



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

Dirección de Investigación y Posgrado

Periodo	enero-diciembre	Fecha	13 de diciembre de 2021
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Componente	3. Investigación	Actividad	3.1 Productos de Investigación
Nombre del Indicador	Porcentaje de productos de investigación científica y tecnológica realizados		
Resumen Narrativo	3.1 Realización de productos de investigación científica y tecnológica de educación superior		
Supuestos	Los investigadores participan en las convocatorias para el desarrollo de proyectos de investigación científica y tecnológica.		
Medios de Verificación	Informe anual de productos de investigación científica y tecnológica realizados generado y ubicado en la Dirección de Investigación y Posgrado adscrito a la Secretaría Académica de la Universidad Politécnica de Tulancingo.		

Metas Anuales

Programada	10	Alcanzada	10
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Descripción de Actividades

En el periodo enero – diciembre 2021 se programaron 10 metas, que derivan en 10 productos de investigación. Estos productos de investigación o artículos de corte científico tecnológico fueron presentados en revistas de corte internacional y son los siguientes:

- 1.-Nombre del artículo: **PLL Wrap Function for Synchronization in Phase Jump Disturbances**
- 2.-Nombre del artículo: **Computation of 2D and 3D High-order Discrete Orthogonal Moments**
- 3.-Nombre del artículo: **Diagnóstico de fallas mediante una LSTM y una red elástica**
- 4.-Nombre del artículo: **Non-Binary Snow Index for Multi-Component Surfaces**
- 5.-Nombre del artículo: **Fast computation of 3D Tchebichef moments for higher order**
- 6.-Nombre del artículo: **Statistical analysis of speckle patterns modeled with Optic Studio®**
- 7.-Nombre del artículo: **Digital Marketing Strategies for the Survival of Micro-Businesses in Tulancingo de Bravo, Hidalgo, Mexico**
- 8.-Nombre del artículo: **A profile-based sentiment-aware approach for depression detection in social media**
- 9.-Nombre del artículo: **Revealing traces of depression through personal statements analysis in social media**
- 10.-Nombre del artículo: **Highly Discriminative Physiological Parameters for Thermal Pattern Classification**



Desarrollo de Actividades y Evidencia Fotográfica

1.-Nombre del artículo: PLL Wrap Function for Synchronization in Phase Jump Disturbances

Autores: Clementina Rueda-Germán*, Iván de Jesús Rivas-Camero**, Hossam A. Gabbar ***, and José Humberto Arroyo-Núñez *

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Revista: INGENIERÍA E INVESTIGACIÓN

Link: <https://revistas.unal.edu.co/index.php/ingainv/article/view/84955>

INGENIERÍA E INVESTIGACIÓN VOL. 41 No. 1, ABRIL - 2021 (e84955)

Research Article/ Electrical and Electronic Engineering

<https://doi.org/10.15446/ingainv.v41n1.84955>

PLL Wrap Function for Synchronization in Phase Jump Disturbances

Función de ajuste de un PLL para la sincronía ante perturbaciones de salto de fase

Clementina Rueda-Germán¹, Iván de Jesús Rivas-Camero², Hossam A. Gabbar³, and José Humberto Arroyo-Núñez⁴

ABSTRACT

Synchrony plays a major role in the interconnection process between local electric power generation systems and the electrical grid. Grid phase disturbances prevent the generation system from maintaining synchrony. Therefore, an efficient phase tracking method is necessary in order to detect phase jumps and abrupt changes in amplitude. In this paper, we propose a software-designed method to strengthen phase tracking based on the wrap process of a second-level Phase Locked Loop (PLL). The term 'wrap' means establishing the phase values of the reference signal in intervals of π to match it with the values obtained from the PLL output (sync pulse). To quantify phase error, a mathematical transformation of the time domain to the frequency domain is implemented. The validity of the proposed wrap function is verified using electrical disturbances.

Keywords: single phase stockicker PLL, SPLL, phase disturbance, wrap, fast Fourier transform, FFT, phase error

RESUMEN

La sincronía es primordial para la interconexión de sistemas locales de generación de energía con el sistema eléctrico. Las perturbaciones en fase evitan que el sistema de generación mantenga la sincronía. Por lo tanto, un método eficiente de seguimiento de fase es necesario para detectar saltos en la misma y cambios abruptos en amplitud. En este trabajo se propone un método para fortalecer el seguimiento de fase basado en el proceso de envoltura de fase de un PLL (Phase Locked Loop) de segundo grado diseñado por software. El término 'envoltura' (wrap) se refiere a establecer los valores de fase de la señal de referencia en intervalos de π para que coincida con los valores obtenidos de la señal de salida del PLL (pulso de sincronía). Una técnica de transformación matemática del dominio del tiempo al dominio de la frecuencia es implementada con el fin de cuantificar el error de fase. La validez de la función de envoltura propuesta es verificada usando perturbaciones eléctricas.

Palabras clave: PLL de fase sencilla, SPLL, disturbio de fase, envoltura, transformada rápida de Fourier (FFT), error de fase

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Universidad Politécnica de Tulancingo

Informe Anual de Actividades

2.-Nombre del artículo: **Computation of 2D and 3D High-order Discrete Orthogonal Moments**

Autores: **José S. Rivera-López ***, **César Camacho-Bello ****, and **Lucia Gutiérrez-Lazcano *****

(Alumno del Doctorado en Optomecatrónica, Profesor de Tiempo Completo de la Maestría en Computación Óptica y Profesor de Tiempo Completo de la Maestría en Desarrollo de Software)

Revista: **Science Gate Publishing P.C.**

Link: https://sciencegatepub.com/sdm_downloads/computation-of-2d-and-3d-high-order-discrete-orthogonal-moments/

CHAPTER 3

Computation of 2D and 3D High-order Discrete Orthogonal Moments

José S. Rivera-Lopez, César Camacho-Bello, and Lucia Gutiérrez-Lazcano

This chapter is about eliminating numerical instability and the error of high-order orthogonal moments by reducing terms in existing recurrence relations and the Gram-Smith orthonormalization process. Besides, the simplification of the terms of the recurrence relations with respect to n of the most used kernels is analyzed, such as Tchebycheff polynomials, Hahn polynomials, Krawtchouk polynomials, Charlier polynomials, and Meixner polynomials. Also, to guarantee the effectiveness of the proposed method, reconstructions of both 3D objects and high-resolution images are presented. The results presented in this chapter will help you utilize moments for processing, recognition, and analysis on 8K Full HD images and 3D objects with large dimensions.



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Informe Anual de Actividades

3.-Nombre del artículo: Diagnóstico de fallas mediante una LSTM y una red elástica

Autores: Márquez-Vera, M.A. *, López-Ortega, O.** , Ramos-Velasco, L.E.***, Ortega-Mendoza, R.M.****, Fernández-Neri, B.J. *, Zúñiga-Peña, N.S.*

(* Profesores de Tiempo Completo de la Universidad Politécnica de Pachuca, ** Profesor de Tiempo Completo de la Universidad Autónoma del Estado de Hidalgo, *** Profesor de Tiempo Completo Universidad Politécnica Metropolitana de Hidalgo, **** Profesora de Tiempo Completo del Doctorado en Optomecatrónica de la Universidad Politécnica de Tulancingo)

Revista: Revista Iberoamericana de Automática e Informática Industrial

Link: <https://doi.org/10.4995/riai.2020.13611>



Revista Iberoamericana de Automática e Informática Industrial



Revista Iberoamericana de Automática e Informática Industrial 18 (2021) 164-175

Diagnóstico de fallas mediante una LSTM y una red elástica

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Resumen

El diagnóstico de fallas es importante en los procesos industriales, ya que permite determinar si es necesario detener el proceso en operación y/o proponer un plan de mantenimiento. En el presente trabajo se comparan dos estrategias para diagnosticar fallas. La primera realiza un preprocesamiento de datos usando el análisis de componentes independientes para reducir la dimensión de los datos, posteriormente, se emplea la transformada wavelet para resaltar las señales de falla, con esta información se alimenta una red neuronal artificial. Por su parte, la segunda estrategia, principal contribución de este trabajo, usa una memoria de corto y largo plazo. Esta memoria es alimentada por las variables más significativas seleccionadas mediante una red elástica para usar tanto la norma L_1 como la L_2 . Como ejemplo de aplicación se utilizó el proceso químico Tennessee Eastman, un proceso ampliamente usado en el diagnóstico de fallas. El aislamiento de fallas mostró mejores resultados con respecto a los reportados en la literatura.

Palabras clave: Diagnóstico de fallas, Transformada Wavelet, Redes neuronales recurrentes, Análisis de componentes independientes, Red elástica.

Fault diagnosis in industrial process by using LSTM and an elastic net

Abstract



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

4.-Nombre del artículo: **Non-Binary Snow Index for Multi-Component Surfaces**

Autores: Mario Arreola-Esquivel *, Carina Toxqui-Quitl **, Maricela Delgadillo-Herrera *, Alfonso Padilla-Vivanco 1**, Gabriel Ortega-Mendoza** and Anna Carbone*** (*Alumnos del Doctorado en Optomecatrónica Universidad Politécnica de Tulancingo, ** Profesores de Tiempo Completo del Doctorado en Optomecatrónica Universidad Politécnica de Tulancingo y *** Profesora de tiempo Completo de Politécnico di Torino, en Turín, Italia).

Revista: REMOTE SENSING

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<https://www.mdpi.com/2072-4292/13/14/2777>



remote sensing



Article

Non-Binary Snow Index for Multi-Component Surfaces

Mario Arreola-Esquivel ¹, Carina Toxqui-Quitl ^{1,*}, Maricela Delgadillo-Herrera ¹, Alfonso Padilla-Vivanco ¹, Gabriel Ortega-Mendoza ¹ and Anna Carbone ²

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Abstract: A Non-Binary Snow Index for Multi-Component Surfaces (NBSI-MS) is proposed to map snow/ice cover. The NBSI-MS is based on the spectral characteristics of different Land Cover Types (LCTs), such as snow, water, vegetation, bare land, impervious, and shadow surfaces. This index can increase the separability between NBSI-MS values corresponding to snow from other LCTs and accurately delineate the snow/ice cover in non-binary maps. To test the robustness of the NBSI-MS, regions in Greenland and France–Italy where snow interacts with highly diversified geographical ecosystems were examined. Data recorded by Landsat 5 TM, Landsat 8 OLI, and Sentinel-2A MSI satellites were used. The NBSI-MS performance was also compared against the well-known Normalized Difference Snow Index (NDSI), NDSI-1, S3, and Snow Water Index (SWI) methods and evaluated based on Ground Reference Test Pixels (GRTPs) over non-binarized results. The results show that the NBSI-MS achieved an overall accuracy (OA) ranging from 0.99 to 1 with kappa coefficient values in the same range as the OA. The precision assessment confirmed the performance superiority of the proposed NBSI-MS method for removing water and shadow surfaces over the compared relevant indices.

Keywords: NDSI; NDSI-1; S3; SWI; NBSI-MS; Landsat 5 TM; Landsat 8 OLI; Sentinel-2A



Citation: Arreola-Esquivel, M.; Toxqui-Quitl, C.; Delgadillo-Herrera, M.; Padilla-Vivanco, A.; Ortega-Mendoza, J.G.; Carbone, A. Non-Binary Snow Index for Multi-Component Surfaces. *Remote Sens.* **2021**, *13*, 2777. <https://doi.org/10.3390/rs13142777>



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

5.-Nombre del artículo: **Fast computation of 3D Tchebichef moments for higher orders**

Autores: **J. Saúl Rivera-López*** · **César Camacho-Bello**** · **Horlando Vargas-Vargas*** · **Alicia Escamilla-Noriega*** (*Alumnos del Doctorado en Optomecatrónica, **Profesor de Tiempo Completo de la Maestría en Computación Óptica)

Revista: **Journal of Real-Time Image Processing**

Link: <https://doi.org/10.1007/s11554-021-01152-5>

<https://link.springer.com/article/10.1007%2Fs11554-021-01152-5>

Journal of Real-Time Image Processing
<https://doi.org/10.1007/s11554-021-01152-5>

ORIGINAL RESEARCH PAPER



Fast computation of 3D Tchebichef moments for higher orders

J. Saúl Rivera-Lopez¹ · César Camacho-Bello¹ · Horlando Vargas-Vargas¹ · Alicia Escamilla-Noriega¹

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Abstract

This article proposes a new method for the fast and efficient calculation of 3D Tchebichef moments, which are an essential tool for the characterization and analysis of 3D objects. This method integrates the Kronecker tensor product to the computation of 3D Tchebichef moments for higher orders with the advantage of being parallelizable. The experimental results clearly show the benefits and efficacy of the proposed method compared to existing methods.

Keywords 3D discrete orthogonal Tchebichef moments · Fast computation · 3D image reconstruction · High-order moments · Kronecker tensor product

1 Introduction

Discrete orthogonal moments have the characteristic of representing 2D and 3D images with minimal redundant information used in different applications for processing and analysis, such as image watermark [1–3], image compression [4–6], invariant characteristics in pattern recognition [7, 8], segmentation [9], noise analysis [10], restoration Image [11], face recognition [12], analysis of medical images [13], classification of images and objects [14, 15], texture analysis [16], reconstruction of images and objects [17], analysis of scenes and analysis of objects in 3D [18].

on this problem, some authors have proposed algorithms to minimize the computational cost. Among the most outstanding works is Hosny et al. [19], which presents an algorithm for calculating Legendre moments, using parallel multicore processors and GPUs. Mesbah et al. [20, 21], uses a fast and accurate algorithm based on matrix multiplication to extract local characteristics of 3D Krawtchouk moments. Karmouni et al. presents the fast and stable computation of Mexnier [22] and Charlier [23] 3D moments by using digital filters the Z transformation and dividing it into a set of fixed-size blocks that are processed moments separately. Also, they propose a fast and efficient method for calculat-



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

6.-*Nombre del artículo:* **Statistical Analysis of Speckle Patterns Modeled with Optic Studio®**

Autores: **Román Díaz Reyes***, **José A. Delgado Atencio****, **Margarita Cunill Rodríguez****, **Alejandra Cárdenas Rosales***, **Enrique González Gutiérrez*****

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Revista: **SPIE Optical Engineering + Applications,**

Link: doi:10.1117/12.2595173

<https://www.spiedigitallibrary.org/conference-proceedings-ofspie/11817/118170P/Statistical-analysis-of-speckle-patterns-modeledwithOpticStudio/10.1117/12.2595173.short?SSO=1>

Statistical Analysis of Speckle Patterns Modeled with OpticStudio®

Román Díaz Reyes^{*a}, José A. Delgado Atencio^a, Margarita Cunill Rodríguez^a, Alejandra Cárdenas Rosales^a, Enrique González Gutiérrez^a

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ABSTRACT

A coherent beam of incident light that impinges on a turbid medium or a rough surface, generates a characteristic interference pattern called "speckle". In this research work, was modeled the speckle pattern due to volumetric scattering within a turbid medium by using Monte Carlo simulations in OpticStudio® when the optical parameters (OP) of the medium were kept constant. A variable number of analysis rays from the light source was considered in order to evaluate the adequacy of the statistical distribution of intensities and its agreement to fully developed speckle (FDS) as predicted by the theory. In the non-sequential mode of OpticStudio®, it was implemented an optical setting of diffuse reflection geometry composed of: a coherent light source (Source Ellipse), a scattering volume (Rectangular Volume), and a detector (Rectangle Detector) with dimensions typical of a realistic sensor. The source was configured with a coherence length of 50×10^3 mm, a linear polarization along the x-axis ($J_x = 1$), and a diameter beam of 1 mm. The OP of the scattering volume were defined using the Henyey-Greenstein scattering model with the following parameters: mean path $MP = 0.1$ mm, transmission $T = 0.9$, and anisotropy factor $g = 0.95$. Detector settings were established as: dimension = 4.8×3.8 mm², resolution = 1328×1048 pixels, and Polarization Flag = 1. The study was performed for 2, 5, 10, 15, 20, 25, 30, 50, 75, 100 and 500 million analysis rays launched from the light source. The goodness of fit between simulated normalized histograms of intensity and the negative exponential probability density function of speckle patterns predicted by the theory was determined by using the software Minitab®. It was demonstrated that a good agreement between these previous mentioned quantities is achieved for the higher number of analysis rays. This study provides a guideline about a threshold number of analysis rays that should be used in OpticStudio® when simulations of coherent scattering in turbid media are performed. This study could also impact in different fields of speckle metrology by predicting results using OpticStudio® during the modeling specific optical configurations.



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

7.-Nombre del artículo: **Digital Marketing Strategies for the Survival of Micro-Businesses in Tulancingo de Bravo, Hidalgo, México**

Autores: **Claudia Vega Hernández^{1*}, Liliana de Jesús Gordillo Benavente^{**}, Juan Carlos Nery Guzmán^{***}**

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Revista: **Journal of Hunan University (Natural Sciences)**

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Open Access Article

Digital Marketing Strategies for the Survival of Micro-Businesses in Tulancingo de Bravo, Hidalgo, Mexico

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Abstract: Currently, technology has changed and has led each business to stay in the digital age. The advertising media have changed enormously. Previously the use of the press and TV were the most recurrent. This is how marketing has had to evolve along with this change so much that today digital marketing has become a valuable mechanism to improve the quality of life and access to goods and services to meet the population's needs. This research aims to design digital marketing strategies that contribute to the survival of microenterprises in Tulancingo de Bravo Hidalgo, Mexico, as the main tool for doing business. The scientific and technological impact is that the Internet has become the best way to carry a brand everywhere since it does not have territorial or cultural limits, unlike other media. The method used was with a quantitative approach, with a non-experimental, transactional correlational research design. What was sought was to see the relationship digital marketing strategies have with the survival of microenterprises in Tulancingo de Bravo Hidalgo, Mexico. Digital marketing has become one of the fundamental pillars of any business since it offers unbeatable advantages, ranging from basic advertising to improving sales. Large companies have made digital marketing one of their strategic axes, and for micro, small and medium-sized companies, it is essential that they also carry out digital marketing strategies to get ahead in the market, face competition, and it will last in time. For this research, the SPSS statistical package was used with the confirmatory factor analysis inference statistic, with the Principal Component Analysis technique, which allowed measuring the association between the digital marketing variables with survival. The main results showed that the digital marketing strategy plays an important role for survival among the strategies that can be cited: use of WhatsApp, Facebook, Instagram, email, profile on google, website, use of advertising videos, Facebook watch, Periscope, Servifast alliances, content generation, Google Ads.

Keywords: digital marketing, micro-business, small businesses, survival.



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

8.-Nombre del artículo: **A profile-based sentiment-aware approach for depression detection in social media**

Autores: **José de Jesús Titla-Tlatelpa, Rosa María Ortega-Mendoza^{2*}, Manuel Montes-y-Gómez and Luis Villaseñor-Pineda**

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Revista: **EPJ Data Science**

Link: <https://epjdatascience.springeropen.com/articles/10.1140/epjds/s13688-021-00309-3>

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Titla-Tlatelpa et al. *EPJ Data Science* (2021) 10:54
<https://doi.org/10.1140/epjds/s13688-021-00309-3>




 **EPJ Data Science**
a SpringerOpen Journal

REGULAR ARTICLE

Open Access

A profile-based sentiment-aware approach for depression detection in social media



José de Jesús Titla-Tlatelpa¹, Rosa María Ortega-Mendoza^{2*} , Manuel Montes-y-Gómez¹ and Luis Villaseñor-Pineda¹

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Abstract

Depression is a severe mental health problem. Due to its relevance, the development of computational tools for its detection has attracted increasing attention in recent years. In this context, several research works have addressed the problem using word-based approaches (e.g., a bag of words). This type of representation has shown to be useful, indicating that words act as linguistic markers of depression. However, we believe that in addition to words, their contexts contain implicitly valuable information that could be inferred and exploited to enhance the detection of signs of depression. Specifically, we explore the use of user's characteristics and the expressed sentiments in the messages as context insights. The main idea is that the words' discriminative value depends on the characteristics of the person who is writing and on the polarity of the messages where they occur. Hence, this paper introduces a new approach based on specializing the framework of classification to profiles of users (e.g., males or women) and considering the sentiments expressed in the messages through a new text representation that captures their polarity (e.g., positive or negative). The proposed approach was evaluated on benchmark datasets from social media; the results achieved are encouraging, since they outperform those of state-of-the-art corresponding to computationally more expensive methods.

Keywords: Depression detection; Author profiling; Sentiment analysis



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Informe Anual de Actividades

9.-Nombre del artículo: **Revealing traces of depression through personal statements analysis in social media**

Autores: **Rosa María Ortega-Mendoza***, **Delia Irazú Hernández-Farías ****, **Manuel Montes-y-Gómez****, **Luis Villaseñor-Pineda****.

(*Profesores de Tiempo Completo del Doctorado en Optomecatrónica, Universidad Politécnica de Tulancingo, Hgo. México, **Profesores de Tiempo Completo del Instituto Nacional de Astrofísica, Óptica y Electrónica (INAOE),)

Revista: ScienceDirect

Link:

<https://www.sciencedirect.com/science/article/pii/S0933365721001950?via%3Dihub>

<https://doi.org/10.1016/j.artmed.2021.102202>

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Revealing traces of depression through personal statements analysis in social media

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ARTICLE INFO

Keywords:

Depression detection
Personal information
Personal pronouns
DPP-EXPEI

ABSTRACT

Depression is a common and very important health issue with serious effects in the daily life of people. Recently, several researchers have explored the analysis of user-generated data in social media to detect and diagnose signs of this mental disorder in individuals. In this regard, we tackled the depression detection task in social media considering the idea that terms located in phrases exposing personal statements (i.e., phrases characterized by the use of singular first person pronouns) have a special value for revealing signs of depression. First, we assessed the value of the personal statements for depression detection in social media. Second, we adapted an automatic approach that emphasizes the personal statements by means of a feature selection method and a term weighting scheme. Finally, we addressed the task in hand as an early detection problem, where the aim is to detect traces of depression with as much anticipation as possible. For evaluating these ideas, benchmark Reddit data for depression detection was used. The obtained results indicate that the personal statements have high relevance for revealing traces of depression. Furthermore, the results on early scenarios demonstrated that the proposed approach achieves high competitiveness compared with state-of-the-art methods, while maintaining its simplicity and interpretability.



Universidad Politécnica de Tulancingo

Informe Anual de Actividades

10.-Nombre del artículo: Highly Discriminative Physiological Parameters for Thermal Pattern Classification

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Article

Highly Discriminative Physiological Parameters for Thermal Pattern Classification

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Abstract: Infrared Thermography (IRT) is a non-contact, non-intrusive, and non-ionizing radiation tool used for detecting breast lesions. This paper analyzes the surface temperature distribution (STD) on an optimal Region of Interest (RoI) for extraction of suitable internal heat source parameters. The physiological parameters are estimated through the inverse solution of the bio-heat equation and the STD of suspicious areas related to the hottest spots of the RoI. To reach these values, the STD is analyzed by means the Depth-Intensity-Radius (D-I-R) measurement model and the fitting method of Lorentz curve. A highly discriminative pattern vector composed of the extracted physiological parameters is proposed to classify normal and abnormal breast thermograms. A well-defined RoI is delimited at a radial distance, determined by the Support Vector Machines (SVM). Nevertheless, this distance is less than or equal to 1.8 cm due to the maximum temperature location close to the boundary image. The methodology is applied to 87 breast thermograms that belong to the Database for Mastology Research with Infrared Image (DMR-IR). This methodology does not apply any image enhancements or normalization of input data. At an optimal position, the three-dimensional scattergrams show a correct separation between normal and abnormal thermograms. In other cases, the feature vectors are highly correlated. According to our experimental results, the proposed pattern vector extracted at optimal position $d = 1.6$ cm reaches the highest sensitivity, specificity, and accuracy. Even more, the proposed technique utilizes a reduced number of physiological parameters to obtain a Correct Rate Classification (CRC) of 100%. The precision assessment confirms the performance superiority of the proposed method compared with other techniques for the breast thermogram classification of the DMR-IR.

Keywords: breast thermography; heat source parameters; feature extraction; infrared imaging; D-I-R model



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