Universidad Politécnica de Tulancingo

Informe Trimestral de Actividades

Dirección de Investigación y Posgrado

Trimestre	julio-septiembre	**Fecha**	20 de septiembre de 2021

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 trimestral de productos de investigación científica y tecnológica realizados generado y ubicado en la Dirección de Investigación y Posgrado adscrito a la Secretaria Académica de la Universidad Politécnica de Tulancingo.		

Metas Trimestrales			
Programada	3	Alcanzada	3

Descripción de Actividades

En el periodo Julio - Septiembre 2021 se programaron 3 metas, que derivan en 3 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: **Non-Binary Snow Index for Multi-Component Surfaces**

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

3.-Nombre del articulo: **Statistical analysis of speckle patterns modeled with OpticStudio®**

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Desarrollo de Actividades y Evidencia Fotográfica

En el periodo Julio – Septiembre 2021 se programaron 3 metas, que derivan en 3 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*: **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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remote sensing MDPI

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), NDSII-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; NDSII-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

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2.-*Nombre del articulo*: **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)

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ORIGINAL RESEARCH PAPER

Fast computation of 3D Tchebichef moments for higher orders

J. Saúl Rivera-Lopez[1] · César Camacho-Bello[1] · Horlando Vargas-Vargas[1] · Alicia Escamilla-Noriega[1]

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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-

3.-*Nombre del artículo*: **Statistical Analysis of Speckle Patterns Modeled with OpticStudio®**

Autores: Román Díaz Reyes*, José A. Delgado Atencio**, Margarita Cunill Rodríguez**, Alejandra Cárdenas Rosales*, Enrique González Gutiérrez*** (*Alumnos del Doctorado en Optomecatrónica, **Profesores de Tiempo Completo la Maestría en Computación Óptica, ***Profesor de Tiempo Completo de la División de Ingenierías de la Universidad Politécnica de Tulancingo.)

Revista: SPIE Optical Engineering + Applications,

Link: doi:10.1117/12.2595173

https://www.spiedigitallibrary.org/conference-proceedings-of-spie/11817/118170P/Statistical-analysis-of-speckle-patterns-modeled-withOpticStudio/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]

[a]Laboratorio de Óptica Biomédica, Universidad Politécnica de Tulancingo; Ingenierías 100 Huapalcalco 43629, Tulancingo de Bravo, Hidalgo, México.

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 $50x10^{3}$ mm, a linear polarization along the x-axis (Jx =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= 4.8x3.8 mm^2, resolution= 1328x1048 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.

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Elaboró	Autorizó
	
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