Hans I. Bjelkhagen

Dr Hans I. Bjelkhagen, Hansholo Consulting Ltd and Professor *Emeritus* at Glyndŵr University in UK. Over the last fifteen years Bjelkhagen has received much international recognition for his work in the field of 3D Imaging, colour holography and holographic recording materials. His most important academic contribution is the Springer book on *Silver-Halide Recording Materials for Holography and Their Processing* and the newly published *Ultra-Realistic Imaging* CRC book. In 2001 he received the RPS SAXBY AWARD and in 2011 the DENISYUK MEDAL, from the D.S. Rozhdestvensky Optical Society, Russia.

Ultra-Realistic Imaging – Analogue and Digital Colour Holography

Dr Hans I. Bjelkhagen
Hansholo Consulting Ltd
E-mail: hansholo@aol.com

Abstract

Recent improvements in key foundation technologies are set to potentially transform the field of 3D Imaging and Display Holography. Full-colour digital and analogue holograms may now be created with substantially better image characteristics than previously possible, leading to new types of displays and new applications. In particular new recording systems, based on recent DPSS and semiconductor lasers combined with novel recording materials and processing, have now demonstrated full-colour analogue holograms of both lower noise and higher spectral accuracy. Large format full-parallax digitally printed reflection holograms having fundamentally larger clear image depths. Progress in illumination technology, for example the new LED lights, is leading to a further major reduction in display noise and to a significant increase of the clear image depth and brightness of such holograms.

Pascal Picart [1,2]

1- LUNAM Université, Université du Maine, CNRS UMR 6613, LAUM, Avenue Olivier Messiaen, 72085 LE MANS Cedex 9, France LAUM CNRS, Université du Maine, Avenue Olivier Messiaen, 72085 LE MANS Cedex 9, France
2- École Nationale Supérieure d'Ingénieurs du Mans, rue Aristote, 72085 Le Mans Cedex 9, France
email: pascal.picart@univ-lemans.fr

Pascal PICART, 46, graduated from the Ecole Supérieure d'Optique in 1992 and received a PhD in Physics from the Université Paris XI-Orsay in 1995. In 1996, he became an assistant professor at the National School of Engineers of Le Mans (ENSIM) and joined the Acoustics Laboratory of the University of Maine (LAUM) to develop optical methods for acoustics and mechanical metrology. P. PICART is the author of more than 110 articles in international peer-reviewed journals and conferences. In 2007, he won the Jean Ebbeni Award from the Club "Measures and Controls for Industry" of the French Optical Society. His current research interests involve the development of color digital holography for applications in the field if acoustics and mechanics.

3D sensing with digital color holography and application for acoustics and mechanics

Pascal PICART[1,2]

1- LUNAM Université, Université du Maine, CNRS UMR 6613, LAUM, Avenue Olivier Messiaen, 72085 LE MANS Cedex 9, France LAUM CNRS, Université du Maine, Avenue Olivier Messiaen, 72085 LE MANS Cedex 9, France
2- École Nationale Supérieure d'Ingénieurs du Mans, rue Aristote, 72085 Le Mans Cedex 9, France
E-mail: pascal.picart@univ-lemans.fr

Abstract

Digital holography became properly available since its confirmation was established in 1994 [1]. In few years, a lot of spectacular applications have been demonstrated such as microscopic imaging and phase-contrast digital holographic microscopy [2], three-dimensional object recognition and securing information [3], vibrations analysis with pulsed lasers and time averaging, also multidimensional dynamic investigations [4] and digital color holography [5].
This paper presents recent developments in digital color holography, focuses on its applications in the field of acoustics and mechanics and especially discussed the possibility of simultaneous 3D measurements.
After a brief review on how the simultaneous recording of digital color holograms is made possible, we will discuss about the different opportunities to reconstruct these holograms. In order to compensate for the wavelength dependence of the pixel pitch in the Fresnel transform and to save the physical horizon of the object, we present different reconstruction strategies based on the Fresnel transform, spectrum scanning and convolution with adjustable magnification. The close relation that exists between the optical phases encoded in holograms and the displacement at the surface of any structure will be discussed, leading to the design of a simultaneous and full field three-color sensing probe having the capability of measuring three dimensional displacement fields.
The principle of the three-chromatic holographic sensing is then adapted to structural mechanics and acoustics. Illustrations of the proposed method concern applications in flow measurements at Mach 0.45, 3D surface acoustic wave visualization and measurement, and crack investigation in composite materials. Since such new scientific instrument uses several laser wavelengths, attention must be paid to the error-free holographic reconstructions. In this context, we will discuss about origin of chromatism in digital color holography and propose a robust and simple method to compensate for such aberrations.

1. Schnars, U, Jüptner, W (1994) Direct recording of holograms by a CCD target and numerical reconstruction. Applied Optics 33:179-181.

2. Zhang, T, Yamaguchi, I (1998) Three-dimensional microscopy with phase shifting digital holography. Optics Letters 23:1221-1223.
3. Javidi, B, Tajahuerce, E (2000) Three-dimensional object recognition by use of digital holography. Optics Letters 25:610-612.
4. Picart, P, Leval, J, Grill, M, Boileau, J-P, Pascal, J-C, Breteau, J-M, Gautier, B, Gillet, S (2005) 2D full field vibration analysis with multiplexed digital holograms. Optics Express 13:8882-8892.
5. Ferraro, P, De Nicola, S, Coppola, G, Finizio, A, Alfieri, D, Pierattini, G (2004) Controlling image size as a function of distance and wavelength in Fresnel-transform reconstruction of digital holograms. Optics Letters 29:854-856.

Pietro Ferraro

Pietro Ferraro is currently Director of Unit of Napoli of National Institute of Optics (CNR), Italy. He has published 2 books, 180 papers in journals, 150 papers at International Conferences. He holds 15 patents most of which in holography and 3D imaging. Among his current scientific interests are: holography, interferometry, microscopy, fabrication of nanostructures, ferroelectric crystals. Dr. Ferraro has chaired several international conferences. He is in the Editorial Board of *Optics and Lasers in Engineering* (Elsevier), in the Board of Editors of *Measurement& Science Technology* (IOP), Topical Editor of *Optics Letters (OSA)*, Associate Editor of IEEE/OSA *Journal of Display Technology*

Digital holography at infrared: a new powerful opportunity for increasing performances

Pietro Ferraro
INO-CNR (Istituto Nazionale di Ottica – Consiglio Nazionale delle Ricerche)
Pozzuoli – Napoli, Italy
E-mail : pietro.ferraro@ino.it

Abstract
In this work we demonstrate the capabilities of digital holography at 10.6 µm. Firstly, we show that, using the long wavelength coherent radiation produced by a CO2 laser instead of visible radiation, it is possible to record holograms of human-size targets, i.e. whose dimensions are comparable to the ones of an adult.
In fact, our target is a 190cm tall plastic mannequin, placed at a distance of 300cm from the detector. Thanks to the longer wavelength, the ratio between the wavelength and the pixel size is higher than the ratio achievable with visible wavelength. As a result the maximum size of objects placed at 2m distance from the detector raises up to 85cm (just to make an example, if a 632nm wavelength was employed to capture objects at the same distance and maintaining the same set-up, the maximum size would be 15cm). Then, we demonstrate that imaging alive people through smoke and flames is possible by IR-Digital Holography. So far, the existing thermographic infrared cameras allows to see people through dense smoke, sensing the radiation emitted by human body. However, these devices are often blinded due to the flame emission, and the information of the targets beyond the flames is unavoidably lost. On the contrary, lensless Digital Holography at far infrared avoids the typical saturation of the camera detectors returning clear images of targets seen behind veils of smoke and curtains of flames. Moreover, the lower interferometric and seismic noise sensitivity of IR-DH allows the recording of dynamic human-size targets outside the lab, and therefore an easy detection of live, moving people is achieved through both smoke and flames for safety applications.

Ken Anderson

Dr. Anderson is the CEO and co-founder Akonia Holographics where he and his team are developing the world's first commercial holographic data archival storage drive and media. Dr. Anderson has worked in the field of holography for over 18 years and holds over 38 patents in the area. He is a pioneer in the field of holographic data storage, has developed many critical technologies in the field and has been heavily involved in the design and commercialization of holographic drives and. He has a PhD in Optical Engineering, a MS in Electrical Engineering, a BS in Engineering Physics, and a BS in Computer Science.

3D Holographic Data Storage: Science Fact or Science Fiction ?

Ken Anderson, PhD
CEO Akonia Holographics, LLC
Location : Boulder, Colorado, USA
(303) 517-5390
ken@akoniaholographics.com
Personal Research Web Page: http://www.cs.colorado.edu/~kena/

Abstract
The idea of storing information holographically has been around for almost 50 years. The lure of holographic data storage (HDS) comes the fact that information is stored with a laser in three dimensions; not two dimensions like every other dominate technology on the market: Blu-Ray, tape, magnetic disk, and Flash. With a theoretical storage potential of 3.5 Petabytes in a removable disk the size of a CD, it remains the holy grail of data storage. That is more than 100,000 HD movies on one disk! However, many companies have tried and failed to bring the technology to market. With this much promise, why has it never been commercialized?

The convergence of three independent commercial technologies that are fundamental to holographic storage have provided the modern day framework that make commercializing holographic data storage possible today: CMOS Cameras, micro-displays, and blue lasers. Leveraging these technologies, Akonia Holographics is pioneering the world's first commercial holographic storage device. It is developing technology capable of storing 10Tbytes in a cartridge the same size as LTO tape with a technology roadmap out to 40Tbytes over the next two generations.

The first generation HDS technology will be based on a recent advancement made by Akonia scientists called Dynamic Aperture Multiplexing. It has the potential to reach world record areal densities greater than 2.0Tb/in2, more than 2.8x more than previously demonstrated on an HDS laboratory system.

Jean Sauvage-Vincent

GRADUATE
2013 PhD Graduate in Optic at the Jean Monnet University of Saint –Etienne, FRANCE
2009 Engineer graduate in optic and industrial Vision at TELECOM Saint-Etienne, FRANCE
2006 Technician Graduate in Instrumental Optic at Fresnel School, Paris, FRANCE
2004 Science Bachelor graduate at Louise Michel School, Champigny-sur-Marne, FRANCE

PROFESSIONAL EXPERIENCE
2009-2013 Engineer Research and Development at Hologram Industries, and PhD Thesis in partnership with the Hubert Curien's Laboratory at Saint-Etienne
2006-2009 Engineer graduate training in alternation time between Hologram Industries and TELECOM Saint-Etienne

Holographic security of documents

Jean Sauvage-Vincent
R&D Engineer
Hologram-Industries s.a., Marne-la-Vallée, France
E-mail : j.sauvage@hologram-industries.com

Abstract

Nowadays the losses due to counterfeit of goods and documents are estimated at 400 billion $ each year. More than an economical problem, the counterfeit represents also a threat for the states due to the terrorism or organized crime. Hologram Industries is a supplier of optical and digital solutions to protect goods and value document such as passports, identity cards, driving license.
Founded on a 30 years expertise Hologram Industries is a leading company in the field of security holographic foil industry. A review about most established security holograms types (also known as Optically Variable Device, OVD) and their production workflow will be presented. A focus will be done on a new class of components developed since 10 years: the Zero Order Device (ZOD).
ZODs rely on complex optical structures with nanometric dimension able to couple the impinging light to resonant modes: extraordinary reflection and / or transmission phenomena could be achieved. An example will be describe with the DID®, the first ZOD technology successfully implement by HI on ID documents market. DID® allows the appearance of strong color in reflection that dramatically shifts upon a rotation of 90° of the document. Last HI innovation in ZODs field consists in using Plasmon modes to create astonishing effects in transmission and/or in reflection.
Finally, the presentation will open to the prospect of new controlling tool available to everyone: the smartphone.