

Wed. Nov 27, 2019

Conference Hall

Opening Remarks

[OP] Opening Remarks

Master of Ceremony: Hiromi Katoh (Executive Chair, IDW '19)

9:20 AM - 9:30 AM Conference Hall (1F)

[OpeningRemarks-1] Opening Remarks

*Shinichi Komura¹ (1. General Chair,
IDW '19)

9:20 AM - 9:22 AM

[OpeningRemarks-2] Opening Remarks

*Takatoshi Tsujimura¹ (1. President-
Elect, SID)

9:22 AM - 9:25 AM

[OpeningRemarks-3] Opening Remarks

*Itsuo Kumazawa¹ (1. Vice President,
ITE)

9:25 AM - 9:28 AM

[OpeningRemarks-4] Opening Remarks

*Munehiro Kimura¹ (1. Program Chair,
IDW '19)

9:28 AM - 9:30 AM

Wed. Nov 27, 2019

Conference Hall

Keynote Addresses

[Keynote] Keynote Addresses

Chair: Munehiro Kimura (Program Chair, IDW '19)

Co-Chair: Shinichi Komura (General Chair, IDW '19)

9:30 AM - 10:50 AM Conference Hall (1F)

[KeynoteAddress-1] Bringing the New Age Display with
Social Innovation

*Yasuhisa Itoh¹ (1. Sharp Corporation
(Japan))

9:30 AM - 10:10 AM

[KeynoteAddress-2] Human Centered Automotive Cockpit
HMI

*Taro Oike¹ (1. Mazda Motor (Japan))

10:10 AM - 10:50 AM

Wed. Nov 27, 2019

Conference Hall

Invited Addresses

[Invited] Invited Addresses

Chair: Munehiro Kimura (Program Chair, IDW '19)

Co-Chair: Shinichi Komura (General Chair, IDW '19)

11:00 AM - 12:20 PM Conference Hall (1F)

[InvitedAddress-1] Monolithic Micro-LED Full-Color

Micro-Displays

*Kei May Lau¹ (1. Hong Kong Univ. of
S&T (Hong Kong))

11:00 AM - 11:40 AM

[InvitedAddress-2] Artificial Intelligence: from
Pixels and Phonemes to Semantic
Understanding and Interactions

*Achin Bhowmik¹ (1. Starkey Hearing
Techs. (United States of America))

11:40 AM - 12:20 PM

Wed. Nov 27, 2019

Mid-sized Hall A

Special Talks

[ST] Special Talks

6:30 PM - 7:10 PM Mid-sized Hall A (1F)

[SpecialTalks] Special Talks

6:30 PM - 7:10 PM

Wed. Nov 27, 2019

Mid-sized Hall A

Oral Presentation

[VHF1] Image Quality and Measurements

Chair: Kenichiro Masaoka (NHK)

Co-Chair: Keita Hirai (Chiba Univ.)

1:40 PM - 3:10 PM Mid-sized Hall A (1F)

[VHF1-OP] Opening

1:40 PM - 1:45 PM

[VHF1-1] A Fundamental Evaluation of Visual Resolution of Displays Considering Different Sub-Pixel Structures*Daisuke Nakayama¹, Midori Tanaka¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

1:45 PM - 2:05 PM

[VHF1-2] Perceptually Optimized Image Enhancement for OLED Displays in Power-constrained Conditions*Hsuan-Chi Huang¹, Pei-Li Sun¹ (1. National Taiwan University of Science and Technology (Taiwan))

2:05 PM - 2:25 PM

[VHF1-3] Estimation of Equivalent Conditions for Display Sparkle Measurement*Makio Kurashige¹, Gen Furui¹, Kazutoshi Ishida¹, Shumpei Nishio¹, Toshiyuki Nakai¹, Hiroko Suzuki¹, Masayuki Tsunekawa¹, Yukimitsu Iwata¹, Norinaga Nakamura¹ (1. Dai Nippon Printing Co., Ltd. (Japan))

2:25 PM - 2:45 PM

[VHF1-4L(Invited)] Repeatability and Reproducibility Considerations for BlackMURA Measurements*Ingo Rotscholl¹, Tobias Porsch¹, Udo Krüger¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))

2:45 PM - 3:10 PM

Oral Presentation

[VHF2] Ergonomics for Automotive Applications

Chair: Yoshie Imai (Mitsubishi Elec.)

Co-Chair: Yukio Endo (AGC)

3:20 PM - 4:45 PM Mid-sized Hall A (1F)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving*Katsunori Okajima¹ (1. Yokohama National University (Japan))

3:20 PM - 3:45 PM

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

3:45 PM - 4:05 PM

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display - Basic Study on the Relationship between Degree of Correction and Driver's Recognition-*Kazuki Matsushashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

4:05 PM - 4:25 PM

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

4:25 PM - 4:45 PM

Oral Presentation

[VHF3/DES3] Virtual Reality

Chair: Takashi Shibata (Tokyo Univ. of Social Welfare)

Co-Chair: Johan Bergquist (Consultant)

5:00 PM - 6:30 PM Mid-sized Hall A (1F)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

5:00 PM - 5:25 PM

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

5:25 PM - 5:50 PM

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is

Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹,
Koudai Ito¹ (1. National Institute of
Advanced Industrial Science and Technology
(Japan))

5:50 PM - 6:10 PM

[VHF3/DES3-4] Color Perception Comparison of Scene
Images between Head-Mounted Display and
Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko
Horiuchi¹ (1. Chiba University (Japan))

6:10 PM - 6:30 PM

Mid-sized Hall B

Oral Presentation

[AMD1] Foldable Technology of OLED Displays

Chair: Koichi Miwa (LG Display Co.,Ltd)

Co-Chair: Keisuke Omoto (Apple)

1:40 PM - 3:15 PM Mid-sized Hall B (1F)

[AMD1-1(Invited)] Development of Foldable AMOLED
Displays Based on Neutral-Plane
Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹,
Masatomo Hishinuma¹, Hajime Yamaguchi¹,
Akio Murayama¹ (1. Japan Display Inc.
(Japan))

1:40 PM - 2:05 PM

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age
of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹,
Xianrui Qian¹, Jiye Xia¹ (1. Visionox
Technology Inc (China))

2:05 PM - 2:30 PM

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung
Hee University (Korea))

2:30 PM - 2:45 PM

[AMD1-4] Positive Bias-Stress Stability of Flexible
Amorphous InGaZnO Thin Film Transistors with
Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng
Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong
University (China))

2:55 PM - 3:15 PM

Oral Presentation

[AMD2] High Resolution Display

Chair: Junichi Takeya (University of Tokyo)

Co-Chair: Hiroki Hamada (Kinki Univ.)

3:20 PM - 4:45 PM Mid-sized Hall B (1F)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED
TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok
Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹, Shin-
Kyun Park¹ (1. LG Display Co., Ltd.
(Korea))

3:20 PM - 3:45 PM

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis
Aligned Crystalline Oxide
Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹,
Takashi Nakagawa¹, Yuki Tamatsukuri¹,
Hideaki Shishido¹, Shogo Uesaka¹, Ryohei
Yamaoka¹, Takaaki Nagata¹, Tomoya
Aoyama¹, Yutaka Okazaki¹, Takayuki
Ikeda¹, Shunpei Yamazaki¹ (1.
Semiconductor Energy Laboratory Co.,
Ltd. (Japan))

3:45 PM - 4:10 PM

[AMD2-3] Novel Compensation Pixel Circuit with
Simultaneous Emission Driving Scheme for
High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun
Chen¹, Chih-Lung Lin¹ (1. National Cheng Kung
University (Taiwan))

4:10 PM - 4:30 PM

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local
Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹,
Yongyuan Qiu¹, Quansheng Liu¹, Yong Yang¹, Junling
Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹,
Xin Zhang¹ (1. Shenzhen China Star
Optoelectronics Technology Co., Ltd (China))

4:30 PM - 4:45 PM

Oral Presentation

[AMD3] Driving Technology of Micro/Mini LED Displays

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Keisuke Omoto (Apple)

5:00 PM - 6:35 PM Mid-sized Hall B (1F)

[AMD3-1(Invited)] Crystal LED Display System for
Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹,
Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony
Semiconductor Solutions Corporation
(Japan), 2. Sony Corporation (Japan))
5:00 PM - 5:25 PM

[AMD3-2(Invited)] Active Matrix Driving mini-LED
Device
*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-
Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹,
Minoru Shibazaki² (1. Innolux
Corporation (Taiwan), 2. Innolux Japan
(Japan))
5:25 PM - 5:50 PM

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix
Micro-LED Display with Low-
Temperature-Poly-Silicon TFT
Backplane
*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki
Ito¹, Takanobu Suzuki¹, Masahiko
Nishide¹, Kunio Imaizumi¹, Katsumi
Yamanoguchi¹, Fanny Rahadian¹, Katsumi
Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹
(1. Kyocera Corporation (Japan))
5:50 PM - 6:15 PM

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro
Display
*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian
Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong
University of Science and Technology (Hong Kong))
6:15 PM - 6:35 PM

Room 107

Oral Presentation

[LCT1] Evaluation Techniques
Chair: Masaru Inoue (Toyo Tech. LLC)
Co-Chair: Yoshinori Iwashita (DIC)
1:40 PM - 3:00 PM Room 107 (1F)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays
Caused by Polyimide Anion Radicals
*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC
Petrochemical Corporation (Japan))
1:40 PM - 2:00 PM

[LCT1-2] The Systematically Investigation on the
Influence Factor on Vertical Alignment State
of Polyimide-free Liquid Crystal Displays
*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-

Jen Tseng², Chung-Ching Hsieh² (1. Peking
University Shenzhen Graduate School (China), 2.
Shenzhen China Star Optoelectronics Technology Co.,
Ltd (China))
2:00 PM - 2:20 PM

[LCT1-3] Second-Harmonic Imaging of Flexoelectric
Polarization in Various Liquid Crystal Cells
*Koichiro Shiota¹, Fumito Araoka¹, Yutaka Yamagata¹
(1. RIKEN (Japan))
2:20 PM - 2:40 PM

[LCT1-5L] A Novel Orientation Method for Nematic LCs
by Using Magnetic Field Lines with Permanent
Magnets and Electric Field for Assisting the
Reorientation
Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro
Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University
(Japan))
2:40 PM - 3:00 PM

Oral Presentation

[LCT2] LC Flat Diffractive Optics
Chair: Toshiaki Nose (Akita Prefecture University)
Co-Chair: Hiroyuki Yoshida (Osaka University)
3:20 PM - 4:50 PM Room 107 (1F)

[LCT2-1(Invited)] Fundamentals and Applications of
Liquid Crystal-Based, Polarization-
Dependent Diffractive
Optics Fundamentals and Applications
of Liquid Crystal-Based,
Polarization-Dependent Diffractive
Optics
*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto
Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹
(1. Osaka University (Japan))
3:20 PM - 3:40 PM

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and
Next Generation Displays
*Nelson Tabirian¹, David Roberts¹, Anna
Tabirian¹, Brian R Kimball², Timothy J
Bunning³ (1. BEAM Engineering for
Advanced Measurements Co. (United States
of America), 2. U.S. Army Natick Soldier
Systems Center, Natick, Massachusetts
(United States of America), 3. Air Force
Research Laboratories, Wright-Patterson
Air Force Base, Ohio (United States of

America))

3:40 PM - 4:05 PM

- [LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements
*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

4:05 PM - 4:30 PM

- [LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up Displays
Xiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))
4:30 PM - 4:50 PM

Oral Presentation

- [LCT3] Advanced LCD Technologies
Chair: Hiroyuki Okada (University of Toyama)
Co-Chair: Koichi Miyachi (JSR)
5:00 PM - 6:20 PM Room 107 (1F)

- [LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method
*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))
5:00 PM - 5:20 PM
- [LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell
*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))
5:20 PM - 5:40 PM
- [LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD
*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))
5:40 PM - 6:00 PM
- [LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application
*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

6:00 PM - 6:20 PM

Room 108

Oral Presentation

- [FMC2] Metrology and Manufacturing
Chair: K Kälantär (Global Optical Solutions)
Co-Chair: Toshiaki Nonaka (Merck Performance Materials)
3:20 PM - 4:40 PM Room 108 (1F)

- [FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices
*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))
3:20 PM - 3:40 PM

- [FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field
*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))
3:40 PM - 4:00 PM

- [FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD
*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))
4:00 PM - 4:20 PM

- [FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM
*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))
4:20 PM - 4:40 PM

Oral Presentation

- [PRJ1/FMC1] AR/VR
Chair: Satoshi Ouchi (Hitachi)
Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)
1:40 PM - 3:05 PM Room 108 (1F)

- [PRJ1/FMC1-OP] Opening
Satochi Ouchi¹, Hirotsugu Yamamoto² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))

1:40 PM - 1:45 PM

[PRJ1/FMC1-1(Invited)] Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays

*Zong Qin¹, Jui-Yi Wu¹, Ping-Yen Chou¹, Cheng-Ting Huang¹, Yu-Ting Chen¹, Yi-Pai Huang¹ (1. National Chiao Tung University (Taiwan))

1:45 PM - 2:05 PM

[PRJ1/FMC1-2] Possibility of Deblurring Aerial Image Based on Deconvolution Processing

*Hayato Kikuta^{1,2}, Hirotsugu Yamamoto^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))

2:05 PM - 2:25 PM

[PRJ1/FMC1-3] Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display

*Takeru Utsugi¹, Mayumi Sasaki², Kazuhiko Ono², Yukinobu Tada² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))

2:25 PM - 2:45 PM

[PRJ1/FMC1-4] High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations

*Ryuji Ukai¹, Takuma Kuno¹, Toshiteru Nakamura¹, Masahito Uchiyama¹, Satoshi Ouchi¹ (1. Hitachi, Ltd. (Japan))

2:45 PM - 3:05 PM

Oral Presentation

[FLX1/FMC3] Advanced Materials and Components for Flexible Electronics

Chair: Toshihide Kamata (National Institute of Advanced Industrial Science and Technology)

Co-Chair: Makoto Arai (ULVAC Inc.)

5:00 PM - 6:30 PM Room 108 (1F)

[FLX1/FMC3-OP] Opening

5:00 PM - 5:05 PM

[FLX1/FMC3-1(Invited)] Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device

*Masato Ohsawa¹, Natsuki

Hashimoto¹, Naoki Takeda², Shota Tsuneyasu², Toshifumi Satoh² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))

5:05 PM - 5:30 PM

[FLX1/FMC3-2] Al alloying effect in functionalization of mechanical resistance to foldable display interconnections

*Chiharu Kura¹, Mototaka Ochi¹, Hiroyuki Okuno², Hiroshi Goto² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))

5:30 PM - 5:50 PM

[FLX1/FMC3-5L] Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics

*John Fahlteich¹, Michiel Top¹, Stefan Hinze¹, Uwe Meyer¹, Tobias Vogt¹, Valentijn von Morgen², Matthias Fahland¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))

5:50 PM - 6:05 PM

[FLX1/FMC3-4] Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer

*Yuto Toshimori¹, Sohei Nonaka¹ (1. Mitsubishi Materials Corporation (Japan))

6:10 PM - 6:30 PM

Small Hall

Oral Presentation

[3DSA1/3D1] Holography 1

Chair: Hoang Yan Lin (Nat. Taiwan Univ.)

Co-Chair: Takashi Kakue (Chiba Univ.)

1:40 PM - 3:05 PM Small Hall (2F)

[3DSA1/3D1-OP] Opening

Shiro Suyama¹ (1. Tokushima Univ. (Japan))

1:40 PM - 1:45 PM

[3DSA1/3D1-1(Invited)] Complex Spatial Light

Modulation for Holographic Displays

*Hwi Kim¹ (1. Korea University (Korea))

1:45 PM - 2:05 PM

[3DSA1/3D1-5L] A Fast Hologram Calculation Method Based on the Light Field Rendering
 *Tiantian Zhang¹, Li Liu¹, Jun Xia¹ (1. Southeast University (China))

2:05 PM - 2:25 PM

[3DSA1/3D1-3] Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging

*Zi Wang¹, Guoqiang Lv¹, Qibin Feng¹ (1. Hefei University of Technology (China))

2:25 PM - 2:45 PM

[3DSA1/3D1-4] Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens

*KiHong Choi¹, Jongmin Kim¹, Keehoon Hong², Joongki Park², Sung-Wook Min¹ (1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

2:45 PM - 3:05 PM

Oral Presentation

[3DSA3/3D3] Light Field 1

Chair: Yasuhiro Takaki (Tokyo Univ. of A&T)

Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)

5:00 PM - 6:20 PM Small Hall (2F)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

5:00 PM - 5:20 PM

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

5:20 PM - 5:40 PM

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoung-ho Lee¹ (1. Seoul National University (Korea))

5:40 PM - 6:00 PM

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

6:00 PM - 6:20 PM

Oral Presentation

[3D2/3DSA2] Holography 2

Chair: Hwi Kim (Korea Univ.)

Co-Chair: Yuji Sakamoto (Hokkaido Univ.)

3:20 PM - 4:40 PM Small Hall (2F)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

3:20 PM - 3:40 PM

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMOG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

3:40 PM - 4:00 PM

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

4:00 PM - 4:20 PM

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

4:20 PM - 4:40 PM

Room 204

Oral Presentation

[OLED1] OLED Devices

Chair: Takahisa Shimizu (NHK)

Co-Chair: Ken-ichi Nakayama (Osaka University)

1:40 PM - 3:00 PM Room 204 (2F)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹ (1. Technische Universität Dresden (Germany))

1:40 PM - 2:00 PM

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

2:00 PM - 2:20 PM

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

2:20 PM - 2:40 PM

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

2:40 PM - 3:00 PM

Oral Presentation

[OLED2] OLED Material

Chair: Takahiro Komatsu (JOLED)

Co-Chair: Hitoshi Kuma (Idemitsu Kosan)

3:20 PM - 4:40 PM Room 204 (2F)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

3:20 PM - 3:40 PM

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

3:40 PM - 4:00 PM

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

4:00 PM - 4:20 PM

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

4:20 PM - 4:40 PM

Oral Presentation

[OLED3] OLED Display

Chair: Taishi Tsuji (NIPPON STEEL Chemical &Material)

Co-Chair: Masaya Adachi (Japan Display Inc)

5:00 PM - 6:25 PM Room 204 (2F)

[OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range

*Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))

5:00 PM - 5:20 PM

[OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display

*Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))

5:20 PM - 5:40 PM

[OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds

*Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))

5:40 PM - 5:55 PM

[OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode

*Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co., Ltd. (Japan), 2. Toray Industries, Inc. (Japan))

5:55 PM - 6:10 PM

[OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs Significance of Energy-Level Alignment in 3D Perovskite ELs

*KIHUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))

6:10 PM - 6:25 PM

Room 206

Oral Presentation

[AIS1/INP2] Smart Society and Information Display

Chair: Katashi Nagao (Nagoya University)
Co-Chair: Toshiaki Fujii (Nagoya University)
3:20 PM - 4:35 PM Room 206 (2F)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us
*Kazuyuki Fujita¹ (1. Tohoku University (Japan))
3:20 PM - 3:45 PM

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN
*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))
3:45 PM - 4:10 PM

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN
*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))
4:10 PM - 4:35 PM

Oral Presentation

[AIS2] AI and Information Display
Chair: Yuki Ban (The University of Tokyo)
Co-Chair: Kazuyuki Fujita (Tohoku University)
5:00 PM - 6:25 PM Room 206 (2F)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays
*Katashi Nagao¹ (1. Nagoya University (Japan))
5:00 PM - 5:25 PM

[AIS2-2(Invited)] Light-field image processing using deep neural network
*Toshiaki Fujii¹ (1. Nagoya University (Japan))
5:25 PM - 5:50 PM

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering
*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))
5:50 PM - 6:10 PM

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO

algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai²,
Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei²
(1. National Taiwan University of Science and
Technology (Taiwan), 2. National Chung-Hsing
University (Taiwan))

6:10 PM - 6:25 PM

Oral Presentation

[INP1] In-Cell Touch Panels and Fingerprint Sensors

Chair: Noemie Ballot (ISORG)

Co-Chair: Yuji Suzuki (Japan Display Inc.)

1:40 PM - 2:56 PM Room 206 (2F)

[INP1-OP] Opening

Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))

1:40 PM - 1:41 PM

[INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor

*Yuji Suzuki¹, Satoshi Uchino¹, Kohei
Azumi¹, Tadayoshi Katsuta¹, Daichi
Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹
(1. Japan Display Inc. (Japan))

1:41 PM - 2:06 PM

[INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement

*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi
Ishikawa¹ (1. The University of Tokyo (Japan))
2:06 PM - 2:21 PM

[INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones

*Noemie Ballot¹ (1. ISORG (France))
2:31 PM - 2:56 PM

Room 207

Oral Presentation

[EP1] Emerging Electronic Paper Displays

Chair: Makoto Omodani (Tokai University)

Co-Chair: Masayoshi Higuchi (NIMS)

5:00 PM - 6:35 PM Room 207 (2F)

[EP1-OP] Opening

5:00 PM - 5:05 PM

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya
Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹,
Takehisa Ishida¹, Kenji Takagi¹, Isao
Takahashi¹, Hirohisa Amago², Taichi
Takeuchi², Asuka Tejima², Maho Watanabe²,
Yuki Oishi¹, Takahiro Kamei¹, Kazumasa
Nomoto¹ (1. Sony Corporation (Japan), 2.
Sony Global Manufacturing & Operations
Corporation (Japan))

5:05 PM - 5:30 PM

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink.
(Taiwan))

5:30 PM - 5:55 PM

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University
(China))

5:55 PM - 6:20 PM

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanao Fujisaki¹ (1. Tokai University (Japan))
6:20 PM - 6:35 PM

Oral Presentation

[DES1] 8K Systems

Chair: Ryutaro Oke (Panasonic Liquid Crystal Display)

Co-Chair: Hyun-Wook Lim (SAMSUNG ELECTRONICS)

1:40 PM - 3:00 PM Room 207 (2F)

[DES1-OP] Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:40 PM - 1:45 PM

[DES1-1(Invited)] Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹,
Ryutaro Oke², Kenkichi Tanioka¹, Toshio
Chiba¹ (1. Kairos Co., Ltd. (Japan), 2.
Panasonic Liquid Crystal Display Co.,
Ltd. (Japan))

1:45 PM - 2:10 PM

[DES1-2(Invited)] Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho
Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹,

Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

2:10 PM - 2:35 PM

[DES1-3(Invited)] Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application
*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))
2:35 PM - 3:00 PM

Oral Presentation

[DES2] Driving Technology

Chair: Chih-Wen Lu (Nat. Tsing Hua Univ.)

Co-Chair: Keiichi Nakajima (Tianma Japan)

3:20 PM - 4:40 PM Room 207 (2F)

[DES2-1] Relationship Between Charging Rate and Color Gamma Cross-talk for TFT-LCD with Flip Pixel Driven Architecture
*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

3:20 PM - 3:40 PM

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays
*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:40 PM - 4:00 PM

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT
*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

4:00 PM - 4:20 PM

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs
*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

4:20 PM - 4:40 PM

Wed. Nov 27, 2019

Main Hall

Authors Interview

[AI-01] Authors Interview

6:30 PM - 7:00 PM Main Hall (1F)

[AI-1] Authors Interview

6:30 PM - 7:00 PM

Opening Remarks

[OP] Opening Remarks

Master of Ceremony: Hiromi Katoh (Executive Chair, IDW '19)

Wed. Nov 27, 2019 9:20 AM - 9:30 AM Conference Hall (1F)

[OpeningRemarks-1] Opening Remarks

*Shinichi Komura¹ (1. General Chair, IDW '19)

9:20 AM - 9:22 AM

[OpeningRemarks-2] Opening Remarks

*Takatoshi Tsujimura¹ (1. President-Elect, SID)

9:22 AM - 9:25 AM

[OpeningRemarks-3] Opening Remarks

*Itsuo Kumazawa¹ (1. Vice President, ITE)

9:25 AM - 9:28 AM

[OpeningRemarks-4] Opening Remarks

*Munehiro Kimura¹ (1. Program Chair, IDW '19)

9:28 AM - 9:30 AM

9:20 AM - 9:22 AM (Wed. Nov 27, 2019 9:20 AM - 9:30 AM Conference Hall)

[OpeningRemarks-1] Opening Remarks

*Shinichi Komura¹ (1. General Chair, IDW '19)

9:22 AM - 9:25 AM (Wed. Nov 27, 2019 9:20 AM - 9:30 AM Conference Hall)

[OpeningRemarks-2] Opening Remarks

*Takatoshi Tsujimura¹ (1. President-Elect, SID)

9:25 AM - 9:28 AM (Wed. Nov 27, 2019 9:20 AM - 9:30 AM Conference Hall)

[OpeningRemarks-3] Opening Remarks

*Itsuo Kumazawa¹ (1. Vice President, ITE)

9:28 AM - 9:30 AM (Wed. Nov 27, 2019 9:20 AM - 9:30 AM Conference Hall)

[OpeningRemarks-4] Opening Remarks

*Munehiro Kimura¹ (1. Program Chair, IDW '19)

Keynote Addresses

[Keynote] Keynote Addresses

Chair: Munehiro Kimura (Program Chair, IDW '19)

Co-Chair: Shinichi Komura (General Chair, IDW '19)

Wed. Nov 27, 2019 9:30 AM - 10:50 AM Conference Hall (1F)

[KeynoteAddress-1] Bringing the New Age Display with Social Innovation

*Yasuhisa Itoh¹ (1. Sharp Corporation (Japan))

9:30 AM - 10:10 AM

[KeynoteAddress-2] Human Centered Automotive Cockpit HMI

*Taro Oike¹ (1. Mazda Motor (Japan))

10:10 AM - 10:50 AM

9:30 AM - 10:10 AM (Wed. Nov 27, 2019 9:30 AM - 10:50 AM Conference Hall)

[KeynoteAddress-1] Bringing the New Age Display with Social Innovation

*Yasuhisa Itoh¹ (1. Sharp Corporation (Japan))

Based on the social infrastructure upgrade, the creation of new applications as well as divarication demands for display technology, it is possible for the display market to grow sustainably in the future. I will talk about next generation display technology aiming at such social innovation.

10:10 AM - 10:50 AM (Wed. Nov 27, 2019 9:30 AM - 10:50 AM Conference Hall)

[KeynoteAddress-2] Human Centered Automotive Cockpit HMI

*Taro Oike¹ (1. Mazda Motor (Japan))

An automotive display in the cockpit is an HMI device. It projects useful information for the driver, but it can also causes driver distractions. Driving safety is the most important factor in automobiles, and HMI device design requirements must be met for that purpose. Since automotive displays emit and reflect light, light control technology is important for automotive displays.

Invited Addresses

[Invited] Invited Addresses

Chair: Munehiro Kimura (Program Chair, IDW '19)

Co-Chair: Shinichi Komura (General Chair, IDW '19)

Wed. Nov 27, 2019 11:00 AM - 12:20 PM Conference Hall (1F)

[InvitedAddress-1] Monolithic Micro-LED Full-Color Micro-Displays

*Kei May Lau¹ (1. Hong Kong Univ. of S&T (Hong Kong))

11:00 AM - 11:40 AM

[InvitedAddress-2] Artificial Intelligence: from Pixels and Phonemes to Semantic Understanding and Interactions

*Achin Bhowmik¹ (1. Starkey Hearing Techs. (United States of America))

11:40 AM - 12:20 PM

11:00 AM - 11:40 AM (Wed. Nov 27, 2019 11:00 AM - 12:20 PM Conference Hall)

[InvitedAddress-1] Monolithic Micro-LED Full-Color Micro-Displays

*Kei May Lau¹ (1. Hong Kong Univ. of S&T (Hong Kong))

Monolithic LED arrays with color conversion schemes for full-color displays will be reported. Two micro-LED arrays fabricated using blue and dual wavelength LED epilayers are extended to full-color by quantum-dot down conversion technology. Both approaches exhibit feasible manufacturability and decent visual quality, showing promise toward volume production of full-color micro-displays.

11:40 AM - 12:20 PM (Wed. Nov 27, 2019 11:00 AM - 12:20 PM Conference Hall)

[InvitedAddress-2] Artificial Intelligence: from Pixels and Phonemes to Semantic Understanding and Interactions

*Achin Bhowmik¹ (1. Starkey Hearing Techs. (United States of America))

In the recent years, unprecedented advances in artificial intelligence (AI) technologies and applications are being enabled by rapid developments in machine learning, big data, and specialized computing architectures. We will review how devices are increasingly being endowed with technologies to sense and understand the world, often surpassing human-level performances, and ushering in a new wave of intelligent applications.

Special Talks

[ST] Special Talks

Wed. Nov 27, 2019 6:30 PM - 7:10 PM Mid-sized Hall A (1F)

[SpecialTalks] Special Talks

6:30 PM - 7:10 PM

6:30 PM - 7:10 PM (Wed. Nov 27, 2019 6:30 PM - 7:10 PM Mid-sized Hall A)

[SpecialTalks] Special Talks

 Oral Presentation

[VHF1] Image Quality and Measurements

Chair: Kenichiro Masaoka (NHK)

Co-Chair: Keita Hirai (Chiba Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A (1F)

- | | |
|--------------------|---|
| [VHF1-OP] | Opening
1:40 PM - 1:45 PM |
| [VHF1-1] | A Fundamental Evaluation of Visual Resolution of Displays Considering Different Sub-Pixel Structures
*Daisuke Nakayama ¹ , Midori Tanaka ¹ , Takahiko Horiuchi ¹ (1. Chiba University (Japan))
1:45 PM - 2:05 PM |
| [VHF1-2] | Perceptually Optimized Image Enhancement for OLED Displays in Power-constrained Conditions
*Hsuan-Chi Huang ¹ , Pei-Li Sun ¹ (1. National Taiwan University of Science and Technology (Taiwan))
2:05 PM - 2:25 PM |
| [VHF1-3] | Estimation of Equivalent Conditions for Display Sparkle Measurement
*Makio Kurashige ¹ , Gen Furui ¹ , Kazutoshi Ishida ¹ , Shumpei Nishio ¹ , Toshiyuki Nakai ¹ , Hiroko Suzuki ¹ , Masayuki Tsunekawa ¹ , Yukimitsu Iwata ¹ , Norinaga Nakamura ¹ (1. Dai Nippon Printing Co., Ltd. (Japan))
2:25 PM - 2:45 PM |
| [VHF1-4L(Invited)] | Repeatability and Reproducibility Considerations for BlackMURA Measurements
*Ingo Rotscholl ¹ , Tobias Porsch ¹ , Udo Krüger ¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))
2:45 PM - 3:10 PM |

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-OP] Opening

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-1] A Fundamental Evaluation of Visual Resolution of Displays Considering Different Sub-Pixel Structures

*Daisuke Nakayama¹, Midori Tanaka¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

Keywords: Display resolution, Visual experiment, Sub-pixel

We conducted a psychometric evaluation of different display sub-pixel structures. Our assessments of the RGB sub-pixel structure showed that the vertical visual resolution was higher than the horizontal visual resolution. In addition, the visual resolution itself differed according to the sub-pixel structures.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-2] Perceptually Optimized Image Enhancement for OLED Displays in Power-constrained Conditions

*Hsuan-Chi Huang¹, Pei-Li Sun¹ (1. National Taiwan University of Science and Technology (Taiwan))

Keywords: OLED Display, APL (Average Pixel Level), Low-power Image Enhancement

A psycho-visual experiment was conducted to optimize the parameters of an image enhancement model for OLED displays to maintain image quality in power-constrained conditions.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-3] Estimation of Equivalent Conditions for Display Sparkle Measurement

*Makio Kurashige¹, Gen Furui¹, Kazutoshi Ishida¹, Shumpei Nishio¹, Toshiyuki Nakai¹, Hiroko Suzuki¹, Masayuki Tsunekawa¹, Yukimitsu Iwata¹, Norinaga Nakamura¹ (1. Dai Nippon Printing Co., Ltd. (Japan))

Keywords: sparkle, sparkle contrast, anti-glare display

Various measurement conditions of sparkle contrast were analysed in terms of the equivalent area of the resolution spot of the imaging system on the display. The results show the possibility to achieve the equivalent measurement conditions among different measurement distance, F-number and focal length of imaging lens.

2:45 PM - 3:10 PM (Wed. Nov 27, 2019 1:40 PM - 3:10 PM Mid-sized Hall A)

[VHF1-4L(Invited)] Repeatability and Reproducibility Considerations for BlackMURA Measurements

*Ingo Rotscholl¹, Tobias Porsch¹, Udo Krüger¹ (1. TechnoTeam Bildverarbeitung GmbH (Germany))

Keywords: BlackMURA, Measurement Uncertainty, Reproducibility, Imaging Luminance Measurement Device

The "Uniformity measurement standard for Displays", which is used for automotive applications, describes precise setup and alignment procedures to ensure reproducible measurement results. However, the influences of the tested device and the ILMD are not considered in detail. This contribution shows experiments and simulations to estimate these influences as well.

Oral Presentation

[VHF2] Ergonomics for Automotive Applications

Special Topics of Interest on Automotive Displays

Chair: Yoshie Imai (Mitsubishi Elec.)

Co-Chair: Yukio Endo (AGC)

Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A (1F)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving

*Katsunori Okajima¹ (1. Yokohama National University (Japan))

3:20 PM - 3:45 PM

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition

*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

3:45 PM - 4:05 PM

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display -Basic Study on the Relationship between Degree of Correction and Driver's Recognition-

*Kazuki Matsunashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

4:05 PM - 4:25 PM

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display

*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

4:25 PM - 4:45 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-1(Invited)] Application of Visibility Index Function for Driving

*Katsunori Okajima¹ (1. Yokohama National University (Japan))

Keywords: Visibility, Character, Visual distance, Visual size, Luminance

We demonstrate VIF (Visibility Index Function) can be applied for precisely simulating and improving the visibility of driving environments as well as human-interface devices in driving. The VIF is convenient to design information display and traffic signs with considering visibility while driving.

3:45 PM - 4:05 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-2] Effect of External Human Machine Interface (eHMI) of Automated Vehicle on Pedestrian's Recognition

*Naoto Matsunaga¹, Tatsuru Daimon¹, Naoki Yokota¹, Satoshi Kitazaki² (1. Keio University (Japan), 2. National Institute of Advanced Industrial Science and Technology (Japan))

Keywords: external Human Machine Interface (eHMI), automated vehicle, interaction, pedestrian, crosswalk

The interaction between a pedestrian and an automated vehicle equipped with an external human machine interface at an unsignalized crosswalk is discussed. The external human machine interface has the potential to provide an effective communication cue from which the pedestrian can judge whether the automated vehicle is yielding to them.

4:05 PM - 4:25 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-3] Influence of Cabin Vibration on Driver's Depth Perception and Subjective Conviction When Using Automotive 3D Head-Up Display -Basic Study on the Relationship between Degree of Correction and Driver's Recognition-

*Kazuki Matsushashi¹, Tatsuru Daimon², Ryo Noguchi¹, Ken'ichi Kasazumi³, Toshiya Mori³ (1. Graduate School of Keio (Japan), 2. University of Keio (Japan), 3. Panasonic Corporation (Japan))

Keywords: human factors, human machine interface, head-up display, recognition, depth perception

This study discusses the driver's depth perception and subjective conviction to be corrected for in the display contents of an automotive three-dimensional head-up display, such as navigation arrows, based on the levels of the basic correction method used to reduce the effect of car vibration due to various road surfaces.

4:25 PM - 4:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall A)

[VHF2-4] The Evaluation for Visibility of a Back Image on a Transparent Display

*Naruki Yamada¹, Yoshinori Iguchi¹, Yukihiro Tao¹ (1. AGC Inc. (Japan))

Keywords: Transparent display, Transparent screen, Visibility, Back image, HUD

Transparent display is useful device for some applications but has a privacy issue that a back image appears on the opposite side to the display image. We investigated the condition human cannot see a back image.

Oral Presentation

[VHF3/DES3] Virtual Reality

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Takashi Shibata (Tokyo Univ. of Social Welfare)

Co-Chair: Johan Bergquist (Consultant)

Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A (1F)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution

*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

5:00 PM - 5:25 PM

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation

*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

5:25 PM - 5:50 PM

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹, Koudai Ito¹ (1. National Institute of Advanced Industrial Science and Technology (Japan))

5:50 PM - 6:10 PM

[VHF3/DES3-4] Color Perception Comparison of Scene Images between Head-Mounted Display and Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

6:10 PM - 6:30 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-1(Invited)] VR headset with human-eye resolution

*Osku Sahlsten¹ (1. Varjo Technologies Oy (Finland))

Keywords: Virtual reality, Resolution, ppi, ppd, VR-1

With current display manufacturing methods, it would be very hard to produce a single near eye display that offers 60 pixels / degree resolution over the whole field of view and is small enough to fit into the headset. In case of greater than 90-degree field of view, basically 6k x 6k panel would be required. With the high refresh rates of virtual reality applications, this would mean also very large data transfer rates and high rendering load on GPU's.

Varjo overcome these challenges by composing the single eye image from two different display sources, while minimizing the effect on total rendering load. High angular resolution is used on the area where it is mostly needed. Precise analysis of displays with geometrical- and optical adjustments is needed to blend the 2 separate images to a one uniform scene.

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-2(Invited)] Metrology challenges in near to eye display characterization for human factors correlation

*Richard Lee Austin¹, Bruce Denning¹, John Penczek² (1. Gamma Scientific (United States of America), 2. University of Colorado, Boulder (United States of America))

Keywords: AR/VR near-eye display Eye-Box, pupil rotation versus eye rotation, Resolution, Luminance, Color

We present metrology challenges and solutions to measure Near Eye Displays performance parameters that can produce visual discomfort and headaches. Accurate measurement data correlates to what the eye perceives when the entrance pupil of the Light Measurement Device (LMD) matches the location and pointing direction of the display user's eye.

5:50 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-3] Optic Flow, but Not Retinal Flow, Is Essential to Induce VR Sickness

*Hiroyasu Ujike¹, Kei Hyodo¹, Mitsunori Tada¹, Koudai Ito¹ (1. National Institute of Advanced Industrial Science and Technology (Japan))

Keywords: VR sickness, VIMS, optic flow, retinal flow, SSQ

We conducted an experiment measuring VR sickness using HMD, manipulating optic flow and retinal flow in three conditions. The results showed that sickness scores increased according to the amount of optic flow, but not of retinal flow, indicating that optic flow, not retinal flow, is essential to induced VR sickness.

6:10 PM - 6:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Mid-sized Hall A)

[VHF3/DES3-4] Color Perception Comparison of Scene Images between Head-Mounted Display and Desktop Display

*Tomonori Nishimura¹, Keita Hirai¹, Takahiko Horiuchi¹ (1. Chiba University (Japan))

Keywords: Color perception, Image appearance, Visual experiment, Virtual reality, CIELAB color difference

In this paper, subjective evaluation experiments using scene images were conducted to investigate the difference of luminance and chroma perception between an HMD and a desktop display. The results showed that the perception of luminance and chroma of the HMD were higher compared with those of the desktop display.

Oral Presentation

[AMD1] Foldable Technology of OLED Displays

Chair: Koichi Miwa (LG Display Co.,Ltd)

Co-Chair: Keisuke Omoto (Apple)

Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B (1F)

[AMD1-1(Invited)] Development of Foldable AMOLED Displays Based on Neutral-Plane Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹, Masatomo Hishinuma¹, Hajime Yamaguchi¹, Akio Murayama¹ (1. Japan Display Inc. (Japan))

1:40 PM - 2:05 PM

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹, Xianrui Qian¹, Jiye Xia¹ (1. Visionox Technology Inc (China))

2:05 PM - 2:30 PM

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung Hee University (Korea))

2:30 PM - 2:45 PM

[AMD1-4] Positive Bias-Stress Stability of Flexible Amorphous InGaZnO Thin Film Transistors with Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong University (China))

2:55 PM - 3:15 PM

1:40 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-1(Invited)] Development of Foldable AMOLED Displays Based on Neutral-Plane Splitting Concept

*Masumi Nishimura¹, Kisako Takebayashi¹, Masatomo Hishinuma¹, Hajime Yamaguchi¹, Akio Murayama¹ (1. Japan Display Inc. (Japan))

Keywords: Foldable display, Neutral-plane splitting, Bending stiffness, Adhesive, Organic light-emitting diode

Splitting of the mechanical neutral plane is a promising concept for foldable displays because it reduces the folding stress and stiffness of the display. We verified the concept experimentally and developed 5.5-inch full high-definition foldable AMOLED displays, which endured 150 k inward folding cycles with folding radius of 3 mm.

2:05 PM - 2:30 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-2(Invited)] Ubiquitous Display, The Golden Age of OLED

*Chenggong Wang¹, Zhibo Yao¹, Yifan Liu¹, Xianrui Qian¹, Jiye Xia¹ (1. Visionox Technology Inc (China))

Keywords: AMOLED, Flexible display

The AMOLED display technology became more and more popular in the display field. However, there are still many challenges for this technology. We spend a lot of time working on it to make progress of the mass production of AMOLED, especially for the flexible AMOLED.

2:30 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-5L] Stretchable Oxide TFTs on PI/SEBS Substrate

*Chanju Park¹, Suhui Lee¹, Jin Jang¹ (1. Kyung Hee University (Korea))

Keywords: Amorphous indium gallium zinc oxide (a-IGZO), Thin-film transistor (TFT), Stretchable substrate

We present stretchable amorphous indium-gallium-zinc-oxide (a-IGZO) thin-film transistors (TFTs) transferred onto styrene ethylene/butylene styrene (SEBS) thermoplastic elastomer. The fabricated stretchable oxide TFT showed electrical properties even after 40% strain without mechanical and electrical degradations. This stiff island on the stretchable substrate was demonstrated to enable for stretchable electronics.

2:55 PM - 3:15 PM (Wed. Nov 27, 2019 1:40 PM - 3:15 PM Mid-sized Hall B)

[AMD1-4] Positive Bias-Stress Stability of Flexible Amorphous InGaZnO Thin Film Transistors with Double-Stacked Gate Insulators

*Chengyuan Dong¹, Guochao Liu¹, Ying Zhang¹, Guofeng Feng¹, Wen Zhang¹ (1. Shanghai Jiao Tong University (China))

Keywords: flexible, a-IGZO TFT, Double-stacked Gate Insulator, PBS

Double-stacked gate insulators (SiO_x/TaO_x) made flexible amorphous InGaZnO thin film transistors more stable under both mechanical bending and positive bias-stress, which was assumed to result from their better neutral plane position and front-channel interface states. A simple model was built to explain this improvement effect.

Oral Presentation

[AMD2] High Resolution Display

Chair: Junichi Takeya (University of Tokyo)

Co-Chair: Hiroki Hamada (Kinki Univ.)

Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B (1F)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹,
Shin-Kyun Park¹ (1. LG Display Co., Ltd. (Korea))

3:20 PM - 3:45 PM

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis Aligned Crystalline Oxide Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹, Takashi Nakagawa¹, Yuki Tamatsukuri¹,
Hideaki Shishido¹, Shogo Uesaka¹, Ryohei Yamaoka¹, Takaaki Nagata¹, Tomoya
Aoyama¹, Yutaka Okazaki¹, Takayuki Ikeda¹, Shunpei Yamazaki¹ (1. Semiconductor
Energy Laboratory Co., Ltd. (Japan))

3:45 PM - 4:10 PM

[AMD2-3] Novel Compensation Pixel Circuit with Simultaneous Emission Driving Scheme for High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun Chen¹, Chih-Lung Lin¹ (1.
National Cheng Kung University (Taiwan))

4:10 PM - 4:30 PM

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹, Yongyuan Qiu¹, Quansheng Liu¹, Yong
Yang¹, Junling Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹, Xin Zhang¹
(1. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

4:30 PM - 4:45 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-1(Invited)] Development of 88-inch 120Hz 8K OLED TV for Mass Production

*Koichi Miwa¹, Hyun-Haeng Lee¹, Seong-Eok Han¹, Yong-Joon Heo¹, Du-Hwan Oh¹, Shin-Kyun Park¹ (1. LG Display Co., Ltd. (Korea))

Keywords: OLED, 8K, oxide TFT, white on color filter, mass production

88-inch 8K OLED TV has been launched to the market. The display features 7680 x 4320 pixel resolution and 120Hz refresh rate. White OLED on Oxide TFT backplane architecture is applied as were in our 4K/2K OLED TV products. Design and driving features will be presented in this paper.

3:45 PM - 4:10 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-2(Invited)] 5291 ppi OLED Display with C-Axis Aligned Crystalline Oxide Semiconductor

*Shuichi Katsui¹, Hidetomo Kobayashi¹, Takashi Nakagawa¹, Yuki Tamatsukuri¹, Hideaki Shishido¹, Shogo Uesaka¹, Ryohei Yamaoka¹, Takaaki Nagata¹, Tomoya Aoyama¹, Yutaka Okazaki¹, Takayuki Ikeda¹, Shunpei Yamazaki¹ (1. Semiconductor Energy Laboratory Co., Ltd. (Japan))

Keywords: IGZO, VR, OLED, High resolution, Micro display

C-axis aligned crystalline oxide semiconductor field-effect transistor (CAAC-OS FET) can be scaled down to a width and length of 60 nm. We have fabricated an organic light-emitting diode (OLED) display with more than 5000 ppi required in virtual reality (VR) displays by using CAAC-OS FETs as the backplane.

4:10 PM - 4:30 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-3] Novel Compensation Pixel Circuit with Simultaneous Emission Driving Scheme for High-Resolution AMOLED Displays

*Jui-Hung Chang¹, Chin-Hsien Tseng¹, Sung-Chun Chen¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

Keywords: Active-matrix organic light-emitting diode, low-temperature polycrystalline silicon thin-film transistor, pixel circuit

This proposed work using simultaneous emission (SE) driving scheme to compensate for the V_{TH} variations of LTPS TFTs for high-resolution AMOLED displays. Simulated results demonstrate that the relative current error rates are all below 3.5% when V_{TH} of driving TFT varies by ± 0.5 V.

4:30 PM - 4:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:45 PM Mid-sized Hall B)

[AMD2-4L] 75-inch LCD Displays with AM MiniLED Local Dimming Backlight Units on Glass

Juncheng Xiao¹, *Jiayang Fei¹, Hongyuan Xu¹, Yongyuan Qiu¹, Quansheng Liu¹, Yong Yang¹, Junling Liu¹, Jiaqing Zhuang¹, Chunming Liu¹, Daobing Hu¹, Xin Zhang¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

Keywords: AM miniLED, local dimming, halo effect

We developed AM miniLED local dimming backlight systems on glass for 75-inch LCD displays, with each consisting of 5184 zones. The display achieves HDR, which is comparable to those of Dual-cells and OLEDs. In addition, the system exhibit advantages such as low fabrication cost, long life time and more energy-efficient.

Oral Presentation

[AMD3] Driving Technology of Micro/Mini LED Displays

Special Topics of Interest on Micro/Mini LEDs

Chair: Kazumasa Nomoto (Sony)

Co-Chair: Keisuke Omoto (Apple)

Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B (1F)

[AMD3-1(Invited)] Crystal LED Display System for Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹, Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony Semiconductor Solutions Corporation (Japan), 2. Sony Corporation (Japan))

5:00 PM - 5:25 PM

[AMD3-2(Invited)] Active Matrix Driving mini-LED Device

*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹, Minoru Shibasaki² (1. Innolux Corporation (Taiwan), 2. Innolux Japan (Japan))

5:25 PM - 5:50 PM

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix Micro-LED Display with Low-Temperature-Poly-Silicon TFT Backplane

*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki Ito¹, Takanobu Suzuki¹, Masahiko Nishide¹, Kunio Imaizumi¹, Katsumi Yamanoguchi¹, Fanny Rahadian¹, Katsumi Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹ (1. Kyocera Corporation (Japan))

5:50 PM - 6:15 PM

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro Display

*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

6:15 PM - 6:35 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-1(Invited)] Crystal LED Display System for Immersive Viewing Experience

*Katsuhiro Tomoda¹, Norifumi Kikuchi¹, Goshi Biwa^{2,1}, Hisashi Kadota^{1,2} (1. Sony Semiconductor Solutions Corporation (Japan), 2. Sony Corporation (Japan))

Keywords: micro LED, micro IC, Crystal LED display system, ambient contrast ratio

We developed a novel active matrix driving technology that integrates RGB micro LEDs and a micro IC in each pixel for our Crystal LED display system. With precise tiling technology, a large-scale image with immersive viewing experience can be delivered.

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-2(Invited)] Active Matrix Driving mini-LED Device

*Chin-Lung Ting¹, Chung-Kuang Wei¹, Li-Wei Mau¹, Ker-Yih Kao¹, Ho-Tien Chen¹, Minoru Shibazaki² (1. Innolux Corporation (Taiwan), 2. Innolux Japan (Japan))

Keywords: mini-LED, active matrix driving, LCD backlight, public information display

We have developed a glass- or flexible substrate-based AM driving mini-LED device. The AM driving mini-LED device controls each mini-LED element precisely with TFT, and can be applied to PID and BL of LCD, improving the optical performance of dynamic range, CR, color purity and viewing angle performance of the display.

5:50 PM - 6:15 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-3(Invited)] A 200-ppi Full Color Active Matrix Micro-LED Display with Low-Temperature-Poly-Silicon TFT Backplane

*Masaya Tamaki¹, Sho Nakamitsu¹, Hiroaki Ito¹, Takanobu Suzuki¹, Masahiko Nishide¹, Kunio Imaizumi¹, Katsumi Yamanoguchi¹, Fanny Rahadian¹, Katsumi Aoki¹, Seiji Matsuda¹, Ryoichi Yokoyama¹ (1. Kyocera Corporation (Japan))

Keywords: micro-LED, LTPS, TFT backplane, MPRT, HDR

A 1.8-inch 200-ppi full color active matrix micro light emitting diode (LED) display prototype has been developed with a low-temperature-poly-silicon (LTPS) TFT backplane. The frame rate of 240Hz and the luminance of 2000nits, both of which are promising attributes for high motion image quality and high dynamic range (HDR) applications, being superior to existing display technologies, were achieved by our LTPS TFT technology.

6:15 PM - 6:35 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Mid-sized Hall B)

[AMD3-4] Active Matrix Monolithic Full-Color LED Micro Display

*Longheng Qi¹, Xu Zhang¹, Wing Cheung Chong¹, Peian Li¹, Chak Wah Tang¹, Kei May Lau¹ (1. The Hong Kong University of Science and Technology (Hong Kong))

Keywords: Active matrix, Full-color, Micro-LED, QDs-PR

An active matrix monolithic full-color LED micro-display is demonstrated, combining monolithic blue GaN-on-Si LED array and quantum dots down conversion technology. This full-color scheme shows feasible manufacturability and visual quality, paving a new pathway toward volume production of full-color LED micro-display in the near future.

Oral Presentation

[LCT1] Evaluation Techniques

Chair: Masaru Inoue (Toyo Tech. LLC)

Co-Chair: Yoshinori Iwashita (DIC)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107 (1F)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays Caused by Polyimide Anion Radicals

*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC Petrochemical Corporation (Japan))

1:40 PM - 2:00 PM

[LCT1-2] The Systematically Investigation on the Influence Factor on Vertical Alignment State of Polyimide-free Liquid Crystal Displays

*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-Jen Tseng², Chung-Ching Hsieh² (1. Peking University Shenzhen Graduate School (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

2:00 PM - 2:20 PM

[LCT1-3] Second-Harmonic Imaging of Flexoelectric Polarization in Various Liquid Crystal Cells

*Koichiro Shirota¹, Fumito Araoka¹, Yutaka Yamagata¹ (1. RIKEN (Japan))

2:20 PM - 2:40 PM

[LCT1-5L] A Novel Orientation Method for Nematic LCs by Using Magnetic Field Lines with Permanent Magnets and Electric Field for Assisting the Reorientation

Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University (Japan))

2:40 PM - 3:00 PM

1:40 PM - 2:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-1] DC Image Sticking in Liquid Crystal Displays Caused by Polyimide Anion Radicals

*Yasutomo Nagano¹, Takanori Mori¹ (1. JNC Petrochemical Corporation (Japan))

Keywords: Imide anion radical, DC image sticking, LCD reliability

We investigated the anion radical effect from aromatic imide groups in polyimide alignment layers of liquid crystal cells by means of electron spin resonance and absorption measurements. We found anion radicals generated by ultra-violet or blue light irradiation shows a clear correlation to DC image sticking.

2:00 PM - 2:20 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-2] The Systematically Investigation on the Influence Factor on Vertical Alignment State of Polyimide-free Liquid Crystal Displays

*Yu Zhang^{1,2}, Song Lan², Qian Li², Xingwu Chen², Te-Jen Tseng², Chung-Ching Hsieh² (1. Peking University Shenzhen Graduate School (China), 2. Shenzhen China Star Optoelectronics Technology Co., Ltd (China))

Keywords: polyimide-free, liquid crystal displays, vertical alignment, self-assembly capability, hydrogen bond

In this report, we systematically investigated the influence of types of substrate, different treatment method, the concentration of additive, the routes and temperature of process on the polyimide-free liquid crystal display. We presume two key factors, one is self-assembly capability, the other is hydrogen bond force.

2:20 PM - 2:40 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-3] Second-Harmonic Imaging of Flexoelectric Polarization in Various Liquid Crystal Cells

*Koichiro Shirota¹, Fumito Araoka¹, Yutaka Yamagata¹ (1. RIKEN (Japan))

Keywords: Flexoelectric effect, SHG microscopy, Nematic, IPS cell

Since the flexoelectric polarization of LCs attracts much attention in the LCD industry, we visualize the flexoelectric polarization in nematic LCs with SHG microscopy. The observed flexoelectric polarization is induced by applying an electric field to various nematic LCs with positive or negative dielectric anisotropy in several types of cells.

2:40 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 107)

[LCT1-5L] A Novel Orientation Method for Nematic LCs by Using Magnetic Field Lines with Permanent Magnets and Electric Field for Assisting the Reorientation

Yoshihiro Aoyagi¹, Yuichi Saito¹, *Yukihiro Kudoh¹, Taiju Takahashi¹ (1. Kogakuin University (Japan))

Keywords: Radial orientation, Permanent magnet, LC lens, Polymer stabilization

We proposed an LC orientation treatment method that was used by the magnetic field lines and the electric field for assisting the director reorientation. It was shown that a radial orientation could be obtained by performing this process with the vertical alignment cell in the initial state.

Oral Presentation

[LCT2] LC Flat Diffractive Optics

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Toshiaki Nose (Akita Prefecture University)

Co-Chair: Hiroyuki Yoshida (Osaka University)

Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107 (1F)

[LCT2-1(Invited)] Fundamentals and Applications of Liquid Crystal-Based, Polarization-Dependent Diffractive Optics*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹ (1. Osaka University (Japan))

3:20 PM - 3:40 PM

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and Next Generation Displays*Nelson Tabirian¹, David Roberts¹, Anna Tabirian¹, Brian R Kimball², Timothy J Bunning³ (1. BEAM Engineering for Advanced Measurements Co. (United States of America), 2. U.S. Army Natick Soldier Systems Center, Natick, Massachusetts (United States of America), 3. Air Force Research Laboratories, Wright-Patterson Air Force Base, Ohio (United States of America))

3:40 PM - 4:05 PM

[LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

4:05 PM - 4:30 PM

[LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up DisplaysXiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))

4:30 PM - 4:50 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-1(Invited)] Fundamentals and Applications of Liquid Crystal-Based, Polarization-Dependent Diffractive Optics

*Hiroyuki Yoshida¹, SeongYong Cho¹, Yuto Tsuboi¹, Yuji Tsukamoto¹, Masanori Ozaki¹ (1. Osaka University (Japan))

Keywords: Diffractive Optics, Holography, Photoalignment

There is recently interest in LC-based diffractive optical elements (DOEs) that enable modulation of the light phasefront through the spatial distribution of its optic axis. The operating principles of both transmissive and reflective devices are reviewed and their applications are discussed.

3:40 PM - 4:05 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-2(Invited)] Ultimate Planar Optics for AR/VR and Next Generation Displays

*Nelson Tabirian¹, David Roberts¹, Anna Tabirian¹, Brian R Kimball², Timothy J Bunning³ (1. BEAM Engineering for Advanced Measurements Co. (United States of America), 2. U.S. Army Natick Soldier Systems Center, Natick, Massachusetts (United States of America), 3. Air Force Research Laboratories, Wright-Patterson Air Force Base, Ohio (United States of America))

Keywords: Switchable optics, Flat lenses, Augmented reality, Displays, Liquid crystals

Only one planar optics technology - diffractive waveplates - has shown capability to match large sizes and low-cost of Fresnel optics and the bandwidth of refractive optics. Electrically switchable and tunable with low-power controls, the thinnest lenses, prisms, and holograms make diffractive waveplate optics best suitable for AR/VR applications.

4:05 PM - 4:30 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-3(Invited)] Emerging Near-eye Displays with Pancharatnam-Berry Optical Elements

*TAO ZHAN¹, JIANGHAO XIONG¹, JUNYU ZOU¹, GUANJUN TAN¹, SHIN-TSON WU¹ (1. University of Central Florida (United States of America))

Keywords: near-eye displays, flat optics, liquid crystals, Pancharatnam-Berry phase

Near-eye displays with enhanced images quality are developed with planar optics employing Pancharatnam-Berry (PB) phase. Advanced broadband PB deflectors and lenses are fabricated to enhance the apparent pixel density and reduce the chromatic aberrations in immersive near-eye displays. Both simulation and experimental results are presented.

4:30 PM - 4:50 PM (Wed. Nov 27, 2019 3:20 PM - 4:50 PM Room 107)

[LCT2-4] Fast-response Pancharatnam-Berry Lens for Head-up Displays

Xiuying Ren¹, *Sida Li¹, Yueda Liu¹, Yan Li¹, Yikai Su¹ (1. Shanghai Jiao tong University (China))

Keywords: Pancharatnam-Berry lens, fast-response, head-up display, adjustable distance

In this paper we demonstrate fast-response Pancharatnam-Berry lenses (PBLs) based on polymer-stabilized liquid crystal. After photo-alignment technique and UV curing, the PBLs show submillisecond response time. Based on two identical PBLs, a head-up display system that can generate four different diopters is demonstrated.

Oral Presentation

[LCT3] Advanced LCD Technologies

Chair: Hiroyuki Okada (University of Toyama)

Co-Chair: Koichi Miyachi (JSR)

Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107 (1F)

[LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method

*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

5:00 PM - 5:20 PM

[LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell

*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))

5:20 PM - 5:40 PM

[LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD

*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

5:40 PM - 6:00 PM

[LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application

*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

6:00 PM - 6:20 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-1] A Four-Ways Viewing Angle Controllable Display using Specify Pixel Structure and Separated Rubbing Method

*Limei Jiang¹, Huilong Zheng¹, ChiaMin Yu¹, Smart Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

Keywords: Four-Ways, Viewing Angle, Controllable, Specify Pixel, Separated Rubbing

We present a viewing angle controllable display capable of displaying in two viewing modes, i.e. wide view mode and four-ways privacy mode. Pixel is divided into two domains of perpendicular LC orientation direction with separated rubbing method. By controlling the LC phase retardation at off-axis, viewing angle switching realized.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-2] Optimization of color and transmittance in a dye-doped chiral-nematic liquid crystal cell

*Seung-Min Nam¹, Seung-Won Oh¹, Jae-Won Huh¹, Seong-Min Ji¹, Eunjung Lim², Jinhong Kim², Tae-Hoon Yoon¹ (1. Pusan National University (Korea), 2. LG Chem. (Korea))

Keywords: liquid crystal, dichroic dye, dye-doped liquid crystal, transmittance-control device

Among various dye-doped liquid crystal (LC) devices, a chiral-nematic LC cell provides the highest transmittance difference between its transparent and opaque states. We propose a systematic approach to find the optimal dye mixing for black color in the opaque state and optimization method in the parameter space for the maximum transmittance difference.

5:40 PM - 6:00 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-3] An In-Screen Optical Fingerprint Recognition Structure for Full-Screen LCD

*Hailiang Wang¹, Yan Lin¹, Ling Wu¹, Poping Shen¹, JunYi Li¹, JianMou Huang¹, Yan Yang¹, Ting Zhou¹ (1. Xiamen Tianma Microelectronics Co., Ltd. (China))

Keywords: Full-Screen Display, LCD, In-Screen Optical Fingerprint Recognition Structure

We report a new type of LCD screen with an in-screen optical fingerprint recognition structure. This in-screen fingerprint recognition structure uses layers on the TFT&CF glass to make a collimating structure for accurate recognition. It can achieve fingerprint recognition at any position on the screen. It has a better user experience than traditional fixed location recognition.

6:00 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Room 107)

[LCT3-4L] Ambient Contrast Ratio Improvement of Low Reflection LCD for Automotive Application

*Lihong Chen¹, Liting Fang¹, Ling Wu¹, Poping Shen¹ (1. XiaMen Tianma Microelectronics Co., Ltd. (China))

Keywords: low reflection, ambient contrast ratio, automotive display

A LCD for a 12.3 inch vehicle dashboard was proposed to enhance ambient contrast ratio. The LCD can achieve 0.8% reflection by using AR treatment and optimizing shielding layer material. It demonstrates high contrast ratio and color gamut under high ambient light situation.

Oral Presentation

[FMC2] Metrology and Manufacturing

Chair: K Käläntär (Global Optical Solutions)

Co-Chair: Toshiaki Nonaka (Merck Performance Materials)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108 (1F)

[FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices

*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))

3:20 PM - 3:40 PM

[FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field

*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))

3:40 PM - 4:00 PM

[FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD

*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

4:00 PM - 4:20 PM

[FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM

*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-1(Invited)] Surface Strain Analysis of Bending Substrates for Design of Flexible Devices

*Atsushi Shishido¹ (1. Tokyo Institute of Technology (Japan))

Keywords: Flexible, Foldable, Wearable, Strain, Bending

Fracture and fatigue of bending flexible materials and devices prevent their commercialization. The problem is that quantitative understanding has not been explored on bending behavior. Here we report quantitative analysis of surface strain of bending substrates by a surface labeled grating method.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-2] Metrology Issues of a Non-Planar Light Source with Radius Comparable to that of Measurement Field

*K Kalantar¹, Tomonori Tashiro¹, Yasuki Yamauchi¹ (1. Yamagata University (Japan))

Keywords: Non-planar light source, arbitrary curvature, single curvature, curved display, curved light source

The effect of small curvature radius on characteristics of non-planar light sources (NPLS) has been studied using flexible OLEDs. The bending effect on light emission through the substrate was simulated and the issues extracted. The metrologies of NPLSs were studied by simulating the MF's area on different NPLSs.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-3] Researches of Process Reduction for Viewing Angle Controllable LCD

*Shih-Bin Liu¹, Lujie Wang¹, Jun Jiang¹, Yanbing Qiao¹, Chia-Te Liao¹, Te-Chen Chung¹ (1. InfoVision Optoelectronics (Kunshan) Co., Ltd. (China))

Keywords: mask reduction, half-tone mask, product process, LCD

In this paper, a better condition is found to maintain the thickness of PR for half-tone technology, and some issues of process reduction in B-ITO and M3 layers are solved. These issues of topology for M3 after ashing and last wet etching are still being studied.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 108)

[FMC2-4] Research on Failure Factors of Salt Spray Test and the Solutions for COG 2.4mm-down-border LTPS LCM

*zuoyin li¹, xianfeng lin¹, zhenqing xie¹, chunrong lin¹, lihua zheng¹, fushan dai¹, dandan yan¹, xiaoyu wang¹, changjuan zhang¹, qingwen hu¹, xuexin lan¹, guozhao chen¹, junyi li¹, lei wang¹ (1. Xiamen Tianma Microelectronics Co., Ltd., Xiamen, China (China))

Keywords: Salt Spray Test, COG 2.4mm-down-border, LCM, Full-screen-display

The salt spray test is failed more and more frequently for full-screen display. Experiments were done to research the possible factors. It revealed that the combination of PI (polyimide), silver conductive glue and the dispensed location resulted in the failure. Based on the analysis, the improvement solutions were proposed.

Oral Presentation

[PRJ1/FMC1] AR/VR

Special Topics of Interest on AR/VR and Hyper Reality

Chair: Satoshi Ouchi (Hitachi)

Co-Chair: Hirotsugu Yamamoto (Utsunomiya Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108 (1F)

-
- | | |
|------------------------|--|
| [PRJ1/FMC1-OP] | Opening
Satochi Ouchi ¹ , Hirotsugu Yamamoto ² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))
1:40 PM - 1:45 PM |
| [PRJ1/FMC1-1(Invited)] | Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays
*Zong Qin ¹ , Jui-Yi Wu ¹ , Ping-Yen Chou ¹ , Cheng-Ting Huang ¹ , Yu-Ting Chen ¹ , Yi-Pai Huang ¹ (1. National Chiao Tung University (Taiwan))
1:45 PM - 2:05 PM |
| [PRJ1/FMC1-2] | Possibility of Deblurring Aerial Image Based on Deconvolution Processing
*Hayato Kikuta ^{1,2} , Hirotsugu Yamamoto ^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))
2:05 PM - 2:25 PM |
| [PRJ1/FMC1-3] | Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display
*Takeru Utsugi ¹ , Mayumi Sasaki ² , Kazuhiko Ono ² , Yukinobu Tada ² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))
2:25 PM - 2:45 PM |
| [PRJ1/FMC1-4] | High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations
*Ryuji Ukai ¹ , Takuma Kuno ¹ , Toshiteru Nakamura ¹ , Masahito Uchiyama ¹ , Satoshi Ouchi ¹ (1. Hitachi, Ltd. (Japan))
2:45 PM - 3:05 PM |

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-0P] Opening

Satochi Ouchi¹, Hirotsugu Yamamoto² (1. Hitachi (Japan), 2. Utsunomiya Univ. (Japan))

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-1(Invited)] Modeling, Algorithm, and Implementation of Resolution-Tripled Near-Eye Light Field Displays

*Zong Qin¹, Jui-Yi Wu¹, Ping-Yen Chou¹, Cheng-Ting Huang¹, Yu-Ting Chen¹, Yi-Pai Huang¹ (1. National Chiao Tung University (Taiwan))

Keywords: Light field display, Integral imaging, 3D display, Resolution enhancement

A physical model incorporating all factors affecting the retinal image formation in a near-eye light field display is proposed, based on which, an algorithm recombining subpixels across elemental images to nearly triple the resolution is developed. Finally, an e-shifting method is suggested to further enhance the resolution to 30 pixels-per-degree.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-2] Possibility of Deblurring Aerial Image Based on Deconvolution Processing

*Hayato Kikuta^{1,2}, Hirotsugu Yamamoto^{2,3} (1. Mitsubishi Electric Corp. (Japan), 2. Utsunomiya University (Japan), 3. ACCEL (Japan))

Keywords: Aerial image by retro-reflection, Point spread function, Image deconvolution

This paper proposes a deblurring an aerial image formed with aerial imaging by retro-reflection. We have measured the point spread function (PSF) according to the incident angle to the retro-reflector. Simulated results show possibility of deblurring the aerial image by applying the deconvolution processing based on the obtained PSF.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-3] Volume-Holographic Multiplexed-Mirror Waveguide for Head-Mounted Display

*Takeru Utsugi¹, Mayumi Sasaki², Kazuhiko Ono², Yukinobu Tada² (1. Hitachi, Ltd. (Japan), 2. Hitachi-LG Data Storage, Inc. (Japan))

Keywords: Waveguide, Volume hologram, Argument Reality, Photopolymer

As a waveguide for a head mounted display, we propose a volume-holographic multiplexed-mirror waveguide, which could achieve high luminance efficiency, wide field of view and excellent transparency. We clearly demonstrate that high performance waveguide is achieved by the combination of multiplex-recorded hologram and broad wavelength light sources.

2:45 PM - 3:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Room 108)

[PRJ1/FMC1-4] High See-Through and High Efficiency Waveguide for Head Mounted Displays and Waveguide Evaluations

*Ryuji Ukai¹, Takuma Kuno¹, Toshiteru Nakamura¹, Masahito Uchiyama¹, Satoshi Ouchi¹ (1. Hitachi, Ltd. (Japan))

Keywords: waveguide, head mounted display, specifications, transmittance, luminance

We have developed head mounted displays with high see-through property and high luminance which could be utilized outside safely without dimming glasses. We specified required performance threshold and developed beam-splitter-array waveguide to achieve the requirements. We also established versatile waveguide measurement method applicable to different-type waveguides.

Oral Presentation

[FLX1/FMC3] Advanced Materials and Components for Flexible Electronics

Chair: Toshihide Kamata (National Institute of Advanced Industrial Science and Technology)

Co-Chair: Makoto Arai (ULVAC Inc.)

Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108 (1F)

-
- | | |
|------------------------|--|
| [FLX1/FMC3-OP] | Opening
5:00 PM - 5:05 PM |
| [FLX1/FMC3-1(Invited)] | Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device
*Masato Ohsawa ¹ , Natsuki Hashimoto ¹ , Naoki Takeda ² , Shota Tsuneyasu ² , Toshifumi Satoh ² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))
5:05 PM - 5:30 PM |
| [FLX1/FMC3-2] | Al alloying effect in functionalization of mechanical resistance to foldable display interconnections
*Chiharu Kura ¹ , Mototaka Ochi ¹ , Hiroyuki Okuno ² , Hiroshi Goto ² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))
5:30 PM - 5:50 PM |
| [FLX1/FMC3-5L] | Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics
*John Fahlteich ¹ , Michiel Top ¹ , Stefan Hinze ¹ , Uwe Meyer ¹ , Tobias Vogt ¹ , Valentijn von Morgen ² , Matthias Fahland ¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))
5:50 PM - 6:05 PM |
| [FLX1/FMC3-4] | Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer
*Yuto Toshimori ¹ , Sohei Nonaka ¹ (1. Mitsubishi Materials Corporation (Japan))
6:10 PM - 6:30 PM |

5:00 PM - 5:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-0P] Opening

5:05 PM - 5:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-1(Invited)] Printed Invisible Silver-Grid Transparent Electrode on Flexible Epoxy Film and Application to Powder Electroluminescent Device

*Masato Ohsawa¹, Natsuki Hashimoto¹, Naoki Takeda², Shota Tsuneyasu², Toshifumi Satoh² (1. ULVAC, Inc. (Japan), 2. Tokyo Polytechnic University (Japan))

Keywords: Invisible Ag-grid, PEDOT:PSS, Gravure offset printing, Epoxy film, Electroluminescence

Invisible Ag-grid transparent electrodes have been printed on a flexible epoxy film. The Ag-grid electrode were laminated with a poly(3,4-ethylenedioxythiophene): poly(styrenesulfonate) layer. The electrode shows no noticeable resistance change throughout the bending cycles at a bending radius of 1.0 mm. The transparent electrode-based powder electroluminescent device develops excellent flexibility.

5:30 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-2] Al alloying effect in functionalization of mechanical resistance to foldable display interconnections

*Chiharu Kura¹, Mototaka Ochi¹, Hiroyuki Okuno², Hiroshi Goto² (1. Kobe Steel, LTD. (Japan), 2. Kobelco Research Institute, Inc. (Japan))

Keywords: Al alloys, bending resistance, intermetallic compounds

For the metal interconnection in foldable displays, bending resistance is essential in addition to heat resistance and low electrical resistivity. The bending resistance of Al-Nd alloy interconnections can be controlled by precipitation of intermetallic compounds. Then, the Al alloy interconnections capable of dry-etching patterning have also been developed.

5:50 PM - 6:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-5L] Roll-to-roll Processing of Transparent and Robust Permeation Barrier Films for Flexible Electronics

*John Fahlteich¹, Michiel Top¹, Stefan Hinze¹, Uwe Meyer¹, Tobias Vogt¹, Valentijn von Morgen², Matthias Fahland¹ (1. Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP (Germany), 2. DuPont Teijin Films Ltd. (UK))

Keywords: Permeation Barrier, Flexible Electronics Encapsulation, Magnetron Sputtering, PECVD, Roll-to-Roll

Water vapor permeability of permeation barrier films and thin film encapsulation coatings is determined both by intrinsic factors: material and technology selection and extrinsic factors: e.g. particle contamination or process defects. This paper discusses optimization strategies to achieve low permeability gas barrier films that are robust in roll-to-roll processing and integration to devices. Water vapor transmission rates of $<5 \cdot 10^{-4}$ g/(m² d) at 38° C / 90 % r.h. are demonstrated reproducibly in a full roll-to-roll process chain using a sputtered barrier layer and a protective top-coat.

6:10 PM - 6:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:30 PM Room 108)

[FLX1/FMC3-4] Improvement of the Corrosion Resistance of TCO/Ag/TCO Structure for Transparent Conductive Layer

*Yuto Toshimori¹, Sohei Nonaka¹ (1. Mitsubishi Materials Corporation (Japan))

Keywords: Transparent conductive layer, TCO/Ag/TCO structure, Ag alloy, Corrosion

The corrosion resistance of TCO/Ag/TCO structure was improved by using new Ag alloy and TCO. These can inhibit corrosion defect which was one of the biggest challenges for practical use. It can be applied to various devices, such as display electrodes, touch sensor and IR cut film.

 Oral Presentation

[3DSA1/3D1] Holography 1

Chair: Hoang Yan Lin (Nat. Taiwan Univ.)

Co-Chair: Takashi Kakue (Chiba Univ.)

Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall (2F)

[3DSA1/3D1-0P]

Opening

Shiro Suyama¹ (1. Tokushima Univ. (Japan))

1:40 PM - 1:45 PM

[3DSA1/3D1-1(Invited)] Complex Spatial Light Modulation for Holographic Displays

*Hwi Kim¹ (1. Korea University (Korea))

1:45 PM - 2:05 PM

[3DSA1/3D1-5L] A Fast Hologram Calculation Method Based on the Light Field Rendering

*Tiantian Zhang¹, Li Liu¹, Jun Xia¹ (1. Southeast University (China))

2:05 PM - 2:25 PM

[3DSA1/3D1-3] Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging

*Zi Wang¹, Guoqiang Lv¹, Qibin Feng¹ (1. Hefei University of Technology (China))

2:25 PM - 2:45 PM

[3DSA1/3D1-4] Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens

*KiHong Choi¹, Jongmin Kim¹, Keehoon Hong², Joongki Park², Sung-Wook Min¹
(1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

2:45 PM - 3:05 PM

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-0P] Opening

Shiro Suyama¹ (1. Tokushima Univ. (Japan))

1:45 PM - 2:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-1(Invited)] Complex Spatial Light Modulation for Holographic Displays

*Hwi Kim¹ (1. Korea University (Korea))

Keywords: holographic display, spatial light modulation, complex light modulation, diffractive optics

Complex light modulation is a fundamental and crucial issue for holographic displays. We propose three-phase amplitude structure that has three fixed phase and controllable amplitudes to implement a single complex value. In this study, it is also expected to implement an ultra-low noise holographic display with active complex modulation.

2:05 PM - 2:25 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-5L] A Fast Hologram Calculation Method Based on the Light Field Rendering

*Tiantian Zhang¹, Li Liu¹, Jun Xia¹ (1. Southeast University (China))

Keywords: Computer holography, Wavefront encoding, Holographic display

We propose a new method based on ray-sampling (RS) algorithm to reconstruct the holographic light field. Different from the previous method, we accumulate elemental images in the space domain without any Fourier transform. The results demonstrate that the proposed method successfully reconstructs the 3D scene with accurate depth cues.

2:25 PM - 2:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-3] Performance Improvement for Computer-Generated Holographic Stereogram Based on Integral Imaging

*Zi Wang¹, Guoqiang Lv¹, Qibin Feng¹ (1. Hefei University of Technology (China))

Keywords: Computer holography, integral imaging, holographic stereogram

We want to introduce several recent works for improving the performance of integral imaging (II) based holographic stereogram (HS). First, we have proposed a resolution-enhanced II-based HS using the moving array lenslet technique (MALT). [1] Second, we have proposed the concept of resolution priority HS (RPHS) for the first time, which is based on the principle of resolution priority II, by adding a quadratic phase term on the conventional Fourier transform. [2] Finally, a simple and fast algorithm for computer-generated hologram (CGH) based on pinhole-type II using a look-up table was

proposed. [3]

2:45 PM - 3:05 PM (Wed. Nov 27, 2019 1:40 PM - 3:05 PM Small Hall)

[3DSA1/3D1-4] Analysis about system parameters of self-interference incoherent digital holographic recording system utilizing geometric phase lens

*KiHong Choi¹, Jongmin Kim¹, Keehoon Hong², Joongki Park², Sung-Wook Min¹ (1. Kyung Hee University (Korea), 2. Electronics and Telecommunications Research Institute (Korea))

Keywords: Digital holography, Self-interference, Geometric phase

Self-interference incoherent digital holography utilizing the geometric phase lens has recently been developed with a super-simple design and the compactness of system structure. In this study, some of the acquisition performance related to the system parameters are analyzed to enhance the hologram acquisition quality.

Oral Presentation

[3DSA3/3D3] Light Field 1

Chair: Yasuhiro Takaki (Tokyo Univ. of A&T)

Co-Chair: Hirotugu Yamamoto (Utsunomiya Univ.)

Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall (2F)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

5:00 PM - 5:20 PM

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

5:20 PM - 5:40 PM

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoung-ho Lee¹ (1. Seoul National University (Korea))

5:40 PM - 6:00 PM

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

6:00 PM - 6:20 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-1] Depth Range Control in Visually Equivalent Light Field 3D (VELF3D) Display

*Munekazu Date¹, Shinya Shimizu¹, Hideaki Kimata¹ (1. Nippon Telegraph and Telephone Corporation (Japan))

Keywords: autostereoscopic 3D display, light field, linear blending, depth range

Light field displays have limited display depth range, which is a serious issue in supporting live action content. Though generating depth maps and re-rendering is a solution, it incurs huge computational cost. In this paper, we achieve depth range compression simply by calculating the weighted average of multi-camera images.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-5L] An Adaptive Time-Division Multiplexing Parallax Barrier Allowing Multiple Observers

*Bin Yang¹, Hideki Kakeya¹ (1. University of Tsukuba (Japan))

Keywords: Autostereoscopy, Active Barrier, Fractional Time-Division, Subpixel

We propose an autostereoscopic display allowing multiple observers with adaptive time-division multiplexing parallax barrier. To make sure that every observer is in the proper viewing zone to enable stereoscopy, the number of time-division multiplexing is switched in accordance with the distance between the observers.

5:40 PM - 6:00 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-3] High Field-of-View Near-Eye Display Using Total Internal Reflection Prism and Holographic Printing Technique

*Jinsoo Jeong¹, Juhyun Lee¹, Byoungho Lee¹ (1. Seoul National University (Korea))

Keywords: holographic display, holographic optical element, near-eye display, augmented reality

By using holographic printing, high field-of-view (FOV) holographic eyepiece for near-eye display can be implemented. However, due to the high FOV, it is hard to separate the reference and signal beam. We used total internal reflection prism to solve the problem and an augmented reality holographic near-eye display is implemented.

6:00 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:20 PM Small Hall)

[3DSA3/3D3-6L] Slim Holographic Retina Display Based on Holographic Waveguide

*Li Liu¹, Tiantian Zhang¹, Jun Xia¹ (1. Southeast University (China))

Keywords: Near-eye display, Holographic waveguide, Holographic optical elements

In this paper, we propose a slim system for holographic retina display on the basis of holographic waveguide and holographic optical elements (HOEs), promising in augmented reality (AR) system. By attaching the spatial light modulator (SLM) to the waveguide directly, we decrease the form factor of the AR system greatly.

Oral Presentation

[3D2/3DSA2] Holography 2

Chair: Hwi Kim (Korea Univ.)

Co-Chair: Yuji Sakamoto (Hokkaido Univ.)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall (2F)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

3:20 PM - 3:40 PM

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMoG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

3:40 PM - 4:00 PM

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

4:00 PM - 4:20 PM

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-1(Invited)] Evaluation of Hologram Quality Based on Digital and Analog Types of Spatial Light Modulators

Chih-Hao Chuang¹, Siao-Ting Li², Chien-Yu Chen², *Hoang-Yan Lin¹, Kuan-Hsu Fan-Chiang³, Hsien-Chang Tsai³ (1. National Taiwan University (Taiwan), 2. National Taiwan University of Science and Technology (Taiwan), 3. Himax Display Inc. (Taiwan))

Keywords: Digital spatial light modulator, Analog spatial light modulator, Image quality evaluation, human factors experiment

A prototype system of head-mounted holographic display with multi-depth is presented. The system adopts the modified Gerchberg-Saxton algorithm to produce the phase-only functions on digital and analog types of spatial light modulators. Furthermore, the proposed system could achieve multi-depth by using human-eye focusing and zooming mechanism. Finally, the quality of images is also analyzed and evaluated.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-2(Invited)] Development of 72K Ultra-High-Resolution SLMoG system for high-capacity digital holography image

*Jae-Eun Pi¹, Ji-Hun Choi¹, Jong-Heon Yang¹, Chi-Young Hwang¹, Gi Heon Kim¹, Hee-Ok Kim¹, Young-gi Kim², Myung Yu Kim², Ha Kyun Lee³, Chi-Sun Hwang¹, Jinwoong Kim¹ (1. ETRI (Korea), 2. Silicon Works (Korea), 3. MVTech (Korea))

Keywords: digital holography system, SLM on Glass, vertically stacked TFT, high-capacity data handling

We present ultra-high-resolution digital holography operation system supporting 72K x 3.2K spatial-light-modulator on glass (SLMoG) panel which is composed of the state-of-the-art 1μm-pitch pixel. To control the high-capacity digital holography image, we have developed 40 Gbps optical transmit (Tx) / receive (Rx) and high-speed data handling system. Furthermore, we designed 6K channel of source driver IC with 1:2 demultiplexer (DeMux) control signal to operate 72K column line by using multi-MIPI interface.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-3] Reducing the effect of crosstalk noise from defocused multi-depth holographic image with a rasterize encoding method

*Siao-Ting Li¹, Chih-Hao Chuang², Chung Feng Kuo¹, Hoang-Yan Lin², Chin-I Huang³, Chien-Yu Chen¹ (1. National Taiwan University of Science and Technology (Taiwan), 2. National Taiwan University (Taiwan), 3. National Kaohsiung First University of Science and Technology (Taiwan))

Keywords: defocused image, rasterize encoding, multi-depth

Crosstalk noise from defocused light affects the image quality of target image in multi-depth holographic display system. In this study, we propose a defocused light noise reduction with the rasterize encoding method. With the objective image quality analysis, it proves that the proposed method could improve the image quality.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Small Hall)

[3D2/3DSA2-4] The Holographic Information Projection System Based on Holographic Optical Element

*Wen-Kai Lin^{1,2}, Hung-Pin Chen², Bor-Shyh Lin¹, Wei-Chia Su² (1. National Chiao Tung University (Taiwan), 2. National Changhua University of Education (Taiwan))

Keywords: Holographic optical element, Computer-generated hologram, Aberration correction

In this paper, a projection type holographic display based on HOE was proposed. The viewing angle of the holographic image is larger than the maximum diffraction angle of the SLM which was employed to display CGH. The theory and aberration were analyzed via the ray tracing technique.

Oral Presentation

[OLED1] OLED Devices

Chair: Takahisa Shimizu (NHK)

Co-Chair: Ken-ichi Nakayama (Osaka University)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204 (2F)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹
(1. Technische Universität Dresden (Germany))

1:40 PM - 2:00 PM

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

2:00 PM - 2:20 PM

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

2:20 PM - 2:40 PM

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

2:40 PM - 3:00 PM

1:40 PM - 2:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-1(Invited)] Investigation of carrier recombination and device stability in phosphorescent and TADF OLEDs

*Sebastian Reineke¹, Paul-Anton Will¹, Jinhan Wu¹, Axel Fischer¹, Simone Lenk¹ (1. Technische Universität Dresden (Germany))

Keywords: organic light-emitting diodes, recombination, stability, phosphorescence, TADF

This presentation will discuss both a detailed investigation of the charge carrier recombination in state-of-the-art OLEDs and an engineering route to increase device lifetime and efficiency by forming so-called ultrastable glass layers. For the latter, both phosphorescent and TADF OLEDs are presented.

2:00 PM - 2:20 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-2] Analysis Method for Dynamics of Exciton in Organic Light-Emitting Diodes Based on Thermally Activated Delayed Fluorescence Emitters: Magnetic Field Effect as Footprint of Exciton

*Masaki Tanaka¹, Ryo Nagata¹, Hajime Nakanotani¹, Chihaya Adachi¹ (1. Kyushu University (Japan))

Keywords: TADF-OLED, magnetic field effect

We investigated magnetic field effects (MFEs) of thermally activated delayed fluorescence based organic light-emitting diodes (TADF-OLEDs) to understand exciton dynamics under device operation. Our analysis showed a clear evidence of triplet annihilation such as triplet exciton-polaron interaction.

2:20 PM - 2:40 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-3] Enhanced Color Purity of Alternating Current-Driven Micro-Cavity Organic Light Emitting Diode

*Duck-Kyu Lim¹, Byeonggon Kim¹, Hak-Rin Kim¹ (1. Kyungpook National University (Korea))

Keywords: Micro-cavity effect, Polyfluorene, Color purity, Solution process, Purcell effect

We introduced the micro-cavity effect on Alternating Current-Driven Polymer Light Emitting Diodes and investigated the color purity enhancement effect depending on the organic layer thickness condition. We have analyzed the electric field inside the device by the finite-difference time-domain method and fabricated the designed optimal devices.

2:40 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 204)

[OLED1-4] An Aging Current Model for OLED Degradation

*Qian CHEN¹ (1. The Institute of Microelectronics of the Chinese Academy of Sciences (China))

Keywords: Organic light-emitting diode, degradation, aging condition, current model

This work presents a new aging current model of organic light-emitting diode (OLED). It can predict the OLED current with different stress time under some aging conditions, which can be used in related simulation software to describe the degradation of OLED.

Oral Presentation

[OLED2] OLED Material

Chair: Takahiro Komatsu (JOLED)

Co-Chair: Hitoshi Kuma (Idemitsu Kosan)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204 (2F)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

3:20 PM - 3:40 PM

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

3:40 PM - 4:00 PM

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

4:00 PM - 4:20 PM

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-1(Invited)] Long-Persistent Luminescence from Organic Molecules

*Ryota Kabe Kabe^{1,2,3} (1. Okinawa Institute of Science and Technology Graduate University (Japan), 2. Kyushu University (Japan), 3. JST ERATO Adachi Molecular Exciton Engineering Project (Japan))

Keywords: Organic Long-Persistent Luminescence, Photoluminescence, Organic semiconductor

We demonstrate long persistent luminescence from simple mixtures of two appropriate organic materials. Moreover, emission color of organic LPL can be tuned by the extra emitter dopants. We also demonstrated a polymer-based organic LPL system that is flexible, transparent, and solution-processable.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-2] Highly Efficient Deep Blue Fluorescence Emitter Based on Highly Conjugated Boron Structure

*Hanjong Yoo¹, Daehyun Ahn¹, Hyuna Lee¹, Juyoung Lee¹, Janghyuk Kwon¹ (1. Kyung Hee University (Korea))

Keywords: Boron TADF, blue TADF, Narrow FWHM

We synthesized and evaluated new deep blue fluorescence emitter, KH-FBD1. This emitter exhibits pure deep blue PL spectrum peak at 452 nm with 20 nm full width half maximum. Fabricated device shows high efficiency of 7.4% with deep blue color coordinate of (0.14, 0.07). In addition, this device indicates long operational lifetime (LT_{95}) of 100 hours at initial luminance 1,000 cd/m². It also shows high efficiency of 12.7% in high T₁ device with maintaining the deep blue color characteristic.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-3] Key Technologies in Soluble OLED Materials

*Koichiro Iida¹, Koichi Ishibashi¹, Yoshiko Shoji¹, Kazuhiro Nagayama¹, Yuki Oshima¹, Hideki Gorohmaru¹ (1. Mitsubishi Chemical Corporation (Japan))

High-performance soluble OLED materials have been developed. Our wide library of platform was effective for improving device performance. For wide color gamut, new emitters with deep in color and narrow full-width at half maximum were developed. Further, solvent systems having physical properties suitable for improving film uniformity were found.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 204)

[OLED2-4] Ellipsometry, XRR, and GCIB-TOF-SIMS Analysis of Small Molecule Layers in Solution Process and Vacuum Deposition

Process

*Takahiro Shibamori¹, Sachiko Kojima¹, Aki Suzuki¹, Yusaku Tanahashi¹, Takashi Miyamoto¹ (1. Toray Research Center, Inc. (Japan))

Keywords: solution process, deposition process, organic light emitting diodes, time-of-flight secondary ion mass spectrometry, gas cluster ion beam

Ellipsometry, XRR, and GCIB-TOF-SIMS are applied to investigation of the spin-coating process as comparison of spin-coated samples and vacuum evaporated samples. The residual solvent of spin-coating process was observed in spin-coated samples by GCIB-TOF-SIMS. The result suggested that it can cause the decrease of refractive index observed in ellipsometry.

Oral Presentation

[OLED3] OLED Display

Chair: Taishi Tsuji (NIPPON STEEL Chemical &Material)

Co-Chair: Masaya Adachi (Japan Display Inc)

Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204 (2F)

- [OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range
 *Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))
 5:00 PM - 5:20 PM
- [OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display
 *Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))
 5:20 PM - 5:40 PM
- [OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds
 *Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))
 5:40 PM - 5:55 PM
- [OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode
 *Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co.,Ltd. (Japan), 2. Toray Industries, Inc. (Japan))
 5:55 PM - 6:10 PM
- [OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs
 *KIHUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))
 6:10 PM - 6:25 PM

5:00 PM - 5:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-1(Invited)] Development of Long Lifetime and High Performance OLED Display with Wide Temperature Range

*Masanobu Mizusaki¹, Masakazu Shibasaki¹, Yuto Tsukamoto¹, Tokiyoshi Umeda¹, Hiroshi Tsuchiya¹, Shinji Shimada¹ (1. Sharp Corporation (Japan))

Keywords: OLED display, Lifetime, Hole-transport layer, High temperature, Automotive application

We developed the long lifetime OLED display by optimizing each organic layer materials. In particular, the optimization of a hole-transport layer material improved the lifetime of the blue-OLED significantly at high temperature such as 85 ° C. The developed OLED display would be useful for automotive application.

5:20 PM - 5:40 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-2] An Investigation on the Effect of Bending on the Circular Polarizer of an Organic Light Emitting Diode Display

*Phuc Toan Dang¹, Jimin Park¹, Ji-Hoon Lee¹ (1. Chonbuk National University (Korea))

Keywords: OLED, circular polarizer, retardation, the slow axis, QWP film

This work reports the experimental research results of the retardation change of a reactive mesogen type quarter-wave plate (QWP) by bending when the slow axis the QWP is oriented with the bending axis according to perpendicular or parallel directions. Moreover, the effect of the retardation changes on the antireflective properties of a quasi-circular polarizer taken accounts for an organic light-emitting diode in the simulation. Based on the obtained results, we assign that the light leakage reduced gradually with bending effect in the vertical viewing orientation, while it was increased in the horizontal viewing direction regardless of the orientation of the slow axis.

5:40 PM - 5:55 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-4L(Invited)] Efficient Electron Injection into Organic Semiconductors Induced by Hydrogen Bonds

*Hirohiko Fukagawa¹, Munehiro Hasegawa², Katsuyuki Morii^{2,3}, Kazuma Suzuki⁴, Tsubasa Sasaki¹, Takahisa Shimizu¹ (1. NHK (Japan), 2. Nippon Shokubai Co., Ltd. (Japan), 3. Osaka University, Nippon Shokubai Research Alliance Laboratories (Japan), 4. Tokyo University of Science (Japan))

Keywords: Electron injection, Hydrogen bond, Flexible OLED

It was found that stable bases widely used in organic syntheses as catalysts can lower the electron injection barrier in organic light-emitting diodes. In contrast to conventional n-doping, the reduction of the injection barrier caused by adding bases is induced by the formation of hydrogen bonds between hosts and bases.

5:55 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-5L] Spectral Narrowing and Efficiency Enhancing in Deep-Red Organic Light Emitting Diode

*Yuichiro Kawamura¹, Takushi Shiomi¹, Kei-ichi Yasukawa¹, Shota Sawano¹, Hiromi Nakano¹, Hisato Matsumoto¹, Toshinari Ogiwara¹, Keiji Okinaka¹, Kazumasa Nagao², Kazunari Kawamoto² (1. Idemitsu Kosan Co.,Ltd. (Japan), 2. Toray Industries, Inc. (Japan))

Keywords: Organic Light Emitting Diode, Deep Red, Fluorescence, TADF, Top-Emission

We developed both thermally activated delayed fluorescence materials with high performances and spectral-narrow fluorescent dopants for deep-red organic light-emitting diodes. We achieved the efficiency of 46 cd/A at 10 mA/cm² and the LT95 of around 90 hours at 50 mA/cm² in the top emission device at CIE_x = 0.679.

6:10 PM - 6:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 204)

[OLED3-6L] Significance of Energy-Level Alignment in 3D Perovskite ELs Significance of Energy-Level Alignment in 3D Perovskite ELs

*KIHYUNG SIM¹, HAYATO KAMIOKA², JUNGHWAN KIM¹, HIDEO HOSONO¹ (1. Materials Research Center for Element Strategy, Tokyo Institute of Technology, (Japan), 2. Department of Physics, College of Humanities and Sciences, Nihon University (Japan))

Keywords: Metal Halide Perovskite, Perovskite light-emitting diode (PeLED), Electron Transport layer (ETL), Exciton Confinement Effect, Charge Balance

In this study, we report a significant phenomenon that EL performances for 3D materials, such as CsPbX₃, are governed by adjacent charge transport layers, which is possibly due to nonradiative recombination resulting from the small exciton binding energy. To overcome this issue, we developed a new electron transport layer (ETL) that enhances exciton confinement effect in 3D CsPbX₃. Consequently, we achieved ultra-high brightness of 500,000 cd/m² at a very small operating voltage of 5V.

Oral Presentation

[AIS1/INP2] Smart Society and Information Display

Chair: Katashi Nagao (Nagoya University)

Co-Chair: Toshiaki Fujii (Nagoya University)

Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206 (2F)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us

*Kazuyuki Fujita¹ (1. Tohoku University (Japan))

3:20 PM - 3:45 PM

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN

*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))

3:45 PM - 4:10 PM

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN

*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))

4:10 PM - 4:35 PM

3:20 PM - 3:45 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-1(Invited)] Adaptive Spatial User Interfaces That Activate Us

*Kazuyuki Fujita¹ (1. Tohoku University (Japan))

Keywords: human-computer interaction, adaptive spatial user interface, workspace

His talk covers adaptive spatial user interfaces to make the users more active and productive. He introduces several projects including Ambient Suite that enhances communication among multiple participants and AI-Supported Meeting Space in which the space itself behaves as "another participant" to make the meeting more productive.

3:45 PM - 4:10 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-2(Invited)] Automated Vibrotactile Generation based on Texture Images or Material Attributes using GAN

*Yuki Ban¹, Yusuke Ujitoko^{2,3} (1. The University of Tokyo (Japan), 2. Hitachi, Ltd. (Japan), 3. The University of Electro-Communication (Japan))

Keywords: Haptic display, Vibration design

We propose the vibrotactile feedback designing system using GAN-based vibrotactile signal generator. Our system generate signals presenting specific tactile impression based on user-defined parameters or images. User studies showed that it was not possible to distinguish between vibrations generated using this model and vibrations recorded from the actual material surface.

4:10 PM - 4:35 PM (Wed. Nov 27, 2019 3:20 PM - 4:35 PM Room 206)

[AIS1/INP2-3(Invited)] Vibrotactile Signal Generation with GAN

*Shotaro Agatsuma¹, Shin Takahashi¹, Satoshi Saga² (1. University of Tsukuba (Japan), 2. Kumamoto University (Japan))

Keywords: Vibrotactile information, Acceleration, GAN

To create valuable content for haptic display, we propose a method of generating alternative data from acquired one instead of collecting a great number of data from real textures. We made a data generation model based on Generative Adversarial Network and held experiments to evaluate the performance of the model.

Oral Presentation

[AIS2] AI and Information Display

Chair: Yuki Ban (The University of Tokyo)

Co-Chair: Kazuyuki Fujita (Tohoku University)

Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206 (2F)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays

*Katashi Nagao¹ (1. Nagoya University (Japan))

5:00 PM - 5:25 PM

[AIS2-2(Invited)] Light-field image processing using deep neural network

*Toshiaki Fujii¹ (1. Nagoya University (Japan))

5:25 PM - 5:50 PM

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering

*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

5:50 PM - 6:10 PM

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai², Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei² (1. National Taiwan University of Science and Technology (Taiwan), 2. National Chung-Hsing University (Taiwan))

6:10 PM - 6:25 PM

5:00 PM - 5:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-1(Invited)] AI-Powered Education: Smart Learning Environment with Large Interactive Displays

*Katashi Nagao¹ (1. Nagoya University (Japan))

Keywords: Smart learning environment, Digital poster panel, Automatic evaluation, Machine learning

Our university is currently developing a smart learning environment that can train students to enhance their presentation and discussion skills. It includes an automatic evaluation system that efficiently records, analyses, and evaluates the presenter's presentation and discussion skills. We call such education promoted by the AI technologies "AI-Powered Education."

5:25 PM - 5:50 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-2(Invited)] Light-field image processing using deep neural network

*Toshiaki Fujii¹ (1. Nagoya University (Japan))

Keywords: 3D image processing, Light field, Deep neural network

In this paper, we report results of our experiments where deep neural networks (DNNs) are adopted to perform the light-field image processing. Experimental results show that we can successfully reduce the computation cost by using DNN with almost the same performance of conventional methods.

5:50 PM - 6:10 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-3] Deep Convolution Neural Networks for Painting-like 3D Rendering

*Zhi Yang¹, Pei-Li Sun¹, Tzung-Han Lin¹ (1. National Taiwan University of Science and Technology (Taiwan))

Keywords: Deep learning, Non-photorealistic rendering, Computer graphics

A 3D rendering model which uses deep convolutional neural networks to imitate 2D painting style is proposed. User can feed the networks with simple paintings of specific objects to render images of 3D objects with any orientations in accordance with the painting style.

6:10 PM - 6:25 PM (Wed. Nov 27, 2019 5:00 PM - 6:25 PM Room 206)

[AIS2-4L] Outdoor Wild Bird Detection based on YOLO algorithm

*Bo-Cheng Zhu¹, Tzung-Han Lin¹, Yao-Chuan Tsai², Kuang-Wen Hsieh², Fuh-Min Fan², Perng-Kwei Lei² (1. National Taiwan University of Science and Technology (Taiwan), 2. National Chung-Hsing University (Taiwan))

Keywords: Deep Learning, Object detection, Small Object

This study focuses on outdoor bird detection in video surveillance to reduce the risk of avian influenza (AI) in poultry farms. Once a bird is detected, our system will trigger another action to drive away the bird. We utilized YOLO algorithm for object detection, and add diversity samples to the dataset to train the model, then recognition accuracy is improved.

Oral Presentation

[INP1] In-Cell Touch Panels and Fingerprint Sensors

Special Topics of Interest on Automotive Displays

Chair: Noemie Ballot (ISORG)

Co-Chair: Yuji Suzuki (Japan Display Inc.)

Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206 (2F)

- [INP1-OP] Opening
Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))
1:40 PM - 1:41 PM
- [INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor
*Yuji Suzuki¹, Satoshi Uchino¹, Kohei Azumi¹, Tadayoshi Katsuta¹, Daichi Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹ (1. Japan Display Inc. (Japan))
1:41 PM - 2:06 PM
- [INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement
*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi Ishikawa¹ (1. The University of Tokyo (Japan))
2:06 PM - 2:21 PM
- [INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones
*Noemie Ballot¹ (1. ISORG (France))
2:31 PM - 2:56 PM

1:40 PM - 1:41 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-OP] Opening

Nobuyuki Hashimoto¹ (1. Citizen Watch (Japan))

1:41 PM - 2:06 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-1(Invited)] Evaluation of the Integrated In-cell Electromagnetic Resonance Sensor and Capacitive Touch Sensor

*Yuji Suzuki¹, Satoshi Uchino¹, Kohei Azumi¹, Tadayoshi Katsuta¹, Daichi Suzuki¹, Hiroyuki Wakana¹, Kaoru Ito¹ (1. Japan Display Inc. (Japan))

Keywords: Electromagnetic resonance, In-cell touch sensor, LTPS, reflective LCD

We developed in-cell EMR reflective LCD panel, which shares the sensor pattern with capacitive touch sensor, without additional sensor layer. This technology contributes many benefits for thin design and less weight of the panel compared with conventional EMR products. This paper shows our in-cell EMR and capacitive touch sensing performance.

2:06 PM - 2:21 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-5L] Reduction of Moving Optical Illusion through Synchronization with Eye Movement

*Yuki Kubota¹, Tomohiko Hayakawa¹, Masatoshi Ishikawa¹ (1. The University of Tokyo (Japan))

Keywords: optical illusion, eye tracking, dynamic image compensation, visual information control

Optical illusions distort our visual information. We propose a system that enables control of imagery rotation synchronously with eye movement. Our subject experiment using Rotating Snakes Illusion suggests that the appropriate performances of compensation can reduce the intensity of the illusion even without eye fixation.

2:31 PM - 2:56 PM (Wed. Nov 27, 2019 1:40 PM - 2:56 PM Room 206)

[INP1-3(Invited)] Large-Area Optical Fingerprint Sensors for Next Generation Smartphones

*Noemie Ballot¹ (1. ISORG (France))

Printing-based organic photodiodes have demonstrated cost effective process and compatibility with Flat Panel industry equipment making large area optical fingerprint sensors viable for volume production. Large area thin film-based optical collimator enables simple behind display integration. Advantages of this technology are high security level for fingerprint, enhanced ease of use and slim

module.

Oral Presentation

[EP1] Emerging Electronic Paper Displays

Chair: Makoto Omodani (Tokai University)

Co-Chair: Masayoshi Higuchi (NIMS)

Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207 (2F)

[EP1-OP] Opening

5:00 PM - 5:05 PM

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹, Takehisa Ishida¹, Kenji Takagi¹, Isao Takahashi¹, Hirohisa Amago², Taichi Takeuchi², Asuka Tejima², Maho Watanabe², Yuki Oishi¹, Takahiro Kamei¹, Kazumasa Nomoto¹ (1. Sony Corporation (Japan), 2. Sony Global Manufacturing & Operations Corporation (Japan))

5:05 PM - 5:30 PM

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink. (Taiwan))

5:30 PM - 5:55 PM

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University (China))

5:55 PM - 6:20 PM

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanao Fujisaki¹ (1. Tokai University (Japan))

6:20 PM - 6:35 PM

5:00 PM - 5:05 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-0P] Opening

5:05 PM - 5:30 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-1(Invited)] Photo-Quality Single Pixel Full-Color Rewritable Sheets with Leuco Dyes

*Kenichi Kurihara¹, Yuriko Kaino¹, Aya Shuto¹, Hiroshi Mizuno¹, Satoko Asaoka¹, Takehisa Ishida¹, Kenji Takagi¹, Isao Takahashi¹, Hirohisa Amago², Taichi Takeuchi², Asuka Tejima², Maho Watanabe², Yuki Oishi¹, Takahiro Kamei¹, Kazumasa Nomoto¹ (1. Sony Corporation (Japan), 2. Sony Global Manufacturing & Operations Corporation (Japan))

Keywords: rewritable sheet, single pixel full-color, parallax, high-resolution, photographic quality

We have developed a laser-addressed photographic-quality rewritable sheet by using a 426-ppi single pixel full-color structure of a thin stacked C/M/Y thermochromic leuco-dye system with an unrecognized parallax. This development will facilitate new applications of on-demand rewritable image design on various surfaces.

5:30 PM - 5:55 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-2(Invited)] Magnetically Written Electrophoretic Display

*CC Tsai¹ (1. E Ink Holdings Ink. (Taiwan))

A new magnetically written electrophoretic display technology (MEPD) has been demonstrated that requires no TFT backplane to image. MEPD maintains the essential paper-like characteristics of ePaper. It has the reflective "paperlike" look, and is readable in direct sunlight. Moreover no power is required for static image. It has the flexibility suitable for bendable, rollable, or foldable applications. MEPD has been coated in a roll-to-roll production line, and is especially applicable for no-lag stylus input and/or large format applications.

5:55 PM - 6:20 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-3(Invited)] Understanding the Mechanisms of E-ink Operation

*Bo-Ru Yang¹ (1. Sun Yat-Sen University (China))

Keywords: E-Paper, Electrophoretic Display, Microcapsules, Bistable Displays

Owing to the unique features of electrophoretic E-ink displays, including the bistability, paper-like appearance, and sunlight visibility, E-ink has been applied in many IoT environments. We will summarize the mechanisms frequently used while designing the E-ink displays, which may facilitate the new beginners to start their research in E-ink fields.

6:20 PM - 6:35 PM (Wed. Nov 27, 2019 5:00 PM - 6:35 PM Room 207)

[EP1-4L] Comparison of handwriting performance of paper / tablet / e-paper in various conditions including standing position.

*Kanao Fujisaki¹ (1. Tokai University (Japan))

Keywords: e-paper, tablet, paperless

Evaluations were performed in writing speed and subjective impression of handwriting task on paper, tablet, e-paper. The tasks were performed at the three conditions: (1)writing on a desk, (2)writing without desk, (3)writing in a standing position. Our results indicated advantages of e-paper especially in the standing position.

Oral Presentation

[DES1] 8K Systems

Chair: Ryutaro Oke (Panasonic Liquid Crystal Display)

Co-Chair: Hyun-Wook Lim (SAMSUNG ELECTRONICS)

Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207 (2F)

[DES1-OP]

Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:40 PM - 1:45 PM

[DES1-1(Invited)]

Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹, Ryutaro Oke², Kenkichi Tanioka¹, Toshio Chiba¹ (1. Kairos Co., Ltd. (Japan), 2. Panasonic Liquid Crystal Display Co., Ltd. (Japan))

1:45 PM - 2:10 PM

[DES1-2(Invited)]

Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹, Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

2:10 PM - 2:35 PM

[DES1-3(Invited)]

Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application

*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))

2:35 PM - 3:00 PM

1:40 PM - 1:45 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-OP] Opening

*Haruhiko Okumura¹ (1. Toshiba (Japan))

1:45 PM - 2:10 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-1(Invited)] Development of 8K-UHD 3D Display for Advanced Digital Surgical Imaging

*Hiromasa Yamashita¹, Junichi Maruyama¹, Ryutaro Oke², Kenkichi Tanioka¹, Toshio Chiba¹ (1. Kairos Co., Ltd. (Japan), 2. Panasonic Liquid Crystal Display Co., Ltd. (Japan))

Keywords: 8K ultra -high definition (UHD), rigid endoscope, microscope, eye surgery

We have developed a prototype of 55-inch 8K ultra-high definition (UHD) three-dimensional (3D) display using a polarization filter for advanced digital surgical imaging with the new camera system with 8K-UHD resolution (7680 x 4320 pixels), which is 16 times as much as that of high-definition (HD; 1920 x 1080 pixels).

2:10 PM - 2:35 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-2(Invited)] Driver Technology for 8K Ultra High Definition TV

*Hyun-Wook Lim¹, Yong-Hoon Yu¹, Jinho Kim¹, Byoung-Yoon Jang¹, Jung-Pil Lim¹, Kyoung-Ho Ryu¹, Kil-Hoon Lee¹, Kyoung-Ho Kim¹, Young-Min Choi¹, Jae-Youl Lee¹ (1. Samsung Electronics (Korea))

Keywords: 8K UHD, Column Driver, Equalization, Line Overdriving, Auto calibration

Driver technology for large 8K UHD 120Hz 10bit color display is presented in 0.13-μ m high-voltage CMOS process for column driver IC, and 14nm CMOS process for TCON. The proposed auto-optimized equalizer could compensate -21.4dB channel loss for 4Gbps receiver per lane for 82-inches 8K UHD panel. The proposed line-overdrive technique could compensate insufficient charging time for each line using variable LUT.

2:35 PM - 3:00 PM (Wed. Nov 27, 2019 1:40 PM - 3:00 PM Room 207)

[DES1-3(Invited)] Adaptive Functions in Timing Controller for 8K4K High Resolution and Large Size Panel Application

*Pu Jen Cheng¹, Tung Ying Wu¹, Cheng Che Tsai¹ (1. Himax Technology (Taiwan))

Keywords: 8K4K LCD panel, Spatial Over Drive (Spatial OD), Digital Low Color Shift (DLCS)

Many panel makers keep committed to manufacture 8K4K LCD panel in recent years. There are some panel issues accompanying by higher resolution and larger panel size, like source driver ability and side viewing color shift (especially in the VA type panel). We propose the adaptive functions to improve the image quality for high resolution and large size panel in Timing Controller (T-CON).

Oral Presentation

[DES2] Driving Technology

Chair: Chih-Wen Lu (Nat. Tsing Hua Univ.)

Co-Chair: Keiichi Nakajima (Tianma Japan)

Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207 (2F)

[DES2-1] Relationship Between Charging Rate and Color Gamma Cross-talk for TFT-LCD with Flip Pixel Driven Architecture

*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

3:20 PM - 3:40 PM

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays

*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

3:40 PM - 4:00 PM

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT

*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

4:00 PM - 4:20 PM

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs

*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

4:20 PM - 4:40 PM

3:20 PM - 3:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-1] Relationship Between Charging Rate and Color Gamma Crosstalk for TFT-LCD with Flip Pixel Driven Architecture

*Jing LIU¹, Sikun Hao¹, Wei li¹ (1. Shenzhen China Star Optoelectronics Technology Co., Ltd (CSOT) (China))

Keywords: TFT-LCD, charging rate, color gamma crosstalk, line overdrive

Color gamma crosstalk (CCT) formula, which compares the luminance of three primary-color images with the luminance of gray-level image, is a way of measuring color expression. In this paper, the negative correlation between charging rate and CCT in the thin film transistor liquid crystal display (TFT-LCD) with flip pixel driven architecture is studied. Based on the analysis and understanding, line overdrive (OD) technology is applied to reduce the value of CCT to the standard range.

3:40 PM - 4:00 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-2] New External Compensated Circuit with Buffer IC for High-Resolution AMOLED Displays

*Feng-Ching Cheng¹, Po-Syun Chen¹, Chia-Lun Lee¹, Chih-Lung Lin¹ (1. National Cheng Kung University (Taiwan))

Keywords: AMOLED, external compensation, low-temperature polycrystalline silicon thin-film transistor

This work presents a new pixel circuit based on LTPS TFTs compensating for TFT V_{TH} variations and V_{DD} I-R drops for AMOLED displays. The simulated results show that the relative current error rates are less than 4.87% with TFT V_{TH} of ± 0.5 V and -0.5 V V_{DD} I-R drops.

4:00 PM - 4:20 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-3] Highly Reliable a-IGZO TFT Gate Driver Circuit to Suppress Threshold Voltage Shift of Pull-down TFT

*Jungwoo Lee¹, Jongsu Oh¹, Eun Kyo Jung¹, KeeChan Park², Jae-Hong Jeon³, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Konkuk University (Korea), 3. Korea Aerospace University (Korea))

Keywords: Oxide TFT, Gate Driver Circuit, Reliability, Duty Ratio

We present the highly reliable gate driver circuit using AC-driven method of a pull-down TFTs. Two pull-down TFTs are driven with duty ratio of 33.3% and 66.7%, respectively, VOUT discharge completely. The proposed circuit can minimize coupling noise by discharging the Q and VOUT node constantly except for output period.

4:20 PM - 4:40 PM (Wed. Nov 27, 2019 3:20 PM - 4:40 PM Room 207)

[DES2-4] Novel Driving Methods of Gate Driver Circuit for Depletion Mode Oxide TFTs

*Jongsu Oh¹, Kyung-Mo Jung¹, Soo-Yeon Lee², KeeChan Park³, Jae-Hong Jeon⁴, Yong-Sang Kim¹ (1. Sungkyunkwan University (Korea), 2. Seoul National University (Korea), 3. Konkuk University (Korea), 4. Korea Aerospace University (Korea))

Keywords: Gate Driver Circuit, Thin-Film Transistor, Depletion Mode, Threshold Voltage, Reliability

We introduce novel driving methods of pull-down unit in a gate driver circuit for enhancement and depletion mode a-IGZO thin-film transistors (TFTs). Using 3T1C diode connection structure, our circuit can compensate for V_{TH} of pull-down unit in the enhancement mode and can be normally operated in the depletion mode.

Authors Interview

[AI-01] Authors Interview

Wed. Nov 27, 2019 6:30 PM - 7:00 PM Main Hall (1F)

[AI-1] Authors Interview

6:30 PM - 7:00 PM

6:30 PM - 7:00 PM (Wed. Nov 27, 2019 6:30 PM - 7:00 PM Main Hall)

[AI-1] Authors Interview