Encabezado General	A. Nombre del Formato:				
UTT TULANCINGO UNIVERSIDAD TECNOLÓGICA DE TULANCINGO Organismo Descentralizado de la Administración Pública Estatal	**SOLICITUD DE RECURSOS ECONOMICOS**				
F-22-01-R1;210817	B: Código/Revisión;Fecha:	F-19-04-R1;210817			
Datos de los Registros (evidencia):	C. Página	1	de	1	
D. Fecha de elaboración:	23/09/2019	E. Periodo al que aplica:	2019		

1. **FOLIO:** 1662

DATOS GENERALES Federal 2019

618-A

2. PROYECTO: 31 3. PARTIDA: 36201 4. REQUISICION NO.
5. SOLICITANTE: **L.A.E. MARICELA SANTUARIO ORTIZ**
6. ÁREA SOLICITANTE: **RECURSOS MATERIALES Y SERV. GENERALAES**
7. PUESTO: **JEFA DE DEPARTAMENTO**
8. CONTRATO O PEDIDO No. **N/A POR NO REBASAR LAS 300 VECES EL SMVDF**
(JUSTIFIQUE EN CASO DE NO INCLUIRLO)

9. **SOLICITUD DE**

VIÁTICOS		PAGO A PROVEEDORES	
GASTOS A COMPROBAR		REPOSICION DE GASTOS	X
REEMB. DE FONDO REV.		BECAS	

(ANEXO F-16-0XX)

10. IMPORTE SOLICITADO: $ 684.40
11. CON LETRA: (Seiscientos ochenta y cuatro pesos 40/100 M.N.)
12. CONCEPTO: Reposición de gastos por impresión de poster en tela de alta calidad.

DEPTO DE CONTABILIDAD
PAGO
PROCESADO

OBSERVACIONES

FORMA DE PAGO

CHEQUE
13. A NOMBRE DE
14. CHEQUE PARA EL DIA:
15. DOCUMENTO COMPROBATORIO: *FACTURA [ ] *RECIBO [ ]

TRASFERENCIA
16. NOMBRE DE Noel Ivan Toto Arellano
0126 5001 2700 9374 27 FAVOR DE VERIFICAR EL NÚM. EN HOJA ANEXA
18. NOMBRE DEL BANCO: Bancomer
19. TRASFERENCIA PARA EL DIA: 24/09/2019
20. DOCUMENTO COMPROBATOR *FACTURA [ ] *RECIBO [ ]

21. **FIRMAS**

ENCARGADA DE ADMINISTRACIÓN Y FINANZAS	RECTORIA
SOLICITO	Vo. Bo.	AUTORIZÓ
L.A.E. MARICELA SANTUARIO ORTIZ	M.A. ORIS ESTELA VARGAS GARCÍA	MTRO. JOSÉ ANTONIO ZAMORA GUIDO

C890 CG180 C01539

24 Sep 2019

PC Plot Impresión Digital

FACTURA : F480

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TIPO COMPROBANTE: INGRESO (I)

EMISOR:
VIRGINIA MORALES MIRANDA
RFC: MOMV801019BD4

RECEPTOR:
UNIVERSIDAD TECNOLOGICA DE TULANCINGO
RFC: UTT9507201EZ
USO CFDI: G03

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IMPORTE $	590.00
IVA (16%)	$94.40
TOTAL $	684.40 MXN

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ESTE DOCUMENTO ES UNA REPRESENTACIÓN IMPRESA DE UN CFDI EFECTOS FISCALES AL PAGO

ULANCINGO
SELLO DE RESPONSABILIDAD

MTRO. JOSÉ ANTONIO ZAMORA GUIDO
RECTOR UNIVERSIDAD TECNOLÓGICA DE TULANCINGO

Misdoctos · 2019 · FE · Pc Lot · 480

RIAO-OPTILAS-MOPM 2019

MACH-ZEHNDER INTERFEROMETER COUPLED TO A MICHELSON CONFIGURATION AND A CUBE BEAM SPLITTER SYSTEM FOR APPLICATIONS IN SINGLE SHOT PHASE SHIFTING INTERFEROMETRY

G. Reséndiz López,[1] A. Montes Pérez [2], J. G. Ortega-Mendoza,[3] J. M. Islas Islas,[1] A. Guzmán Barraza,[3] V. H. Flores-Muñoz,[4] and B. Canales-Pacheco, [5] N. I. Toto-Arellano.[1,*]

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UNIVERSIDAD TECNOLÓGICA DE TULANCINGO

"When you're a kid, they tell you it's all... Grow up, get a job, get married, get a house, have a kid, and that's it. But the truth is, the world is so much stranger than that. It's so much darker. And so much madder. And so much better."

INTRODUCTION

Several industrial sectors and research fields have been incorporating optical and photonic technologies for quality inspection metrics. Therefore, it is important to develop novel techniques and devices capable of high precision measurements without contact and applied to transparent samples [1-2]. These techniques conventionally generate phase shifts in stages by means of a piezoelectric transducer, diffractive elements or actuators having the limitation of being applied on static samples. Some researchers and companies have developed techniques of simultaneous phase shift based on the use of diffractive elements and micro-polarizer ar t generate several interferograms acquired by a single-shot[3-5]. Ir ork, simultaneous phase shifting interferometers have been c d to study transparent samples. The systems generate four patterns, captured in one shot, recovering the optical phase by means of the well-known four step algorithm.

EXPERIMENTAL SETUP

The proposed system consists of three coupled systems: A polarized Mach-Zehnder interferometer (PMZI) which generates a primary pattern with crossed polarizations, coupled to a Michelson Interferometer (MI) and a Beam Splitter system (BSS) that works as a replicator of the primary pattern.

In Figure 1, we show the implemented system. As mentioned above is composed by three-interferometric configurations: a Mach Zehnder Interferometer (MZI) for the phase detection, coupled with a MI configuration and BSS which replicates the output interferogram obtained in the MZI.

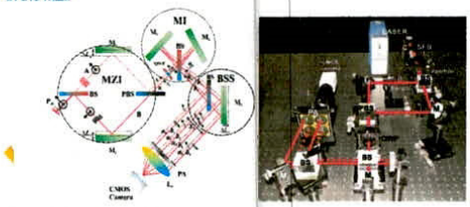

Figure 1. Scheme of the experimental set-up. MZI: Mach-Zehnder Interferometer. SFS: Spatial filtering system. L0: Collimating Lens. P: Polarizer filters. M: Mirrors. Q: Quarter Wave Plate. PBS: Polarizing Beam Splitter. BS: Beam Splitter. A: Reference beam. B: Sample Beam. PA: Polarizer Array. IL: Zoom lens, 10x (13 - 130 mm FL). CMOS: Camera.

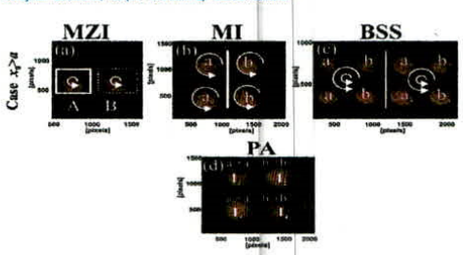

Figure 2. Stages of the replication system.

Figure 2 shows the emerging pattern sequentially, Fig. 2(a) shows the pattern that emerges from the MZI, if A and B beams are superimposed, due to their mutual orthogonal polarization states, no interferogram can be detected at this stage. Figure 2 (b) and 2 (c) shows the replication beams obtained by the coupled system and 2 (d) the interference patterns are shown.

METHODS

The interferometric system is based on polarization phase shifting techniques where a controllable phase shift is introduced on each detected interferogram by using linear polarizers [3-4]. Represented by the Jones calculation, the fields obtained by the reference and object beams in the system are described by $J_{\omega} = \frac{I}{\sqrt{2}}\begin{pmatrix}1\\ i\end{pmatrix}$ and, $J_{\omega} = \frac{I}{\sqrt{2}}\begin{pmatrix}1\\ -i\end{pmatrix}e^{i\phi(x,y)}$ representing left and right circular polarization states. The phase data map term, $\varphi(x,y)$, represents the information to retrieve in a single capture of the object under study. When each field passes through a linear polarizing filter and we superimpose them, the result is an interference pattern modulated by the angle ψ of the transmission axis of the linear polarizer [5].

The four interferograms are acquired in a single shot and recorded under the same conditions. Using these values, the intensities at each point in images 1 to 4 are:

$$I_1(x,y) = A - B\cos[\phi(x,y)] \quad , \quad I_2(x,y) = A - B\sin[\phi(x,y)]$$
$$I_3(x,y) = A + B\cos[\phi(x,y)] \quad , \quad I_4(x,y) = A + B\sin[\phi(x,y)] \qquad (1)$$

Although the terms A_0 and A_1 for the interferograms are equal, a normalization process was applied to the fringe patterns to avoid possible errors introduced by small intensity variations generated by the beam splitters. The phase information of the sample can be calculated as [6-7],

$$\phi(x,y) = \tan^{-1}\left[\frac{I_4(x,y) - I_2(x,y)}{I_3(x,y) - I_1(x,y)}\right] \qquad (2)$$

Figure 3 shows the intensity variation obtained (without sample) by capturing 100 frames at 10 fps, with a temperature variation interval of $\Delta t \approx 0.2\ ^{\circ}$ C. Figure 3(a) shows the four-phase shifted interferograms obtained in a single shot, the average in time obtained for each pixel (interferogram enclosed at a circle) Fig 3(b) and the corresponding standard deviation Fig. 3(c). Figure 3(d) shows the intensity variation of the central pixel of the enclosed interferogram at fig. 3(a). The average intensity obtained corresponds to 6.144 with a standard deviation of 3.042 in a 256 gray levels depth range capture. This result shows that the intensity variations are stable to environmental noise.

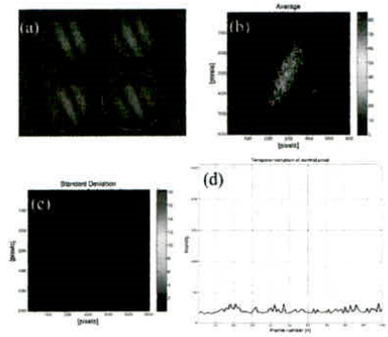

Figure 3. Intensity variation of representative interferogram.(a) Four simultaneous patterns. (b) Temporal average obtained. (c) Standard deviation by each pixel. (d) One-pixel variation. Average.

In this case, the vibrations mainly affects the interference generated by the Mach Zehnder interferometer due to the phase detection properties. In the case where vibration occurs on the replication system (Michelson configurations), the interference pattern registration will be affected, and re-alignment procedures need to be done.

RESULTS

The optical system uses a He-Ne laser operating at 632 nm and a CMOS camera, with a resolution of 2048 x 1536 pixels. Figure 4 shows a reference wavefront. The experimental samples used are shown in Fig. 5. Figure 6 shows experimental results for a pseudoscorpion specimen legs. The region of interest corresponds to the legs of the ventral region, since this is one way of partially identifying the order of the species. Figure 7 shows the (OPD) induced by a group of Red Blood Cells (RBC), where morphology is serves as a very important parameter in the biomedical field to diagnose diseases[8-9]. In order to demonstrate the advantages of the proposed system, Fig. 8 is shows a representative set of frames of a dynamic phase object corresponding to a deformation of an acetate sheet under tension.

The experiment result shows that the method is proven to be capable of performing one-shot interferometric measurement

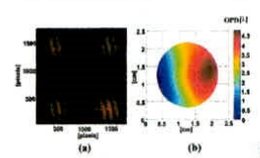

Figure 4. Reference wavefront. (a) Four simultaneous interference patterns. (b) OPD.

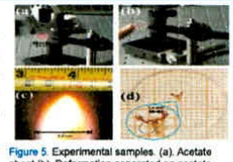

Figure 5. Experimental samples. (a). Acetate sheet (b). Deformation generated on acetate sheet (c). Flame of a bunsen burne. (d) Pseudoscorpion.

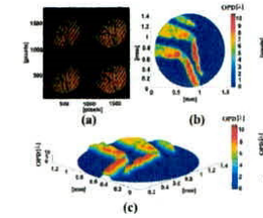

Figure 6. Pseudoscorpion legs.(a) Four simultaneous interference patterns. (b)-(c) OPD.

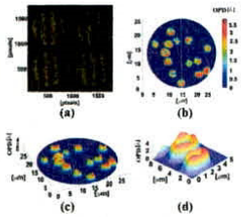

Figure 7. Red Blood Cells. Mean thickness: OPD/Δn = 2.8 µm. Diameter is 7mm . (a) Four simultaneous interference patterns. (b)-(c) OPD. (d) OPD of two RBC

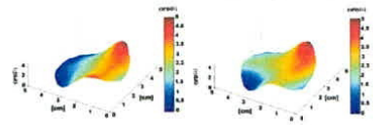

Figure 8. Dynamic phase object. Deformation of the surface of an acetate sheet under tension. Representative frames

CONCLUSIONS

We report a simultaneous phase shifting technique based in a Mach-Zehnder interferometer (MZI) and two replicating systems integrated by a Michelson interferometer and a cube beam splitter. The complete implementation can generate four interference patterns with independent phase shifts. The development of these devices is of great interest in several areas such as biomedical engineering or for industrial purposes, allowing measurements of phase objects in a non-invasive way.

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Encabezado General	A. Nombre del Formato:				
UNIVERSIDAD TECNOLÓGICA DE TULANCINGO Organismo Descentralizado de la Administración Pública Estatal	**REQUISICION DE BIENES Y SERVICIOS**				
F-22-01-R1;210817	B. Código/Revisión; Fecha:		F-16-09-R5;270319		
	Datos para los Registros (Evidencia):	C. Pagin	1	de	1
D. Fecha de elaboración:	viernes, 13 de diciembre de 2019	E. Periodo al que se aplica:	Sep-Dic2019		

RECURSOS MATERIALES Y SERVICIOS GENERALES.

1. Folio: 618-A

2. Fecha que se requiere el bien o servicio: (dd/mm/aaaa)	19/09/2019	3. Núm. de contrato:	Urgente:	x
			4. Prioridad:	
5. Nombre y Firma del solicitante:	CA-ICIT: Dr. Noel Ivan Toto Arellano, Mtro. Angel Monzalvo Hdez, Mtro. Germán Reséndiz López		Normal:	

6. Proyecto:	7. Nombre y Firma del líder del proyecto:
40 Investigación	Mtra. Ma. Elena Hernández Briones

8. JUSTIFICACIÓN:

Es importante difundir el trabajo académico efectuado por estudiantes-maestros, pertenecientes al programa educativo de Ingeniería Industrial y de TSU en Procesos de Producción Area Manufactura, como es el caso del artículo "Mach-Zehnder Interferometer coupled to a Michelson configuration and a cube beam splitter system for applications in single shot phase shifting interferometry"

9 re (Pa...at)	10. Partida (Progr. Y Pres.)	11. Cantidad	12. Unidad de Medida	13. Concepto	14. Especificaciones Técnicas	15. Costo Unitario Aproximado	16. Subtotal
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RECIBIDO 20 SEP 2019

AUTORIZACIÓN DE PROGRAMACIÓN Y PRESUPUESTO

17. Total del Gasto:	18. Máximo Autorizado:	19. Proyecto:	20. Fuente de financiamiento:
			Federal
$ 684.40		31	Estatal
			IP

22. OBSERVACIONES:

21. FIRMA DE AUTORIZACIÓN:

23. NOMBRE Y FIRMA DE ENCARGADA DE ADMINISTRACIÓN Y FINANZAS:

Mtra. Oris Estela Vargas García

24. NOMBRE Y FIRMA DEL RECTOR:

Mtro. José Antonio Zamora Guido

25. NOMBRE Y FIRMAS DE CONFORMIDAD Y FECHA:

NOTA:

En caso de ser **monto mayores de 300 veces la UMA** se deberá de verificar el procedimiento de adiudicación: DIRECTA, INVITACIÓN O LICITACIÓN, dependiendo de ello será el tiempo de entrega, conforme lo estipula la Ley en la materia, y el área usuario deberá requisitar **el anexo técnico.**

Rosalba Barranco Cadena <rosalba@utectulancingo.edu.mx>

para reposicion del POSTER de GRL

1 mensaje

Noel Iván Toto Arellano <noel.toto@utectulancingo.edu.mx> 23 de septiembre de 2019, 15:34
Para: rosalba@utectulancingo.edu.mx

Noel Ivan Toto Arellano
Bancomer
Clabe: 012650012700937427
Cta. 1270093742
No Tarjeta : 4152313412237062

Gracias, Saludos cordiales
--
Dr. Noel Ivan Toto-Arellano
Investigador Nacional Nivel-2
Centro de Tecnologias Opticas y Fotonicas
Universidad Tecnologica de Tulancingo

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BBVA

Fecha y hora de consulta 24/09/2019 2:05:33 PM

Contrato 00088633

Nombre del Cliente UNIVERSIDAD TECNOLOGICA DE TULANCINGO

BBVA Net Cash - Pagos Mismo Banco

Operación autorizada

Datos del firmante

Usuario:	ADMIN1	**Poder:**	100%

Datos de la operación

Tipo de operación:	Pago Mismo Banco		
Descripción:	NOEL	**Importe de la operación:**	684.40 MXP
Cuenta de retiro:	0112682974	**Cuenta de depósito:**	1270093742
Divisa de la cuenta:	MXP	**Divisa de la cuenta:**	MXP
Titular de la cuenta:	UNIVERSIDAD TECNOLOG ICA DE TULANCINGO	**Titular de la cuenta:**	NOEL IVAN TOTO ARELLANO
Fecha de creación:	24/09/2019	**Fecha de aplicación:**	24/09/2019
Hora:	14:05:28		
Instrumento de seguridad:	ASD 1856803838	**Motivo de pago:**	REPOSICION GASTOS

Datos de confirmación de la transferencia

Folio de firma:	0065899185	**Folio único:**	I3232019092414052800658991 92

Estado operación

Porcentaje firmado:	100%	**Estado:**	Operado

Detalle de firmas

Acción	Usuario	Porcentaje aportado	Fecha
CREO	ADMIN1	--- %	24/09/2019
FIRMO	ADMIN1	100 %	24/09/2019