replacement of bone and bone joints or repair and regeneration of bone and associated tissues. Moreover as the average life expectancy is getting increased, more medical attention is required toward alleviation of bone-related problems of people, especially the older group. Quick rehabilitation after a surgery/therapy and extension in life with quality are the need of the hour. With growth in population, coupled with rapid industrialization and urbanization, numerous lifestyle-related orthopedic problems are getting surfaced irrespective of age groups, in addition to age- and trauma-related problems [1]. Thanks to the development of newer surgical procedures, bone prostheses or implants, and modern rehabilitation techniques/aids, the crisis could be offset largely so far.

Initially strength compatible to bone and its inertness toward the host environment were the main considerations for development of alternate materials to be used as implants [2–4]. Accordingly there was great thrust toward the development of synthetic materials for tissue regeneration and growth. During 1970s ceramic materials started evolving as a futuristic material having potential of diversified applications. At the same time, limitations of implant materials in use (steel, cobalt, methyl methacrylate) were

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# Friction Coefficient Analysis of Nano-crystalline $TiO_2$-Added Alumina Ceramics

**Partha Haldar, Tapas Kumar Bhattacharya, and Nipu Modak**

## 1 Introduction

Economic manufacturing of excellent quality product is one of the main targets of research in material science. Generally, some new materials are fabricated in the laboratory; then, the characterization and further testing are done. So as a result, huge experimentation is required before successfully commercialization of a product, and the process is associated with time and cost. Now, if a predictive algorithm is designed which is trained on the basis of some experimental data and can predict the other required parameters, then it will surely cause reduction of time and cost of experimentation.

$Al_2O_3$-based ceramics are becoming popular as mechanical moving contact materials which motivate intensive research in understanding of their wear behavior [1]. They are used as parts of rockets, jet engines, gas turbines, heat shields for space vehicles, fusion reactors, heat treatment furnaces [2, 3], cutting tools [4], etc. As newer advanced ceramics are coming in the market rapidly, so evaluation of their coefficient of friction (COF) with respect to other counter body is one of the prime concerns for practicing engineers before they are tested in a tribometer. As a result, researchers are trying to develop theoretical models to predict the COF of newer materials. Variation in wear behavior is reported by researchers by addition of various secondary phases in alumina like zirconia [5], SiC [6], CuO [7–12] and $TiO_2$ [13, 14]. To understand

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**Softcover ISBN** 978-981-32-9427-1 Published: 01 December 2020

**eBook ISBN** 978-981-32-9425-7 Published: 30 November 2019

**Series ISSN** 2522-5022

**Series E-ISSN** 2522-5030

**Edition Number** 1

**Number of Pages** XXI, 740

# Chapter 60
# The Effect of Normal Load and Sliding Frequency on the Reciprocating Friction Behavior of Nanocrystalline CuO-Based Alumina Ceramics

**Partha Haldar, Tapas Kumar Bhattacharya and Nipu Modak**

**Abstract** This investigation reports the effect of normal load and sliding frequency on the tribological performance of nanocrystalline CuO-based alumina ceramics in relation with CuO addition. Tribological studies were conducted by reciprocating a silicon nitride ball on the prepared samples in dry condition in a linear reciprocating tribotester. Reciprocating friction tests were conducted at normal loads of 0.3, 0.5, 0.7, and 1.0 kgf and the frequencies of 15, 30, 45, and 60 Hz. Coefficient of friction is influenced by the normal load and sliding frequency levels. The friction coefficient increases with increasing sliding frequency, normal load, and nano-oxide addition. The coefficient of friction sharply increases at the level of sliding frequency from 30 to 45 Hz and normal load from 500 to 700 gmf. Since coefficient of friction gradually increases with increase in CuO weight percent in the alumina matrix, it can be inferred that these materials can be used as ceramic brake or clutch.

**Keywords** Alumina ceramics · Cuo nanocrystalline particle · Friction material · Wear · Dry reciprocating friction

## 60.1 Introduction

Research is continuing to find out tailor-made material required for each engineering applications. In recent years, use of alumina ($Al_2O_3$) ceramics has increased exponentially as components of bearings, aircraft brakes, and un-lubricated engines due to its excellent hardness and good wear resistance. In some of the applications, higher friction coefficient is advantageous, e.g., brake or clutch and in some cases the friction should be as minimum as possible, e.g., bearings. However, since alumina is a brittle material, the initiation and propagation of cracks limit its long term use as engineering components. Researchers have added one or several metals or

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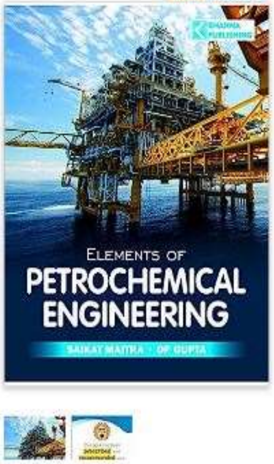


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Chapter

# Deep Learning to Diagnose Diseases and Security in 5G Healthcare Informatics

*By Partha Ghosh*

Book [Machine Learning and Deep Learning Techniques for Medical Science]

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| Edition | 1st Edition |
| First Published | 2022 |
| Imprint | CRC Press |
| Pages | 53 |
| eBook ISBN | 9781003217497 |

## ABSTRACT

We live in the age of algorithms, machine learning (ML), and deep learning (DL) systems, which are transforming industries such as manufacturing, transportation, and management. DL improves performance in multiple areas, such as computer vision, text analysis, and speech. Deal with over time. Due to the extensive use of machine

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ISSN 2522-8595 ISSN 2522-8609 (electronic)
EAI/Springer Innovations in Communication and Computing
ISBN 978-3-031-09728-7 ISBN 978-3-031-09729-4 (eBook)
https://doi.org/10.1007/978-3-031-09729-4

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# Smart Cities: A Data Analytics Perspective

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ISSN 2523-3440 ISSN 2523-3459 (electronic)
Lecture Notes in Intelligent Transportation and Infrastructure
ISBN 978-3-030-60921-4 ISBN 978-3-030-60922-1 (eBook)
https://doi.org/10.1007/978-3-030-60922-1



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## Fundamental of Smart Cities and Data Analytics



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Mahmoud Elkhodr

Release Date: October, 2018 | Copyright: © 2019 | Pages: 384
DOI: 10.4018/978-1-5225-6023-4
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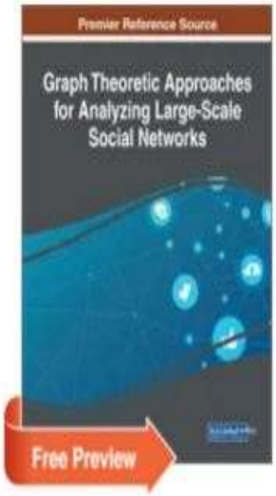


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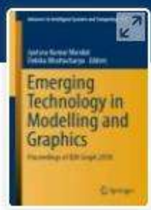


Emerging Technology in Modelling and Graphics pp 359–372 | Cite as

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# Gray Matter Segmentation and Delineation from Positron Emission Tomography (PET) Image

Abhishek Bal, Minakshi Banerjee, Punit Sharma & Mausumi Maitra

Conference paper | First Online: 17 July 2019



Part of the Advances in Intelligent Systems and Computing book series (AISC,volume 937)

## Abstract

Gray matter segmentation and delineation from positron emission tomography (PET) are a very essential requirement in medical applications due to low spatial resolution, presence of noise, and larger variability in the shape as well as in texture. PET images provide the functional details of the brain which are very much essential to detect brain disorders. The diagnosis of dementia, particularly in the early stages, are very much helpful with PET image

# Brain Tumor Segmentation on MR Image Using K-Means and Fuzzy-Possibilistic Clustering

Publisher: IEEE 

Abhishek Bal ; Minakshi Banerjee ; Punit Sharma ; Mausumi Maitra All Authors





**Abstract:**

Automated tumor segmentation and estimation from the magnetic resonance imaging (MRI) is a very crucial task from medical point of view due to high varieties of tumor tissues. The advantage of using the MR images is to provide the anatomical structure of the brain that plays a significant role during automated brain tumor detection. In this work, a method for brain tumor segmentation from MR images is proposed which is based on fuzzy-possibilistic C-means (FPCM) and shape based topological properties to identify the exact tumor region. A patch based K-means method is also implemented for skull stripping (brain tissue extraction) as a preprocessing step. Experimental results show that the proposed method has achieved better performance based on volume metrics than previous state-of-the-art algorithms with respect to ground truth (manual segmentation) on MRI standard benchmark datasets.

**Published in:** 2018 2nd International Conference on Electronics, Materials Engineering & Nano-Technology (IEMENTech)

**Date of Conference:** 04-05 May 2018

**INSPEC Accession Number:** 18128927

**Date Added to IEEE *Xplore*:** 16 September 2018

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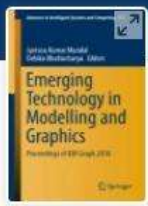


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# Embedded Implementation of Early Started Hybrid Denoising Technique for Medical Images with Optimized Loop

Khakon Das ✉, Mausumi Maitra, Minakshi Banerjee & Punit Sharma

Conference paper | First Online: 17 July 2019



Part of the Advances in Intelligent Systems and Computing book series (AISC,volume 937)

## Abstract

This paper represents the architecture of an embedded system for Early Started Hybrid Denoising Technology for Medical Images (ESHDT) using a very popular embedded processor, ATmega processor, which is inexpensive in terms of computation. Embedded implementation of the ESHDT algorithm is chosen because hardware presents a good scope of parallelism and


Recent Trends in Signal and Image Processing pp 131–140 | Cite as



# Early Started Hybrid Denoising Technique for Medical Images

Khakon Das, Mausumi Maitra, Punit Sharma & Minakshi Banerjee

Conference paper | First Online: 10 May 2018



Part of the Advances in Intelligent Systems and Computing book series (AISC,volume 727)

## Abstract

We propose an Early Started Hybrid Denoising Technique for brain images using modified Haar wavelet transform. To enhance the quality of the images, image fusion is used by combining two brain images obtained using positron emission tomography (PET) and computed tomography (CT) scan. Modified wavelet transform using lifting and in-place calculation has been proposed in the paper which has been shown efficient with respect to

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FEEDBACK

# Testing and Characterization of Fiber Reinforced Epoxy and Polymer Composite

**Soumyabrata Chakravarty,** Mechanical Engineering Department, Jadavpur University, Kolkata, India
**Partha Haldar,** Mechanical Engineering Department, Government College of Engineering and Ceramic Technology, Kolkata, India
**Nipu Modak,** Mechanical Engineering Department, Jadavpur University, Kolkata, India



## Introduction

The need for materials with high strength and light weight is growing day by day. The advancement in engineering supports this growing need by introducing new materials. One of such newly developed materials for engineering applications is composites. Two or more materials with different properties constitute composites. These have two phases: the matrix or base phase which binds the other phase viz. reinforcement in the form of particle or fiber. The properties of composite take the superiorities from both the matrix and reinforcement; thus, tailored properties can be achieved in composites. The composite materials can be broadly classified according to (a) the nature of matrix materials and (b) the nature of reinforcement materials, as shown in Fig. 1. Therefore, by combining different matrix and reinforced materials shown in Fig. 1, six different composites can be obtained such as particle reinforced polymer matrix composites, fiber reinforced polymer matrix composites, etc.

This review is concerned with fiber reinforced polymer matrix composite with special emphasis on epoxy polymer matrix composite where, epoxy is a widely used polymeric material.

One of the most significant advantages of composite material is tailored properties as desired by the application can be obtained. These properties depend on matrix material, reinforcement material, reinforcement concentration, fabrication technique and many other factors. The polymer material is always lighter than the metals, so heavy metals are replaced by composites made of polymer material nowadays (Haldar *et al.*, 2017). Fiber reinforcement provides better strength due to its continuous and inter-wound structure (Ayranci and Carey, 2008). The fiber reinforced polymer matrix composites (PMCs) have high specific strength and specific stiffness which attract the attention of researchers and engineers for being a structural material. Fiber-reinforced composites have applications in aerospace industry along with applications in the marine, armor, automobile, railway, structural engineering, and sporting goods industries (Zhou *et al.*, 2008). The application area and respective properties required for the application extensively depend on the type of fibers used as reinforcements (Shah, 2013). The fiber can be of a different type as per the demand of the applications such as glass fiber, natural fibers, hybrid fiber, carbon fiber, ceramic fibers, boron fibers, aramid fibers and extended chain polyethene fibers etc. (Mallick, 2007). A huge application area for fiber reinforced PMCs demands newer materials. Development of new fiber reinforced PMCs should be passed through standard test procedures and characterization techniques for better sustainability of the product. The detailed characterization can give an insight into the cause of the developed properties which can be used for developing new materials.

In this work, detailed discussion about the testing methods along with characterization techniques of fiber reinforced epoxy and polymer composites have been provided to introspect the nature of composites closely. Along with it, a critical review of previous works has been presented to understand the properties of fiber reinforced PMCs and their dependency on the impact of different parameters.

## Testing and Characterization Methods

Sustainable material development is achieved through a process of rigorous testing and characterization. The tailored properties developed in fiber reinforced epoxy matrix composites should be quantified and compared with standard base materials to understand the improvement in different properties. In general, the properties considered by various researchers have been shown in Fig. 2. In this section, detailed methods of testing these properties are discussed along with previously reported results to get an insight into testing and characterization.

## Physical Properties

The application of fiber reinforced polymer matrix composite in different engineering sectors is achieved sustainably by introspecting physical properties of the developed composite materials. The physical properties include density, fiber content, void content, fiber architect etc. (Bledzki and Gassan, 1999). The properties of developed new material highly depend on these physical parameters.

### Fiber Content, Density, and Void Content

Fiber content is represented in terms of fiber volume fraction by various academicians because volume fraction is the basis of calculation for properties and strength modulus of developed composites (Arib *et al.*, 2006). Weight fraction evaluation of fiber is commonly done by experiment as experimental evaluation of volume fraction of fiber is tedious and lacks proper methodology (Bay and Tucker, 1992).

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**eBook ISBN** 978-981-16-2347-9 Published: 01 July 2021

**Series ISSN** 2195-4356

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# Alumina Based Cutting Tools—A Review

Sourav Mondal, Rajashi Chatterjee, and Partha Haldar

## 1 Introduction

Ceramic materials used in cutting tools today are based either on alumina ($Al_2O_3$) or silicon nitride ($Si_3N_4$). Alumina based cutting tools (ACT) are extensively used as the benchmark for its abundance, cheapness and excellent structural properties [1]. ACT exhibits spectacular mechanical and structural properties, as these can provide long tool life and can carry out machining in hard and tough work pieces like stainless and hardened steel. Its physical properties can be enhanced by various toughening methods like fiber toughening or transformation toughening. Evidently, the machining of most of the complex and hard materials is done through alumina-ceramics and cubic boron nitrides which resembles high hardness at high temperature, chemical stability and its resistance to wearing. There are various advantages associated with using ACT, as it can work out with complex and hard shapes and giving quality surface finish even in tough situations. Various improvements can be made in its tool properties like resistivity to thermal shock and wearing, increased fracture strength and hardness etc. ACT has been found to substitute grinding operations in finishing part of steels, with the help of machining [2]. Machining is carried out between tool and work piece leading to intense abrasion, adhesion and diffusion

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S. K. Ghosh et al. (eds.), *Advances in Thermal Engineering, Manufacturing, and Production Management*, Lecture Notes in Mechanical Engineering,
https://doi.org/10.1007/978-981-16-2347-9_22

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**Rose Dhar, Alok Mukherjee, Kingshuk Chatterjee, and Partha Haldar**

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https://doi.org/10.1007/978-981-16-2347-9_34

ISBN
978-1-83968-432-6

PRINT ISBN
978-1-83968-431-9

EBOOK (PDF) ISBN
978-1-83968-433-3

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# Simulation and Validation of Castings in Shop Floor

Submitted: July 29th, 2020 , Reviewed: October 22nd, 2020 , Published: January 7th, 2021

DOI: 10.5772/intechopen.94596

WRITTEN BY
Partha Haldar and Goutam Sutradhar



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Chapter

# Simulation and Validation of Castings in Shop Floor

*Partha Haldar and Goutam Sutradhar*

## Abstract

Production of sound casting demands a thorough understanding of whole casting process. But still, defects and rejection of castings are ubiquitous because in general, the designer lacks domain knowledge about casting processes and hardly have any methodology to find out the parameters that produce sound casting. Casting simulation software simulates the way how casting engineers decide the casting process in a virtual platform and also analyzes each decision to point out the design modifications needed to enhance the quality of casting as well as reduce lead time, tooling and manufacturing costs. The application of simulation software enables us to say, "Get it right, the first time and every time". Simulation software can be very helpful in calculating tedious formulas, constructing solid modeling which will be helpful to visualise the actual situation like core/mould assembly, gating and feeding arrangements with the main casting before going into actual practice. It can be adopted for troubleshooting existing castings, and for producing new castings without or minimum shop-floor trials. This chapter illustrates the advantages of casting simulation (both tangible and intangible), bottlenecks (technical and resource-related), and some best practices to subdue the bottlenecks. In this chapter some of the live examples have been cited to understand the process logically and scientifically.

**Keywords:** casting simulation, concurrent engineering, design for manufacture, solid modeling, quality assurance

## 1. Introduction

Simulation imitates a real phenomenon by the use of certain mathematical equations. Metal casting is a manufacturing process where molten metal is poured into a mould cavity of required shape and size and allowed to solidify. Naturally, metal casting simulation is a very complex phenomenon which involves flow of fluid, heat transfer between mould and molten metal etc. It is often said that the development of accurate simulation software is a 'rocket science for rocket scientists'. Actually, metal casting is a process which has numerous associated controlling factors. Therefore, the key to develop a practical useful casting simulation software is to figure out the related most important parameters. Several researchers have worked hard for several decades to find out the same. Geometry, material, and process are three major influencing factors related to metal casting [1].

The casting simulation software producing farms always keep target to accurately simulate the physical phenomena as far as possible like the mould filling, associated heat-transfer, solidification pattern of the metal/alloy, and the involved

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|---|---|---|
| 978-981-32-9427-1<br>Published: 01 December 2020 | 978-981-32-9425-7<br>Published: 30 November 2019 | 2522-5022 |
| **Series E-ISSN** | **Edition Number** | **Number of Pages** |
| 2522-5030 | 1 | XXI, 740 |

# Chapter 60
# The Effect of Normal Load and Sliding Frequency on the Reciprocating Friction Behavior of Nanocrystalline CuO-Based Alumina Ceramics

**Partha Haldar, Tapas Kumar Bhattacharya and Nipu Modak**

**Abstract** This investigation reports the effect of normal load and sliding frequency on the tribological performance of nanocrystalline CuO-based alumina ceramics in relation with CuO addition. Tribological studies were conducted by reciprocating a silicon nitride ball on the prepared samples in dry condition in a linear reciprocating tribotester. Reciprocating friction tests were conducted at normal loads of 0.3, 0.5, 0.7, and 1.0 kgf and the frequencies of 15, 30, 45, and 60 Hz. Coefficient of friction is influenced by the normal load and sliding frequency levels. The friction coefficient increases with increasing sliding frequency, normal load, and nano-oxide addition. The coefficient of friction sharply increases at the level of sliding frequency from 30 to 45 Hz and normal load from 500 to 700 gmf. Since coefficient of friction gradually increases with increase in CuO weight percent in the alumina matrix, it can be inferred that these materials can be used as ceramic brake or clutch.

**Keywords** Alumina ceramics · Cuo nanocrystalline particle · Friction material · Wear · Dry reciprocating friction

## 60.1 Introduction

Research is continuing to find out tailor-made material required for each engineering applications. In recent years, use of alumina ($Al_2O_3$) ceramics has increased exponentially as components of bearings, aircraft brakes, and un-lubricated engines due to its excellent hardness and good wear resistance. In some of the applications, higher friction coefficient is advantageous, e.g., brake or clutch and in some cases the friction should be as minimum as possible, e.g., bearings. However, since alumina is a brittle material, the initiation and propagation of cracks limit its long term use as engineering components. Researchers have added one or several metals or

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M. S. Shunmugam and M. Kanthababu (eds.), *Advances in Micro and Nano Manufacturing and Surface Engineering*, Lecture Notes on Multidisciplinary Industrial Engineering,
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ISSN 2194-5357 ISSN 2194-5365 (electronic)
Advances in Intelligent Systems and Computing
ISBN 978-981-33-4366-5 ISBN 978-981-33-4367-2 (eBook)
https://doi.org/10.1007/978-981-33-4367-2



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# A Correlation-Based Classification of Power System Faults in a Long Transmission Line

**Alok Mukherjee, Palash Kumar Kundu, and Arabinda Das**

**Abstract** This article represents a simple and effective way for fault classification in a long transmission line. A correlation-based study has been done in this work using the post-fault transient oscillation of phase voltage and current signals. It is observed that the rms voltage starts to fall very rapidly after the fault and the phase currents increase abruptly for the faulted line(s). These opposite natures of change are mathematically interpreted using correlation analysis. Noise is also incorporated in the signals to develop a more practical environment. Fault location is also varied along the line span. The correlation coefficients of the three lines for ten fault prototypes along with the no-fault condition and the test signal data are arranged. The test data is compared to each fault class signature to predict fault class. Only (3/20) cycle post-fault signals are analyzed using the proposed classifier to produce 99.4286% prediction accuracy.

**Keywords** Fault prototypes · Classifier · Correlation analysis

## 1 Introduction

This paper represents a correlation-based simple scheme for classifying power system faults in a long transmission line using a correlation-based analysis. The phase voltage and current signals of all the three phases are collected and analyzed to find out the correlation between these electrical parameters. It is further observed that when a fault occurs at any point in a transmission line, the phase voltage seems to decrease

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A. E. Hassanien et al. (eds.), *Emerging Technologies in Data Mining and Information Security*, Advances in Intelligent Systems and Computing 1300,
https://doi.org/10.1007/978-981-33-4367-2_12

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ISSN 2194-5357 ISSN 2194-5365 (electronic)
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ISBN 978-981-33-4366-5 ISBN 978-981-33-4367-2 (eBook)
https://doi.org/10.1007/978-981-33-4367-2



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# A Wavelet Entropy-Based Power System Fault Classification for Long Transmission Lines

Alok Mukherjee, Palash Kumar Kundu, and Arabinda Das

**Abstract** This paper describes a wavelet entropy-based simple method for classification of transmission line faults using wavelet entropy analysis of sending end fault current waveforms of one cycle post-fault duration. The fault transients are scaled with respect to the peak value under no-fault condition for respective phases. These three phase scaled current signals are fed to the wavelet classifier model to extract fault features in terms of wavelet entropy values. The variation in the three phase entropy for ten fault classes provides enough features for distinct differentiation among different fault conditions. Two threshold values are identified on detail analysis of the fault class entropies, which helps to develop fault classifier rule base, and in turn, fault signatures. The unknown class is identified by direct comparison of the three phase test entropies with that of fault class signatures. The proposed classifier produces 99.2857% accuracy in classification with one cycle post-fault data.

**Keywords** Wavelet entropy · Fault class entropies · Cycle post

## 1 Introduction

Electrical power system is one of the largest interconnected systems, which often falls under minor to severe level of faults, especially due to the environmental constraints like storm, snow, rain, etc. Sometimes these faults are temporary, and rest of the times these are permanent in nature, requiring manual intervention of the operating

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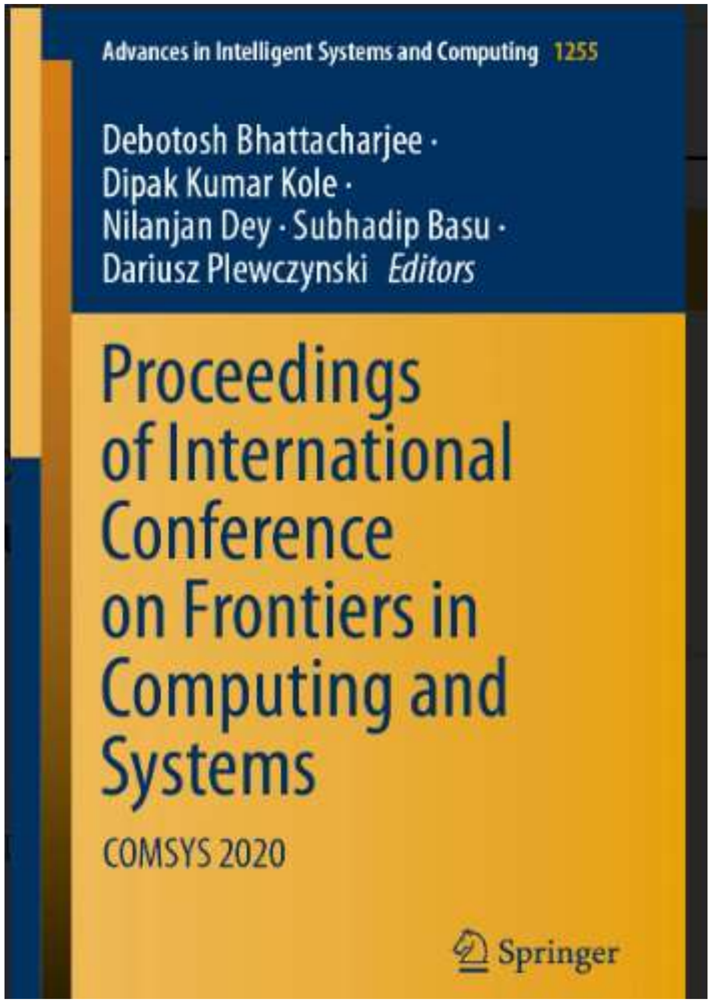

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| DOI | Published | Publisher Name |
| --- | --- | --- |
| https://doi.org/10.1007/978-981-15-7834-2_68 | 24 November 2020 | Springer, Singapore |

| Print ISBN | Online ISBN | eBook Packages |
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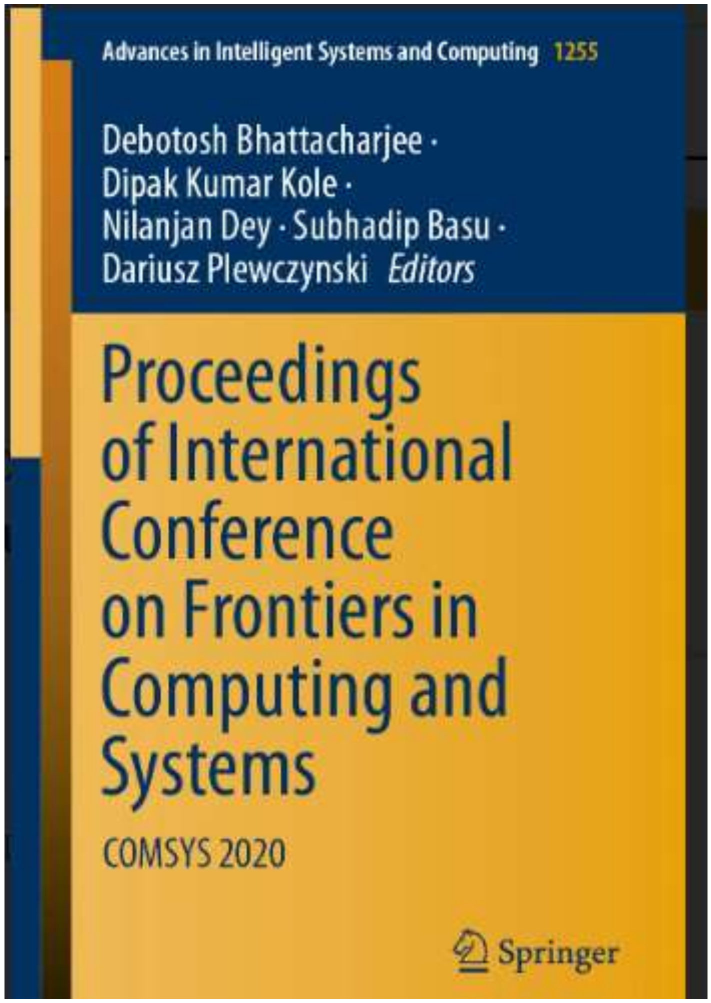
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Cite this paper as:

Pal D., Goswami A., Chowdhury S., Ghoshal N. (2021) A Novel High-Density Multilayered Audio Steganography Technique in Hybrid Domain. In: Bhattacharjee D., Kole D.K., Dey N., Basu S., Plewczynski D. (eds) Proceedings of International Conference on Frontiers in Computing and Systems. Advances in Intelligent Systems and Computing, vol 1255. Springer, Singapore. https://doi.org/10.1007/978-981-15-7834-2_67

- First Online 24 November 2020
- DOI https://doi.org/10.1007/978-981-15-7834-2_67
- Publisher Name Springer, Singapore





- Print ISBN 978-981-15-7833-5
- Online ISBN 978-981-15-7834-2
- eBook Packages Intelligent Technologies and Robotics Intelligent Technologies and Robotics (R0)

SpringerLink

# A Novel High-Density Multilayered Audio Steganography Technique in Hybrid Domain

Proceedings of International Conference on Frontiers in Computing and Systems pp 721-730 | Cite as

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Conference paper
First Online: 24 November 2020



Part of the Advances in Intelligent Systems and Computing book series (AISC, volume 1255)

2018 International Conference on

# Wireless Communications, Signal Processing and Networking ( WiSPNET )

22-24, March 2018

Futuristic Wireless
Mobile Communications Frontiers for Smart World

# Programme

hosted by

Electronics and Communication Engineering Department
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Chennai, India.

IEEE

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|---|---|
| IEEE Catalog Number: | CFP18D52-POD |
| ISBN (Print-On-Demand): | 978-1-5386-3625-1 |
| ISBN (Online): | 978-1-5386-3624-4 |

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**Date of Conference:** 22-24 March 2018

**Date Added to IEEE *Xplore*:** 19 November 2018

▼ **ISBN Information:**

**Electronic ISBN:**978-1-5386-3624-4
**USB ISBN:**978-1-5386-3623-7
**Print on Demand(PoD) ISBN:**978-1-5386-3625-1

**INSPEC Accession Number:** 18269073

**DOI:** 10.1109/WISPNET.2018.8538754

**Publisher:** IEEE

**Conference Location:** Chennai, India

Contents

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