

LDC 2018 PROGRAM

■ April 24, Tue. Room 301

[LDC1] 9:00 - 10:45 **LDC Plenary**

Chairs: Kazuo Kuroda, Utsunomiya University, Japan

Hiroshi Murata, Osaka University, Japan

LDC1-1 9:15 Plenary

Recent Researches and Activities of Korean 3D Display Society

ByoungHo Lee, Seoul National University, Korea

I introduce the latest research trends of 3D displays in Korea including super multi-view display and holographic display based on GIGA KOREA project. Also introduced are researches on augmented reality.

LDC1-2 10:00 Plenary

IR/R/G/B Laser Diodes for Multi-Wavelength Applications

Hidenori Kawanishi, Sharp Corporation, Japan

This paper describes the history of Sharp laser diode development and recent progress in offering a wide wavelength portfolio as a one stop laser supplier for multi-wavelength applications.

10:45-11:00 Break

[LDC2] 11:00 - 12:00 Scanning Systems

Chairs: Masafumi Ide, Magic Leap, Japan

Fergal Shevlin, DYOPTYKA, Ireland

LDC2-1 11:00 Invited

Laser Holographic Head Up Displays

Jamieson Christmas, Envisics Ltd., UK

LDC2-2 11:30

MEMS-Driven Laser Beam Scanning LiDAR: The Future of Variable Spatial Resolution Sensing and Foveated Ranging

Jari O. Honkanen, P. Selvan Viswanathan, MicroVision, Inc., USA

This paper explores why LBS technology is especially well suited for LiDAR applications, and how MEMS-driven LBS LiDAR systems offer compelling advantages such as dynamic variable spatial resolution and foveated depth sensing.

LDC2-3 11:45

Multi-purpose IoT Station Using Scanning Visible Laser Diodes Common to Smart Lighting and LiDAR

Masato Ishino¹⁾, Toshiyuki Kitamura²⁾, Akira Takamori¹⁾, Masahide Okazaki³⁾, Hiroshi Murata⁴⁾, Junichi Kinoshita¹⁾, Noboru Hasegawa²⁾, Masaharu Nishikino²⁾, Kazuhisa Yamamoto¹⁾

1) Osaka University, Japan, 2) National Institute for Quantum and Radiological Science and Technology, Japan, 3) Screen Holdings Co., Ltd, Japan, 4) Graduate School of Engineering Science, Osaka University, Japan

A new concept of IoT station using visible LD-scan technology common to smart lighting

and LiDAR-sensing is proposed. The feasibility of this system is verified using a simply-configured prototype system.

12:00-13:00 Lunch

[LDC3] 13:00 - 16:30 **Special Session: Hyper-Realistic Displays 2018**

Chairs: Hirotsugu Yamamoto, Utsunomiya University, Japan

Daisuke Miyazaki, Osaka City University, Japan

LDC3-1 13:00 Invited

Introductory Talk: 3D Displays from PyeongChang to Tokyo

Hirotsugu Yamamoto^{1), 2)}

1) Utsunomiya University, Japan, 2) JST, ACCEL, Japan

This talk gives an overview of the hyper-realistic displays in 2018. One of the most significant topics is the application of 3D displays for PyeongChang 2018 Olympics. In Japan, aerial displays are becoming popular.

LDC3-2 13:15 Invited

Development of Digital Holographic Display Technology in Giga KOREA Project HOPTECH

Minsik Park, Chi-Sun Hwang, Jinwoong Kim

Electronics and Telecommunications Research Institute, Korea

We will discuss the technology development of table-top digital holographic display that enables user to consume the realistic 3D media for tele-experience service in Giga KOREA Project.

LDC3-3 13:45 Invited

HOPTECH : Hologram Printing Technology and Applications

Ryutaro Oi, Koki Wakunami, Boaz Jackin, Yasuyuki Ichihashi, Makoto Okui, Kenji Yamamoto

National Institute of Information and Communications Technology, Japan

Wavefront printer is useful to make an optical elements. A hologram printing method that includes holographic optical elements fabrication, duplication of holograms and overlap printing method for better view of holograms is described.

LDC3-4 14:15 Invited

Possibilities and Problems of Super-Multiview 3D Display

Sung Kyu Kim, Min-Koo Kang, Yong-Jun Kwon, Ki-Hyuk Yoon

Korea Institute of Science and Technology, Korea

SMV 3D display aims for the characteristics of the horizontal parallax only electro-holographic 3D display. But achieving high quality 3D image and human friendly display performance are significant issues for ideal SMV 3D display.

LDC3-5 14:45

Aerial Protruding DFD Display with AIRR

Yoshiki Terashima¹⁾, Ryosuke Kujime^{1),2)}, Shiro Suyama³⁾, Hirotsugu Yamamoto^{1), 2)}

1) The University of Utsunomiya, Japan, 2) JST ACCEL, Japan, 3) The University of Tokushima, Japan, This paper proposes a novel aerial 3D display, which is based on the protruding DFD display. We form two-layered aerial images with AIRR. We have successfully realized aerial protruding DFD display.

15:00-15:15 Break

LDC3-6 15:15 Invited

Integral 3D Display System Using Multiple Display Devices

Naoto Okaichi, Hayato Watanabe, Hisayuki Sasaki, Masahiro Kawakita, Tomoyuki Mishina

NHK Science & Technology Research Laboratories, Japan

We are conducting research using multiple display devices to improve the performance of integral 3D images. Each of the research results using direct-view displays and projectors as the display devices will be described in detail.

LDC3-7 15:45 Invited

Air Floating Image and Its Applications Using a Dihedral Corner Reflector Array

Yuki Maeda, Parity Innovations Co. Ltd., Japan

A distortion-free full-color real image can be displayed in midair using a dihedral corner reflector array. A basis of the dihedral corner reflector array and some applications, such as a floating touch display, are introduced.

LDC3-8 16:15 Invited

Challenges Toward Visual Interface Based on Aerial Three-Dimensional Image

Daisuke Miyazaki, Osaka City University, Japan

Floating three-dimensional (3-D) image formation without any project screen is advantageous for providing interactive operation to the 3-D data directly using fingers or positioning devices. The several studies on aerial 3-D display technologies are described.

16:30-16:45 Break

[LDC4] 16:45 - 18:00 Projection Technology

Chairs: Jari O. Honkanen, MicroVision Inc., USA

Satoshi Ouchi, Hitachi Consumer Electronics CO., LTD., Japan

LDC4-1 16:45 Invited

Edible Retroreflector for Dynamic Projection Mapping on Foods

Hiromasa Oku, Gunma University, Japan

In this presentation, the concept of an edible retroreflector is introduced. Japan agar was found to be adequate material to form it. The prototype was successfully applied to a marker for dynamic projection mapping.

LDC4-2 17:15 Invited

1000fps, 8bit and low latency projector "DynaFlash"

Takeshi Yuasa¹⁾, Takeshi Yuasa¹⁾, Yoshihiro Watanabe²⁾, Masatoshi Ishikawa²⁾

1) Tokyo Electron Device Ltd., Japan, 2) The University of Tokyo, Japan

High speed projector "DynaFlash" can realize 1000-fps, 8bit depth and 3ms (min) latency based on the Texas Instruments DLP technology and the high-speed control of high-luminance LED.

LDC4-3 17:45

Spatial-division multiplexing in holographic 3D display using high-speed binary phase-mode spatial light modulator

Shigehiko Washizu¹⁾, Syo Harada¹⁾, Xiangyu Quan¹⁾, Kouichi Nitta¹⁾, Shinya Sato²⁾, Nobuyuki Hashimoto²⁾, Osamu Matoba¹⁾

1) Kobe University, Japan, 2) CITIZEN Watch Co. Ltd., Japan

Experimental demonstration of enlarging viewing zone angle and reconstructed image size of holographic 3D display using a high-speed binary-phase-mode spatial light modulator is presented. In the experiment, three-times enlargement is achieved.

■ April 25, Wed. Room 301

Wednesday, April 19 AM

OPIC Opening and Plenary Session 9:00-12:10

Room 501+502

12:10-13:30 Lunch

[IOT-LDC-LEDIA] 13:30 - 17:15 **Joint Session (LEDIA, LDC, and IoT-SNAP)**

Chairs: Atsushi Kanno National Institute of Information and Communications
Technology, Japan
Sunao Kurimura Natinal Institute of Material Science, Japan
Ryuji Katayama Osaka University, Japan

Opening Talk 13:30 - 13:45

Hiroshi Murata Osaka University, Japan
Kenichi Kitayama The Graduate School for the Creation of New Photonics
Industries, Japan
Hiroshi Amano Nagoya University, Japan

IOT-LDC-LEDIA-1 13:45 Invited

IoT revolution and business opportunities in emerging market in ASEAN region
Huei Ee Yap, LP-Research Inc., Japan

IOT-LDC-LEDIA-2 14:15 Invited

Fiber-optic-based Life Cycle Monitoring of Aerospace Composite Structures: Toward Digitalization of Next Generation Aircraft
Shu Minakuchi, Nobuo Takeda, University of Tokyo, Japan
This talk will overview our recent research activity of composite life cycle monitoring by embedded optical fiber sensors. The detailed information obtained from composite structures can be utilized to build the digital replicas and to predict their life-cycle performance.

14:45 -15:15 Break

IOT-LDC-LEDIA-3 15:15 Invited

Laser Diode Based Underwater Optical Wireless Communication

Takao Sawa¹⁾, Koji Tojo²⁾, Naoki Nishimura²⁾, Shin Ito³⁾

1) JAMSTEC, Japan, 2) Shimadzu Corp., Japan, 3) SAS Co., Ltd., Japan

We developed an underwater optical wireless communication modem using high power laser diode. 20 Mbps communication speed at 120 m distance, and 32 kbps at 190 m

distance were established through underwater tests.

IOT-LDC-LEDIA-4 15:45 Invited
Recent Progress of Retinal Imaging Laser Technology
Mitsuru Sugawara, QD Laser, Japan

IOT-LDC-LEDIA-5 16:15 Invited
III-nitride Semiconductor Light Emitting Transistors
Kazuhide Kumakura, Junichi Nishinaka, Hideki Yamamoto
NTT Basic Research Laboratories, NTT Corporation, Japan

IOT-LDC-LEDIA-6 16:45 Invited
High Photosensitivity HFET-type Nitride Based Photosensors
Motoaki Iwaya¹⁾, Tetsuya Takeuchi¹⁾, Satoshi Kamiyama¹⁾, Isamu Akasaki^{1), 2)}
1) Meijo University, Japan, 2) Nagoya University, Japan

■ **Reception** InterContinental Ballroom

18:00-20:00 *complimentary for OPIC/LDC2018 attendees

April 26, Thur. Room 301

[LDC5] 9:00 - 10:30

Special Session: Visible Lasers Connecting Automotive and Human -1-

Chairs: Josef Schug, Lumileds Germany GmbH, Germany
Shigeto Iwamoto, Honda Motor Co., Ltd., Japan

LDC5-1 9:00 Invited

The Future of Automotive Lighting with Laser Technology
Philipp Ansorg, Wolfgang Huhn, AUDI AG, Germany

Laser light sources for car headlamps entered series production and will be improved in performance and safety. New systems combine laser light with a MOEMS mirror scanner, DMD or LCoS to realise new light functionality.

LDC5-2 9:30 Invited

Laser Scanning Headlamp

Takuya Kitazono, Yasushi Kita, Shinya Hoshino, Taiki Mori, Shuichi Harata, Takao Saito, Yasushi Yatsuda, Stanley Electric co., ltd., Japan

The high-resolution Adaptive Driving Beam by the laser scanning headlamp is effective for the reduction of the night traffic fatal accidents. We demonstrated improvement of the visibility and to guide the driver's eyes.

LDC5-3 10:00 Invited

Application of Laser to Headlamps and Thermal Design

Takashi Inoue, Yosuke Ohashi, Takashi Ito, KOITO MANUFACTURING CO.,LTD, Japan

This paper describes how laser diodes can be used for headlamps and their potential as light sources, focusing on headlamp functionality and thermal design.

10:30-10:45 Break

[LDC5] 10:45 – 12:15

Special Session: Visible Lasers Connecting Automotive and Human -2-

Chairs: Philipp Ansorg, Lumileds, Audi AG, Germany

Masaru Kuramoto, Stanley Electric Co., Ltd., Japan

LDC5-4 10:45 Invited

Dynamic Laser-based Lighting for Automotive Headlamps

Josef Schug, Ulrich Hechtfisher, Roman Hohn, Steffen Zozgornik

Lumileds Germany GmbH, Germany

Laser-based lighting finds its application in car headlighting, particularly in the high beam. First implementations use a single static source. Dynamic beam pattern can be either realized with discrete segmented sources or in an advanced way with a laser scanner. The paper reports results.

LDC5-5 11:15 Invited

Laser light technology for Automotive Applications

Paul Rudy, Troy Trottier, Eric Goutain, James Raring, SoraaLaser, USA

Conventional sources such as HID, halogen lamps and LEDs have limitations in reliability, size and luminance. We present an overview of laser light, a new solid-state technology featuring the highest luminance demonstrated commercially.

LDC5-6 11:45 Invited

GaN-based Laser Diodes for Automotive applications

Takashi Miyoshi, Shingo Masui, Shin-ichi Nagahama, Nichia Corporation, Japan

GaN-based single mode blue and green laser diodes (LDs) were fabricated on c-plane GaN substrates. The wall plug efficiency were 26.5% in 453nm and 12.3% in 515nm, respectively.

12:15-13:30 Lunch

[LDC6] 13:30 - 15:00 Speckle/Color

Chairs: Young-Joo Kim, Yonsei University, Korea

Shigeo Kubota, Oxide Corp., Japan

LDC6-1 13:30 Invited

The Development of Speckle Reduction Technologies in Our Group for Laser Projection Displays: a Short Summary

Zhaomin Tong, Shanxi University, China

In this paper, speckle reduction methods developed in our group are reviewed. The methods include polarization diversity, binary phase diffuser, MEMS scanning mirror, and non-sequential technique.

LDC6-2 14:00

Image Resolution of Raster-scan Laser Mobile Projectors Considering Color Speckle Effects

Junichi Kinoshita¹⁾, Akira Takamori¹⁾, Kazuhisa Yamamoto¹⁾, Kazuo Kuroda²⁾, Koji Suzuki³⁾

1) Osaka University, Japan, 2) Utsunomiya University, Japan, 3) Oxide Corporation, Japan

Image resolution of raster-scan laser mobile projectors was analyzed considering color

speckle using a high-speed speckle measurement device. Color speckle has an effect of widening the chromaticity range of various color shifting behaviour.

LDC6-3 14:15

Light source coherence and the impact of diffusers on the image quality of a holographic display system

Yuanbo Deng, Daping Chu, University of Cambridge, UK

We show the relationship between the spatial and temporal coherences of the light source and the image sharpness and speckle in a linear holographic display system and the change due to adding a diffuser.

LDC6-4 14:30

Theoretical Analysis of Angular Dependency of Speckle Contrast

Makio Kurashige, Kazutoshi Ishida, Dai Nippon Printing Co., Ltd., Japan

Angular characteristics of speckle contrast under the moving diffuser condition was analyzed based on the speckle reduction theory. The result was well matched with the theoretical assumption in this report.

LDC6-5 14:45

Measurement of Chromaticity and Photometric Quantity of Laser Displays by the Discrete Centroid Wavelength Method

Keisuke Hieda, Tomoyuki Maruyama, Tomohiro Takesako, Fumio Narusawa

HIOKI E.E. CORPORATION, Japan

The discrete centroid wavelength method can simultaneously measure the centroid wavelength and radiometric quantity of three-color lasers. The accuracy of this new method was experimentally verified by comparing with an optical spectrum analyzer and Si-photodiode.

15:00-15:30 Break

[LDC7] 15:30 - 17:45 Lasers and Light Sources

Chairs: Lung-Han Peng, National Taiwan University, Taiwan

Tetsuya Yagi, Mitsubishi Electric Corp., Japan

LDC7-1 15:30 Invited

Watt-class Green and Blue Laser Diodes

Masahiro Murayama¹⁾, Yusuke Nakayama¹⁾, Yukio Hoshina¹⁾, Hideki Watanabe¹⁾, Noriyuki Fuutagawa¹⁾, Hidekazu Kawanishi¹⁾, Toshiya Uemura²⁾, Hironobu Narui¹⁾

1) Sony Corporation, Japan, 2) Toyoda Gosei Co., Ltd., Japan

Watt-class green and blue laser diodes were successfully fabricated on semipolar {20-21} plane and c-plane GaN substrates, respectively. These lasers are promising light sources that meet the ITU-R Recommendation BT.2020 for future laser display applications.

LDC7-2 16:00 Invited

Development of RGB Light Source for Head-Up Display at Automobile

Nan Ei Yu

Gwangju Institute of Science and Technology, Korea

Fiber-based RGB laser light source module is presented. A set of laser diodes are coupled with optical fiber and merged into single output with optical fiber combiner device.

LDC7-3 16:30 Invited

Progress in self-frequency doubling crystal green modes and its potential application for laser display

JiYang Wang, Haohai Yu, Huaijin Zhang, Shandong University, China

SFD crystals and lasers have gained renewed attention and Nd:RECa₄O(BO₃)₃ (RE = Y or Gd) crystals, with SFD lasers becoming commercial products. The promising application of SFD green laser in laser displays was discussed.

LDC7-4 17:00

Utilizing the unique properties of ceramic fluorescent converters for laser pumped phosphor light-engines in digital projection.

Volker Hagemann¹, Albrecht Seidl¹, Kazuyuki Inoguchi²

1) SCHOTT AG, Germany, 2) SCHOTT Nippon K.K., Japan

Laser pumped phosphors are widely used in solid state based light-engines for digital projection. We compare the properties of ceramic converters to other solutions and present results for irradiance levels up to 230W/mm² and beyond.

LDC7-5 17:15

Highly-Reliable Operation under High Case Temperature in 638-nm BA-LD

Kyousuke Kuramoto, Shinji Abe, Motoharu Miyashita, Masatsugu Kusunoki, Takehiro Nishida, Tetsuya Yagi

Mitsubishi Electric Corp., Japan

638-nm dual-emitter LD with total emitter width of 150-um showed better characteristics compared with the triple-emitter of 180-um under 55 deg. C, pulse. The LD had MTTF around 26K hours, 1.9 times of the triple.

LDC7-6 17:30

Spectral Study of a Side-Emitting Laser-Pumped Phosphor Layer

Masamichi Ohta, Ichiro Fujieda, Ritsumeikan University, Japan

A side-emitting configuration can utilize the photoluminescence photons trapped in a laser-pumped phosphor layer. Shorter-wavelength photons are lost during lateral light propagation due to self-absorption, leading to an angle-dependent spectrum.

■ April 27, Fri. Room 301

[LDC8] 9:00 - 9:45 Modules/Sensors

Chairs: Ray-Hua Horng, National Chiao Tung University, Taiwan

Tomoyuki Miyamoto, Tokyo Institute of Technology, Japan

LDC8-1 9:00

High-efficient Light Detection with Double-side Mirror Reflectors for Light Scattering-type Particle Sensor

Kenya Nakai, Nozomi Enoki, Shota Nakahara, Takashi Fujiwara, Masaaki Shimada, Nobuo Takeshita, Mitsubishi Electric Corp., Japan

Double-side mirror reflectors structure to detect a scattered light efficiently from small particles for an optical particulate matter sensor is studied in simulation. It enables a light-collection-efficiency to increase and an optical detection-area to expand.

LDC8-2 9:15

Importance of Three-color Simultaneous Measurement of RGB Laser Diode Modules
Keisuke Hieda, Tomoyuki Maruyama, Fumio Narusawa, HIOKI E.E. CORPORATION,
Japan

Simultaneous measurement of RGB lasers is important for an accurate evaluation of the optical characteristics of RGB laser diode modules. It is difficult to precisely evaluate their performance if each laser is measured separately.

LDC8-3 9:30

Correlation between Human Perception and Computer-Predicted Daylight Metrics in an Auditorium Building

Aishanura Handina, Nurul Mukarromah, Rizki A. Mangkuto, R. Triyogo Atmodipoero
Institut Teknologi Bandung, Indonesia

Assessments to correlate human perception and computer-predicted metrics of indoor daylighting were conducted in an auditorium in Bandung, Indonesia. The closest relation is found for subjective partially daylight area and the area enclosed with DA150,50%;

[LDCp9] 9:45 - 10:28 **Poster Short Presentation** **Room301**

Chairs: Sunao Kurimura, NIMS, Japan

Tetsuya Yagi, Mitsubishi Electric Corp., Japan

[LDCp9] 10:30 - 12:00 **Poster Session** **Exhibit Hall A**

LDCp9-1

Fiber-Coupled High-Power RGB Laser Module for Underwater Optical Wireless Communication

Ryosuke Nishi¹⁾, Koji Tojo¹⁾, Naoki Nishimura¹⁾, Takao Sawa²⁾

1) Shimadzu Corp., Japan, 2) JAMSTEC, Japan

We developed fiber-coupled high-power RGB laser module for underwater optical wireless communication. The RGB laser module provides over 3.5-W laser output for each wavelength range of red, green, and blue.

LDCp9-2

Experiment on Colour Mixing Using Tunable Red-Green-Blue Light-Emitting Diode Against Flux Luminous and Chromaticity Coordinates Values

Revantino^{1),2)}, Rizki Armanto Mangkuto¹⁾, Abdul Rachman Sanjaya¹⁾, Jaka Kelana Putra¹⁾, F.X. Nugroho Soelami¹⁾

1) Institut Teknologi Bandung, Indonesia, 2) Ministry of Industry of Republic of Indonesia, Indonesia

Experiment was conducted using light-emitting diode with tunability in red-green-blue components. Light intensity of each component was set by microcontroller within variation steps. Results showed variation of green component affected flux luminous and chromaticity values.

LDCp9-3

Optically tunable liquid crystal broadband linear-polarization rotator

Ko-Ting Cheng¹⁾, Cheng-Kai Liu¹⁾, Chian-Yu Chiu¹⁾, Stephen M. Morris²⁾, Min-Cheng Tsai¹⁾, Chii-Chang Chen¹⁾

1) National Central University, Taiwan, University of Oxford, UK

A linear-polarization rotator based on the optically tunable pitch of chiral-azobenzene-doped liquid crystals has been investigated. The rotation angle is dependent on the pitch and the number of turns of the cholesteric LC helix.

LDCp9-4

Proposal of protective filter adjustment for RGB lasers

Yoshihisa Ishiba, Shinya Kajiri, Yamamoto kogaku co., ltd., Japan

We have reported on the details of protection filter which can adjust optical axis for RGB laser.

LDCp9-5

Portable camera based 3D imaging with structured light

Ting-Yi Huang¹⁾, Wei Min Cheng¹⁾, Fan Tim²⁾, J. Andrew Yeh¹⁾, Yuan Luo²⁾

1) National Tsing Hua University, Taiwan, 2) National Taiwan University, Taiwan

Three-dimensional (3D) image reconstruction has been developed for various applications. Here, we proposed a smart phone combined with structured light source to experimentally demonstrate 3D reconstructed images.

LDCp9-6

Utilization of Nanocellulose From Bagasse as Carbon Source on Bcno Synthesis / Sio₂ for White Led Lamp

I Putu Darma Ruswara, Dafi Adinegoro, Bambang Sunendar, Ahmad Nuruddin

Institut Teknologi Bandung, Indonesia

White LED can be made by transmitting UV light source through phosphor material. Phosphor BCNO Silica is made of nanocellulose from bagasse using sol-gel method and calcination at 600° C and used for LED film.

LDCp9-7

Effect of Luminance and Contrast on Psycho-physiological Response of Dentist in General Examination Room of a Dental Hospital

Damarwulan Eka Agustina, Fariza Ardelia Alifah, Rizki A. Mangkuto, Suprijanto

Institut Teknologi Bandung, Indonesia

Three variables yield significant effect on subjective error percentage: maximum face luminance, maximum ambient luminance, and contrast of oral-mannequin. The following values are suggested: $L_{f,max} < 3.42 \text{ cd/m}^2$, $L_{a,max} > 2.24 \text{ cd/m}^2$, $C_{m-f} < 9.66$.

LDCp9-8

Parametric Design for Optimising Dimensions and Specularity of Light Shelves

Rialdi Eka Putra, Fathurrahman Feradi, Rizki Armanto Mangkuto, R. Triyogo Atmodipoero, Institut Teknologi Bandung, Indonesia

This study aims to optimise the design parameters of light shelves in an open-plan space, to maximise daylight availability and minimise glare risk, using parametric design with genetic algorithm optimisation.

LDCp9-9

Secure Transmission and analysis of Optical Scanned Holographic Images for Efficient Communication

Meril Cyriac, Kanjana G, Anusree L, Leena Thomas, Nelwin Raj N.R, Roshan Varghese
SCT College of Engineering, India

A new approach for the secure transmission of optical scanning holographic image is proposed. The optically scanned holographic image is scrambled using different chaotic maps. This image is converted to a quick response code.

LDCp9-10

Development of portable light therapy apparatus using LED for improvement of sleep and wakefulness

Tomonori Yuasa¹⁾, Jun Miura²⁾, Yasumori Sugai³⁾, Yousuke Ito³⁾, Yoshihisa Aizu¹⁾

1) Muroran Institute of Technology, Japan, 2) Hokkaido Pharmaceutical University, Japan, 3) DENSEI COMMUNICATION Inc., Japan

We have developed a portable light therapy apparatus for improvement of sleep quality and wakefulness and performed some preliminary experiments. The experimental results demonstrate usefulness of developed portable light therapy apparatus.

LDCp9-11

Understanding the Exposure-time Effect on Speckle Contrast Measurement for Laser Projection with Rotating Diffuser

Koji Suzuki, Shigeo Kubota, Oxide Corporation, Japan

We measured speckle contrast for laser projection with a rotating diffuser. The exposure-time effect was observed at slow surface velocity. The exposure time won't affect speckle contrast of laser displays if temporally-averaging speed is fast.

LDCp9-12

Improvement of Image Blurring for Aerial Image formed by Dihedral Corner Reflector Array using Optimization Processing

Daisuke Miyazaki, Shinji Onoda, Osaka City University, Japan

A method to improve blurring in an aerial image formed by a micro mirror array imaging element is proposed. A displayed image is optimized to minimize image blur using simulated annealing algorithm.

LDCp9-13

Forming a thermal aerial image with AIRR

Kengo Fujii¹⁾, Ryosuke Kujime^{1), 2)}, Hirotsugu Yamamoto^{1), 2)}

1) Utsunomiya University, Japan, 2) JST ACCEL, Japan

This paper shows the possibility of forming a thermal aerial image with aerial imaging by retro-reflection (AIRR). Although far-infrared rays are absorbed by polymers, near-infrared lights can be retro-reflected and transmit through a beam splitter.

LDCp9-14

Aerial Imaging in a Cylindrical Water Tank with Omnidirectional

Erina Abe¹⁾, Sho Onose¹⁾, Hirotsugu Yamamoto^{1), 2)}

1) Utsunomiya University, Japan, 2) JST ACCEL, Japan

This paper utilizes aerial imaging by retro-reflection (AIRR) for an omnidirectional aerial display. The omnidirectional aerial screen is formed inside a cylindrical water tank, which is aimed for experiments on fish by showing images.

LDCp9-PDP1

The Advantage of Centroid Wavelengths for Precise Evaluation of Laser Displays

Keisuke Hieda, T. Maruyama, F. Narusawa, HIOKI E.E. CORPORATION, Japan

The accuracy of a measurement method for the chromaticity and photometric quantity of laser displays using centroid wavelengths was experimentally verified.

12:00-13:00 Lunch

[LDC10] 13:00 - 14:30 Emerging Displays

Chairs: Jan Heller, JENOPTIK Polymer Systems GmbH, Germany

Makio Kurashige, Dai Nippon Printing Co., Ltd., Japan

LDC10-1 13:00 Invited

Holographic Accessed Volumetric Displays

Kota Kumagai and Yoshio Hayasaki, Utsunomiya University, Japan

Volumetric displays with parallel two- and multi-photon excitations using a computer generated hologram displayed on a liquid crystal spatial light modulator are demonstrated.

LDC10-2 13:30 Invited

Dynamic Illumination for Spatio-temporal Integration of Unwanted Interference in Holographic Displays

Fergal Shevlin, DYOPTYKA, Ireland

The quality of holographic display imagery is improved using a compact, reliable, optically efficient deformable mirror. So-called subjective speckle that can render text and symbols illegible at viewing distances of several meters, is reduced significantly.

LDC10-3 14:00

Holographic real-time image projection with data compression

Paula Adrianna Kočańska, Michał Makowski, Izabela Ducin, Karol Kakarenko, Jarosław Suszek, Marcin Bieda, Adam Kowalczyk

Warsaw University of Technology, Poland

New approach to holographic data compression in real-time holographic transmission with on-the-fly data compression and projection in color between Poland and Japan is presented. Data compression algorithm used in transmission is based on bitplanes extraction.

LDC10-4 14:15

Optical Addressing of Phase-Modulating Materials for Holographic Projection of Images

Joanna Starobrat, Michał Makowski, Piotr Lesiak

Warsaw University of Technology, Poland

The efficiency of real-time holography projection is limited by the SLM pixel density. We propose solutions for purely optical addressing: magneto-optical modulation and implementing LC doped with GNP. Holographic writing for both methods is compared.

14:30-14:45 Break

[LDC11] 14:45 - 16:00 Optical Components

Chairs: Nan Ei Yu, Gwangju Institute of Science and Technology, Korea

Junichi Kinoshita, Osaka University, Japan

LDC11-1 14:45 Invited
Optimized Algorithm for Freeform Optics
Matthew E. Brand, Mitsubishi Electric Research Laboratory, USA

LDC11-2 15:15 Invited
Capabilities in production of Components and Sub-Assemblies for LIDAR
Jan Heller, JENOPTIK Polymer Systems GmbH, Germany
The challenges in the production of components and sub-modules for LIDAR applications.

LDC11-3 15:45
High-Speed Multi-Diffraction-Type Electro-Optic Deflector Using Polarization-Reversed Structures
Yuta Hayashi¹⁾, Hiroshi Murata¹⁾, Atsushi Sanada¹⁾, Masahide Okazaki²⁾, Masato Ishino¹⁾, Kazuhisa Yamamoto¹⁾
1) Osaka University, Japan, 2) SCREEN Holdings Co., Ltd., Japan
We have proposed a new multi-diffraction-type electro-optic deflector using polarization-reversed structures, which can deflect visible laser beams with a high speed. The operational principle, design, and experimental results of the proposed deflector are reported.

[LDC12] 16:00 - 16:30 **Post Deadline**

Chairs: Sunao Kurimura, NIMS, Japan
Tetsuya Yagi, Mitsubishi Electric Corp., Japan

LDC12-1 16:00
Evaluation of key influence factors to luminance lifetime for laser projection TV
Ruhai Guo, Weidong Liu, Xianrong Liu, Houjian Zhou
Hisense Group limited company, China
Nowadays, the luminance lifetime of laser projection TV is often defined by its laser source lifetime, such as 25000hr because the specification of semiconductor laser diode.

LDC12-2 16:10
Applicability of CIELAB volume metric to the latest electronic display with eye adaptation at medium grey scale or with white boosting
Hidefumi Yoshida¹⁾, Keita Hirai²⁾, Yoko Mizokami²⁾
1) Sharp Corporation, Japan, 2) Chiba University, Japan
We found that it is appropriate to adopt CIELAB for checking if the emissive display replicates the original source precisely, but not appropriate if the adaptation point of eyes is at a medium grey scale.

LDC12-3 16:20
Design and simulation of a diffractive diffuser for optimizing speckle contrast in a laser MEMS scanning Head-Up Displays
Giang Nam Nguyen, Ryo Kajiura, Axel Torschmied
Visteon Electronics Germany, Germany
A Diffractive Optical Element is designed as a spot array generator, taking into account the profile and pitch of the laser scanning beam, resulting in a diffusing pattern with low speckle contrast.

[Award and Closing] 16:30 - 16:45

Chairs: Sunao Kurimura, NIMS, Japan

Tetsuya Yagi, Mitsubishi Electric Corp., Japan

16:30 Award Ceremony

16:40 Closing Talk Hiroshi Murata Osaka University, Japan