

**TARJETA INFORMATIVA**

PARA	Dr. Alfonso Padilla Vivanco Secretario Académico de la UPT
DE	Dr. José Humberto Arroyo Núñez Director de Investigación y Posgrado
ASUNTO	Conclusión de Proyecto
FECHA	11 enero 2021

Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

**"In-vivo measurement of the fluorescence spectrum of wild cochineal
(*Dactylopius opuntiae*) "**

El resultado de este trabajo, ha sido publicado en una revista de alto impacto.

Se anexa al presente documento la evidencia de la publicación.

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ATENTAMENTE





OPEN In-vivo measurement of the fluorescence spectrum of wild cochineal (*Dactylopius opuntiae*)

Alejandra Cárdenas Rosales[✉], José Alberto Delgado Atencio, Margarita Cunill Rodríguez & Enrique González Gutiérrez

It is known that the harmful presence of the wild cochineal (*Dactylopius opuntiae*), unlike the fine cochineal (*Dactylopius coccus*), in prickly pear crops of farmers leads to consider it as one of the major pests for this crop. In this study, we present the implementation of an optical setup that ensures the measurement of the in-vivo fluorescence spectra of wild cochineals ranging in size from 440 to 1190 μm in their natural habitat achieved by developing a reproduction model adopted from available literature. It was observed that in-vivo fluorescence spectra of these insects were comprised in the spectral region of 570–760 nm, showing a proportional dependence between the fluorescence intensity emitted and the cochineal size. In addition, we have considered other spectral parameters to perform the comparison between fluorescence spectra of the different cochineal size. These results provide the basis for the development of novel methodologies and equipment aimed towards the early detection of this pest in prickly pear crops from its early growth stages (nymph and II).

The cochineal is an insect that feeds off the prickly pear cactus and from which a red pigment known as carmine is extracted whose use dates back to prehistoric times^{1,2}. It is known that the quality of the dye produced by this insect depends on if it is from the fine cochineal or the wild one. The fine cochineal, *Dactylopius coccus*, is distinguished by an external white dusty coating called *coccerin*³ while wild cochineal, *Dactylopius opuntiae*, shows an external cottony white cover^{4,5}. In contrast with fine cochineal, the wild cochineal does not have a high economic value in food, textile, cosmetics and pharmaceutical industries. On the other hand, its presence in prickly pear and edible cactus farming leads to negative effects to such an extent that it is considered as one of the main insect pests attacking prickly pear crops in several areas of Mexico and other countries^{6–11}. Specifically, problematic are the females, who from their first instar, also known as "crawler", they move on the surface of the plant looking for fresh cladodes to feed. Once the crawler introduces its buccal apparatus into the plant tissue, it will not move again, constantly sucking the sap from the cladode¹², bringing as a consequence the premature fall of cladodes and fruits before their maturation and eventually the death of the plant^{6–10,13,14}.

In general, the farmers notice that their crops are infected by this pest when the cochineal is able to be observed with the naked eye, having at that moment a size of 3.4 mm long by 2.1 mm wide approximately, which according to the study of Rodrigo et al.¹⁵ is when the insect reaches adulthood. The latter means that at this time the cochineal has already fed, reproduced and deposited eggs on the crop; as a result, it is too late for its control, thus favoring the spread of the pest. Therefore, given the high resolution of optical methods and their intrinsic diversity, they might be excellent candidates for the early and efficient detection of the wild cochineal in cactus crops, thus contributing to timely pest monitoring with the consequent reduction of pesticides and other materials that are currently used in the control and treatment of pests and their effects.

Carminic acid¹⁶, which is the main chemical component of carmine, has been widely studied by means of optical spectroscopy for chemical applications^{17–20}. This component was used in these investigations from commercial products available from companies such as Sigma Aldrich and was always diluted in solvents such as water, methanol, boron and hydrochloric acid. In these studies, research on different issues of the fluorescence of this compound is reported.

However, carminic acid is found also naturally within the cochineal as a part of the hemolymph of this insect^{1,16,21}. Its concentration has been studied depending on different factors. For example, Rodríguez et al.²²

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Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

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ATENTAMENTE



Communication

Monitoring the Growth of a Microbubble Generated Photothermally onto an Optical Fiber by Means Fabry–Perot Interferometry

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Abstract: In the present paper, we show the experimental measurement of the growth of a microbubble created on the tip of a single mode optical fiber, in which zinc nanoparticles were photodeposited on its core by using a single laser source to carry out both the generation of the microbubble by photothermal effect and the monitoring of the microbubble diameter. The photodeposition technique, as well as the formation of the microbubble, was carried out by using a single-mode pigtailed laser diode with emission at a wavelength of 658 nm. The microbubble's growth was analyzed in the time domain by the analysis of the Fabry–Perot cavity, whose diameter was calculated with the number of interference fringes visualized in an oscilloscope. The results obtained with this technique were compared with images obtained from a CCD camera, in order to verify the diameter of the microbubble. Therefore, by counting the interference fringes, it was possible to quantify the temporal evolution of the microbubble. As a practical demonstration, we proposed a vibrometer sensor using microbubbles with sizes of 83 and 175 μm as a Fabry–Perot cavity; through the time period of a full oscillation cycle of an interferogram observed in the oscilloscope, it was possible to know the frequency vibration (500 and 1500 Hz) for a cuvette where the microbubble was created.

Keywords: microbubble; Fabry–Perot; optical fiber; cavity; vibrometer

1. Introduction

Fabry–Perot sensing devices have been widely used in several applications, such as hyperspectral images [1], autocorrelation of ultra-short pulse signals [2], medical applications [3], and biosensors [4,5], among others. Fabry–Perot (FP) sensors based on optical fibers offer advantages over electronic sensors; for example, they are safe, free from electromagnetic interference, compact [6–8], and have a high sensitivity [9–11]. Nowadays, interferometric optical fiber sensors have attracted broad interest for their applications in sensing temperature, refractive index, strain measurement, pressure, acoustic waves, vibration, magnetic field, and voltage. Most of them are studied by generating a microbubble on the tip of an optical fiber, which is considered to be a resonant cavity formed by the vapor–liquid interface and the fiber tip [12–17].

Recently, Chen-Li Zhang et al. [18,19] reported the generation of two kinds of optical fiber Fabry–Perot sensors by using a gas microbubble to measure temperature and sucrose concentration. In the first sensor [18], a gold nanofilm was deposited on the tip of the optical fiber, which was submerged in water (absorption coefficient of 10.9 cm^{-1}) in order to generate a microbubble, using a laser source at 1550 nm. However, an optical power greater than 50 mW was necessary in order to induce the microbubble and implement the

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ATENTAMENTE



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 stockticker PLL, SPL, 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, SPL, disturbio de fase, envoltura, transformada rápida de Fourier (FFT), error de fase

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Introduction

Many problems and technical challenges still need to be addressed for the successful interconnection of generation systems. While using renewable energy (RES) with the electrical grid, the biggest challenge is the synchronization of the power inverter (DC/AC); the form of the generated voltage wave generated must be similar to that of the electrical grid, in order to guarantee continuous and stable operation (Jaalam, Rahim, Bakar, Tan, and Haidar, 2016). The phase angle of the utility voltage vector is basic information that allows increasing the number of power conditioning equipment connected to the utility grid, such as AC/DC converters (Arruda, Silva, and Filho, 2001).

The synchrony of the generated electricity is an adaptive process in which an internal reference signal formed by a control algorithm allows the output signal of the power inverter to operate synchronically with the fundamental component of the grid voltage. Jain, Jain, S., and Nema (2015) suggest that ideal synchrony occurs when the phase angle of the electrical grid is precisely followed, efficiently detecting disturbances and high harmonic components, and

responding quickly to changes. However, the phase angle may experience smooth or abrupt changes due to system conditions such as faults (Karimi, Khajehoddin, Jain, and Bakhshai, 2012).

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Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

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ATENTAMENTE



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

Fault diagnosis is important for industrial processes because it permits to determine the necessity of emergency stops in a process and/or to propose a maintenance plan. Two strategies for fault diagnosis are compared in this work. On the one hand, the data are preprocessed using the independent components analysis for dimension reduction, then the wavelet transform is used in order to highlight the faulty signals, with this information an artificial neural network was fed. On the other hand, the second strategy, the main contribution of this work, is the implementation of a long short term memory. This memory is fed with the most representative variables selected by an elastic net to use both, the L_1 and L_2 norms. These strategies are applied in the Tennessee Eastman process, a benchmark widely used for fault diagnosis. The fault isolation had better results than those reported in the literature.

Keywords: Fault diagnosis, Wavelet transform, Recurrent neural networks, Independent component analysis, Elastic net.

1. Introducción

El diagnóstico de fallas, comúnmente conocido como FDI por sus siglas en inglés (Zhang et al., 2002), consta de dos partes: (i) detección de fallas y (ii) aislamiento de fallas. La detección de fallas consiste en notar que un mal funcionamiento

to ha ocurrido (Salahshoor et al., 2011). Por su parte, el aislamiento de fallas, también conocido como clasificación de fallas (Sobhani-Tehrani and Khorasani, 2009) o localización de fallas (Barakat et al., 2014), consiste en reconocer cuál fue la falla que ocurrió entre varias fallas posibles (Jing et al., 2014).

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Por medio del presente documento le informo que el proyecto de investigación que lleva por título:

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

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ATENTAMENTE



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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ATENTAMENTE



Estrategias Organizacionales para Incrementar la Eficiencia Terminal en la Universidad Politécnica de Tulancingo

Maria del Rosario López Torres¹, Juan Carlos Lara Arroyo²,
César Ángel López Torres³ y Julieta Ocádiz García⁴

Resumen— La Eficiencia Terminal (ET), se encuentra relacionada con la reprobación y deserción. Lo que tiene impacto en el rendimiento del estudiante, y aunado a esto, es importante que para medir la eficiencia terminal se considere la duración promedio de los egresados y desertores con indicadores del gasto educativo, lo cual repercute en forma significativa en las Instituciones Educativas de nivel Superior (IES). Pues un problema común en las Universidades Públicas, lo constituye la baja eficiencia terminal (BET); esta situación compromete a las IES, a buscar alternativas para poder subsanar el problema. En este artículo se presentan los resultados de una investigación cuyo objetivo es Proponer estrategias organizacionales para identificar, medir y relacionar los factores sociales, personales e institucionales, que sirvan como herramienta para incrementar la eficiencia terminal de la División Económico Administrativas de la Universidad Politécnica de Tulancingo. Para el desarrollo de este trabajo se tomó una muestra de 1173 estudiantes de las carreras de Administración y Gestión Empresarial y Negocios Internacionales. Se pudo comprobar que existen diferentes factores que influyen en la Eficiencia Terminal, entre los cuales se encuentran los Factores Sociales, Factores Personales, Factores Institucionales, Eficiencia Terminal, estrategias Organizacionales.

Palabras clave— Factores Sociales, Factores Personales, Factores Institucionales, Eficiencia Terminal, estrategias Organizacionales.

Introducción

Las organizaciones son entidades sociales que están dirigidas por personas debidamente capacitadas para el cumplimiento de metas, interactúan con clientes, proveedores, competidores, y están vinculadas con el entorno. Sin embargo, en la actualidad la mayoría de las organizaciones continúan realizando procesos de transformación de acuerdo a modelos previamente elegidos. Por mucho tiempo los directivos han examinado nuevas formas de llevar a cabo estos procesos con el objeto de implementar estrategias que toda la organización conozca, fomentando así el compromiso de las personas y tener una visión compartida (Senge, Ross, Smith, Roberts & Kellner, 2004).

En este sentido Gujarró y Chávez (2006), señalan que las instituciones educativas deben modificar sus esquemas con la finalidad de alcanzar calidad, eficiencia y eficacia. Como en la Universidad de Murcia, la Universidad de Cantabria, el Instituto Tecnológico del Textil de la Comunidad Valenciana, la Universidad Politécnica de Cataluña y la Universidad Politécnica de Valencia donde se encontró que era necesaria la implementación de estrategias organizacionales, debido a que el objetivo ya no es la eficacia social de la educación superior, sino la eficiencia interna de la institución frente a las demandas externas (Chiavenato, 1995); pues la educación de buena calidad engrandece a un país y es la base firme del crecimiento sustentable, es un derecho fundamental para la formación profesional y personal de un individuo, y forja beneficios para el desarrollo social, económico y sustentable de los países. Quien no cuenta con la educación está completamente excluido de todas las instituciones sociales, culturales, políticas y económicas (Espinoza, Castillo, González & Loyola, 2012).

En la actualidad es difícil acceder a un puesto de trabajo bien remunerado, por lo que cada vez más personas aspiran a tener una formación profesional adecuada. Esto, según Janosz (2000), es un indicador de calidad que involucra varios factores, los cuales se ven reflejados en la eficiencia terminal (ET), del estudiante, entendiéndose esta por la proporción de estudiantes que se gradúa en el tiempo estipulado en el plan de estudios (UNESCO, 2007). La ET expresa la efectividad y calidad educativa del proceso de enseñanza-aprendizaje de una institución de educación

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TARJETA INFORMATIVA

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"Some aspects of fractional-order circular moments for image analysis "

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ATENTAMENTE





Some aspects of fractional-order circular moments for image analysis

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ABSTRACT

In this paper, we briefly review the fractional-order circular moments, such as fractional-order Zernike moments, fractional-order Fourier-Mellin moments, fractional-order Legendre-Fourier moments, and fractional-order Chebyshev-Fourier moments, which can characterize, analyze, and manipulate the information contained in an image with minimal redundancy. Also, they depend on an α parameter for better feature extraction. Therefore, we propose a procedure to find the optimal α in terms of image reconstruction error and classification. We validate the search for the best rotation-invariant features using the MNIST and MNIST-R datasets. Finally, we present the study results and conclusions.

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1. Introduction

Orthogonal circular moments defined in a unit radius in polar coordinates are normally used as image descriptors or features. They can concentrate and characterize the information contained in an image without redundancy, enabling its analysis and manipulation. This feature has been extensively used in different fields, such as image analysis, pattern recognition, and machine vision applications [7]. Circular moments are naturally invariant to rotation and have demonstrated their ability to classify rotated objects. Currently, there are different types of circular moments, such as Legendre-Fourier moments [31], Zernike moments [27], Pseudo-Zernike moments [28], Fourier-Mellin moments [26] and Jacobi-Fourier moments [19]. All these are obtained by projecting the image on the polynomials of the same name to which an oscillatory angular part has been added. The evaluation of the polynomials is accurately and efficiently performed through recursive methods. The classical circular moments are limited to integer orders. Xiao

et al. [29] propose a generalization of the radial shifted Legendre moments by introducing the fractional-order modifying the orthogonality condition. From the proposed approach, different families of moments can be generalized, such as the fractional-order Fourier-Mellin Moments [32], and the fractional-order Zernike moments [14]. The fractional-order circular polynomials have the characteristic of generating fractional orders with the relationship $\alpha(n+1) - 1$ where $\alpha \in \mathbb{R}^+$ and n is the order of the set of base moments. Moreover, the results show that the fractional-order circular moments perform better than the classical moments, which are obtained with the particular case of $\alpha = 1$.

On the other hand, there are other generalizations to fractional order, such as the fractional-order Legendre-Fourier [9], the fractional-order polar harmonic transforms [11], the fractional-order Jacobi-Fourier Moments [10], and the fractional-order Gegenbauer Moments [12]. The most relevant aspect of the fractional-order circular moments is the choice of α . Theoretically, any value of α can form a set of orthogonal polynomials. However, some α values may limit their descriptive ability. From another perspective, α value is related to the zero position of the polynomials, which can contribute to improving the descriptive capability.

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ATENTAMENTE





Inverse fuzzy fault model for fault detection and isolation with least angle regression for variable selection

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ABSTRACT

Fault detection is paramount in industrial processes because expensive reparations can be avoided, and the normal flow of operations is not disrupted. However, it is difficult to use a model-based method for fault detection in complex systems. Thus, a data-driven approach is implemented in the Tennessee Eastman process for fault detection and isolation (FDI). As a contribution, this paper proposes an inverse fuzzy fault model to detect and isolate faults. To reduce the amount of data to process, the least angle regression is applied for variable selection. To compare the detection and isolation times obtained using the fuzzy fault model, a fuzzy classifier is described; where the signals are preprocessed with the wavelet transform to highlight the faulty signals. The inverse fuzzy fault model has only four fuzzy rules and shows a smaller isolation time than the required using the fuzzy classifier.

1. Introduction

Fault detection is the awareness regarding the occurrence of a problem in an industrial process. Moreover, to know precisely which fault has appeared is a pivotal task called fault isolation. Hence, fault detection and isolation (FDI) is also referred to as fault diagnosis (Sharma & Dewan, 2015).

To perform FDI two broad approaches are followed: (i) the obtainment of an analytical model (Armeni, Casavola, & Mosca, 2016) and (ii) the use of data-driven methods (Li, Qin, & Yuan, 2016). An analytical model is synthesized mainly through differential equations, but for complex systems, it is difficult to get an analytical model. Fortunately, on the other hand, data-driven methods use the data history for fault diagnosis; they include, but are not limited to, artificial neural networks (ANN) (Faki, Erkaya, Savas, & Yildirim, 2011; Llang et al., 2019), fuzzy logic (Mendoza, Sousa, & SaDaCosta, 2009) or a neuro-fuzzy system (Calado, Mendes, SaDaCosta, & Korbicz, 2002; Salahshoor, Khoshroo, & Kordestani, 2011; Subbaraj & Kannapiran, 2014).

The main idea of the analytical approach is to compute the difference between the real output and the signal computed by the approached

model, this difference is called the residual signal (Methmani, Lafont, Gautier, Damak, & Youni, 2013). If the residual is not zero, the presence of anomalous behavior can be inferred (Zhang, Polyrarpon, & Parisini, 2002). Further, the presence of noise in the output signals can produce false alarms. Therefore, an adaptive threshold can be used to monitor the residuals to avoid false alarms (Alkaya & Eker, 2011). However, the approximated model can be difficult to propose because of the complexity of large-scale industrial processes as Yin, Ding, Haghani, Hao, and Zhang (2012) mentioned in their conclusions.

When an analytical model cannot be obtained, data-driven methods are a solid alternative to detect faults (He et al., 2020). Two main categories exist: (i) based on statistics and (ii) machine learning algorithms. A comparison of statistical methods for fault detection was presented by Yin et al. (2012), where the average fault detection rate was between 73.8% and 84.4% in the faults simulated on the Tennessee Eastman (TE) process, a benchmark widely used to implement algorithms for FDI (Kuang, Yang, & Yao, 2015; Li, Alcalá, Qin, & Zhou, 2011; Stubbs, Zhang, & Morris, 2012). And the methods compared were the Principal Component Analysis, Partial Least Squares, Independent Component Analysis, Fisher Discriminant Analysis, and the Subspace Aided

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