# 2019 INTERNATIONAL IMAGE SENSOR WORKSHOP
Snowbird Resort, Utah, USA
June 24-27, 2019

## PROGRAM

### Sunday, June 23rd 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>18:00</td>
<td>Registration</td>
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### Monday, June 24th 2019

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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>08:00-08:30</td>
<td>Registration / Welcome</td>
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<td>08:30-08:45</td>
<td>Opening</td>
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### Session 01

**Stacking and Small Pixels**
Session Chairs: Yusuke Oike (Sony); Dun-Nian Yaung (TSMC)

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
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<tr>
<td>08:45-09:00</td>
<td>The State-of-the-Art of Smartphone Imagers</td>
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<tr>
<td>R01</td>
<td><em>Ray Fontaine, TechInsights Inc., Canada</em></td>
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<tr>
<td>09:00-09:15</td>
<td>A new 0.8µm CMOS image sensor with low RTS noise and high full well capacity</td>
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<tr>
<td>R02</td>
<td><em>Takama Hasegawa</em></td>
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<td></td>
<td><em>Kazufumi Watanabe</em></td>
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<td><em>Ray Jung</em></td>
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<td><em>Nagatake Tanaka</em></td>
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<td><em>Takashi Nakashikiyo</em></td>
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<td><em>Wu-Zang Yang</em></td>
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<td><em>Alvin Chih Wei Hsiung</em></td>
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<td><em>Zhiqiang Lin</em></td>
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<td><em>Sohei Manabe</em></td>
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<td><em>Vincent C. Venezia</em></td>
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<td><em>Lindsay A. Grant</em></td>
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<td>R03</td>
<td><em>Jungbin Yun</em></td>
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<td><em>Kyungho Lee</em></td>
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<td><em>Junghyang Pyo</em></td>
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<td><em>Masato Fujita</em></td>
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<td><em>Kyoung Mok Son</em></td>
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<td><em>Junseok Yang</em></td>
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<td><em>Hyejung Kim</em></td>
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<td><em>Younghwan Park</em></td>
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<td><em>Sungsoo Choi</em></td>
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<td><em>Eun Sub Shim</em></td>
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<td>R04</td>
<td><em>Jeongjin</em></td>
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<td><em>Cho</em></td>
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<td><em>Seungjin Lee</em></td>
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<td><em>Seogky Yoon</em></td>
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<td><em>Sangil Jung</em></td>
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<td><em>Takashi Nagano</em></td>
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<td><em>Chang-Rok Moon</em></td>
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<td><em>Yongin Park</em></td>
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1. OmniVision Technologies, Santa Clara, CA, USA
2. OmniVision Technologies Japan, Kanagawa, Japan
3. OmniVision Technologies Taiwan, Hsinchu, Taiwan
4. *OmniVision Technologies, Santa Clara, CA, USA*
5. *System LSI Division, Samsung Electronics Co., Ltd*
6. *Foundry Division, Samsung Electronics Co., Ltd*
World first mass productive 0.8㎛ pixel size image sensor with new optical isolation technology of to minimize optical loss for high sensitivity

Yunki Lee¹, Jonghoon Park¹, Bumsuk Kim¹, Jungsaeng Kim¹, Hyungeun Yoo¹, Seungjoo Nah², Donghyuk Park¹, Taesung Lee¹, Bomi Kim¹, Dongmin Keum¹, Heegeun Jeong², Heesang Kwon¹, Myoungsun Kim², Sangil Jung², Yitae Kim¹, Changrok Moon¹ and Yongin Park¹
¹System LSI Division, Samsung Electronics Co., Ltd
²Foundry Division, Samsung Electronics Co., Ltd.

Digital Pixel Image Sensors with Linear and Wide-Dynamic-Range Response Developed by Pixel-Wise 3-D Integration

Masahide Goto¹, Yuki Honda¹, Toshihisa Watabe¹, Kei Hagiwara¹, Masakazu Nanba¹, Yoshinori Iguchi¹, Takuya Saraya², Masaharu Kobayashi², Eiji Higurashi³, Hiroshi Toshiyoshi², and Toshiro Hiramoto²
¹NHK Science and Technology Research Laboratories, Tokyo, Japan,
²The University of Tokyo, Tokyo, Japan,
³National Institute of Advanced Industrial Science and Technology, Ibaraki, Japan

0.8㎛-pitch CMOS Image Sensor with Dual Conversion Gain Pixel for Mobile Applications

Dongyoung Jang, Donghyuk Park, Seungwon Cha, Heesang Kwon, Mihye Kim, Seungwook Lee, Haewon Lee, Seonok Kim, Nakyung Lee, Jinhwa Han, Dachwoong Lee, Kwanyoung Oh, Minseong Lee, Ina Yun, Hana Lee, Seokyong Hong, Yitae Kim, Chang-Rok Moon and Yongin Park
System LSI Division, Samsung Electronics Co., Ltd, Yongin-city, Gyeonggi-do, Korea

0.8㎛-pitch CMOS Image Sensor with Dual Conversion Gain Pixel for Mobile Applications

Dongyoung Jang, Donghyuk Park, Seungwon Cha, Heesang Kwon, Mihye Kim, Seungwook Lee, Haewon Lee, Seonok Kim, Nakyung Lee, Jinhwa Han, Dachwoong Lee, Kwanyoung Oh, Minseong Lee, Ina Yun, Hana Lee, Seokyong Hong, Yitae Kim, Chang-Rok Moon and Yongin Park
System LSI Division, Samsung Electronics Co., Ltd, Yongin-city, Gyeonggi-do, Korea

10:15-10:40

Noise

Session Chair: Bumsuk Kim (Samsung)

0:40-10:55

Modelling Measured 1/f Noise in Quanta Image Sensors (QIS)

Wei Deng¹ (Student), Dakota Starkey¹ (Student), Jiaju Ma² and Eric R. Fossum¹
¹Thayer School of Engineering, Dartmouth College, Hanover, NH, USA
²Gigajot Technology, Inc. Pasadena, CA, USA

Several Process Techniques & Pixel Source Follower Schemes to improve the Pixel Temporal Noise

ManLyun Ha, DongJun Oh, SoEun Park, WooSung Choi, HanGyu Lee, ByeungYeup Lee, Dongil Kim, ChangHun Han, YongChan Kim, Jiul Lee, and YoonJong Lee
CIS Process Development Team, DB HiTek
EumSung, Choongbuk, Korea

Active optical sensing with randomized coded light for intentional interference tolerance

Unghyun Kim, Makoto Ikeda
Department of Electrical Engineering and Information Systems, Graduate School of Engineering, The University of Tokyo, Japan
Identifying the Sources of Random Telegraph Noises in Pixels of CMOS Image Sensors

Calvin Yi-Ping Chao\textsuperscript{1}, Meng-Hsu Wu\textsuperscript{1}, Shang-Fu Yeh\textsuperscript{1}, Kuo-Yu Chou\textsuperscript{1}, Honyh Tu\textsuperscript{1}, Chi-Lin Lee\textsuperscript{1}, Yin Chin\textsuperscript{1}, Philippe Paillet\textsuperscript{2}, and Vincent Goiffon\textsuperscript{3}

\textsuperscript{1}Taiwan Semiconductor Manufacturing Company, Hsinchu, Taiwan
\textsuperscript{2}CEA, DAM, Arpajon, France
\textsuperscript{3}ISAE-SUPAERO, Université de Toulouse, France


Y. Sacchettini\textsuperscript{1,2}, J.-P. Carrère\textsuperscript{1}, R. Duru\textsuperscript{1}, J.-P. Oddou\textsuperscript{1}, V. Goiffon\textsuperscript{2} and P. Magnan\textsuperscript{2}

\textsuperscript{1}STMicroelectronics, France
\textsuperscript{2}ISAE-SUPAERO, Université de Toulouse, France

Random Telegraph Noise Caused by MOSFET Channel Traps and Variable Gate Induced Leakage with Multiple Sampling Readout

Shang-Fu Yeh, Meng-Hsu Wu, Chih-Lin Lee, Chin Yin, Kuo-Yu Chou, Calvin Yi-Ping Chao
Taiwan Semiconductor Manufacturing Company, Hsinchu, Taiwan

Lunch

Session 03
Poster Presentations

Session Chair: Edoardo Charbon (EPFL)

Study of Multilayer FEP Characteristics Using Second Harmonic Generation Measurement

Sung-Kun Park, Ming Lei\textsuperscript{1}, Youngwoong Do, Dong-Hyun Kim, Jae-Hyun Kim, Hyungbok Choi\textsuperscript{2}, Seung-Han Lee\textsuperscript{2}, Kyung-do Kim, Hyun-Joon Kim, Sung-Bo Hwang, Hoon-Sang Oh, Sung-Joo Hong and Kyung-Dong Yoo\textsuperscript{3}
SK hynix, Technology Development Group, Korea

\textsuperscript{1}Femtometrix Inc., USA
\textsuperscript{2}Wonik-IPS Inc., Korea
\textsuperscript{3}Hanyang University, Nanoscale Semiconductor Engineering, Korea

A Reconfigurable 40nm CMOS SPAD Array for LiDAR Receiver Validation

Sarrah M. Patanwala\textsuperscript{1,2}, Istvan Gyongy\textsuperscript{1}, Neale A.W. Dutton\textsuperscript{2}, Bruce R. Rae\textsuperscript{2}, Robert K. Henderson\textsuperscript{1}

\textsuperscript{1}School of Engineering, Institute for Integrated Micro and Nano Systems, University of Edinburgh, UK, EH9 3FF
\textsuperscript{2}STMicroelectronics Imaging Division, 1 Tanfield, Edinburgh, UK
A 110nm CMOS process with fully depleted high resistivity substrate for NIR, X-ray and charged particle imaging

Lucio Pancheri¹,², J. Olave¹,³,⁴, S. Panati¹,⁴, A. Rivetti³, F. Cossio¹,³,⁴, M. D. Da Rocha Rolo⁳,
N. Domaria³, P. Giubilato⁵,⁶, D. Pantano⁵,⁶, S. Mattiazzo⁵,⁶
¹Università di Trento, Trento, Italy, ²TIFPA, Trento, Italy, ³INFN Torino, Torino, Italy,
⁴Politecnico di Torino, DET, Torino, Italy, ⁵Università di Padova, Padova, Italy, ⁶INFN Padova, Padova, Italy

Intrinsic Si Quantum Efficiency, Responsivity, and Other Parameters Temperature Dependence for BSI Image Sensors

Sergey Velichko¹, Bob Gravelle¹, Daniel Tekleab², Michael Guidash², Scott Johnson¹, Minseok Oh², Hung Chih Chang²
¹ON Semiconductor, Meridian, ID, USA, ²ON Semiconductor, Santa Clara, CA, USA

Electrostatic surface passivation for p-type BSI image sensors

¹,²T.Dalleau, ¹R.Duru, ¹D.Benoit, ¹A.Suler, ¹,³C.Chaton, ¹F.Roy, ²G.N.Lu
¹STMicrowelectronics, 850 rue J. Monnet BP16, 38926 Crolles Cedex, France
²Institut des Nanotechnologies de Lyon, Univ. Claude Bernard Lyon 1, 69622 Villeurbanne, France
³CEA Leti, 17 Avenue des martyrs, 38054 Grenoble, France

Floating Diffusion Dark Current and Dark Signal Non-Uniformity Reduction for High Dynamic Range Overflow Collection Pixels in High Temperature Applications

M. Guidash¹, M. Oh¹, D. Collins¹, R. Mauritzson², D. Tekleab¹, W. Xu¹, S. Nicholes²
ON Semiconductor; ¹Santa Clara, CA, ²Meridian, ID

A large-area a-IGZO 256x256 imager using a current-mode transimpedance readout for mammography applications

Florian De Roose¹, Sandra Tedde¹, Kris Myny¹, Siavash Ardekani¹, Manoj Nag¹, Marc Ameys¹, Albert van Breemen¹, Jan-Laurens van der Steen³, Roy Verbeek³, Hylke Akkerman³,
Gerwin Gelink¹, Tim Piessens¹, Jan Genoe¹,⁵, Wim Dehaene¹,⁵, Soeren Steudel¹
¹imec, Leuven, Belgium, ²Siemens Healthcare, Erlangen, Germany, ³Holst Centre / TNO, Eindhoven, The Netherlands, ⁴ICsense, Leuven, Belgium, ⁵KULeuven, Leuven, Belgium

Parameter-free Simulation of Photon-detection Probability in CMOS Single-photon Avalanche Diodes

Chin-An Hsieh and Sheng-Di Lin
Institute of Electronics, National Chiao Tung University, Taiwan

CMOS Single-photon Avalanche Diodes using Gated Reset Circuit with On-chip Pulse Width Modulation

Chun-Chang Hsu, Chia-Ming Tsai, and Sheng-Di Lin
Institute of Electronics, National Chiao Tung University, Taiwan

Fast Charge Transfer in 100µm long PPD Pixels

Ajit Kumar Kalgi, Arne Crouwels, Bart Dierickx, Walter Verbruggen, Dirk Van Aken
Caeleste, Mechelen, Belgium
Long Distance Ranging Performance of Gen3 LiDAR Imaging System based on 1x16 SiPM Array
Salvatore Gneccchi, Colin Barry, Stephen Bellis, Steve Buckley, Carl Jackson
ON Semiconductor, Cork, Ireland

A Low Noise Single-Slope ADC with Signal-Dependent Multiple Sampling Technique
Sanguk Lee, Seunghyun Lee, Bumjun Kim, Seong-Jin Kim
Ulsan National Institute of Science and Technology, South Korea

Pixel with nested photo diodes and 120 dB single exposure dynamic range
Manuel Innocent, Angel Rodriguez, Deb Guruaribam, Muhammad Rahman, Marc Sulfridge,
Swarnal Borthakur, Bob Gravelle, Takayuki Goto, Nathan Dougherty, Bill Desjardin, David
Sabo, Marko Mlinar and Tomas Geurts
ON Semiconductor, Belgium/USA

Fully Depleted SiPMs Optimized for Automotive NIR ToF in 180nm Technology
Amos Fenigstein and Tomer Leitner
TowerJazz, Migdal Ha’emek, Israel

Pixel Design Utilized P-type Substrate to Achieve Superior NIR Sensitivity and Resolution with
Low Dark Noise
Takanori Usuki, Masayuki Saeki, Takefumi Komiishi, Hiroshi Iwata, Kenichi Nagai, and Toshio
Yoshida Semiconductor Business Unit, Sharp Hakuyama Semiconductor Co., Ltd., Hiroshima,
Japan

A 132 by 104 10µm-Pixel 250µW 1kefps Dynamic Vision Sensor with Pixel-Parallel Noise and
Spatial Redundancy Suppression
Chenghan Li1, Luca Longinotti1, Federico Corradi2, Tobi Delbruck3
1 iniVation AG, 2 iniLabs GmbH, 3 INI UZH&ETH, Zurich, Switzerland

Extending Image Sensor Dynamic Range by Scene-aware Pixelwise-adaptive Coded Exposure
Huifeng Ke1, Navid Sarhangnejad1, Rahul Gulve1, Zhengfan Xia1, Nikita Gusev1, Nikola
Katic1, Kiriakos N. Kutulakos2, Roman Genov1
University of Toronto, Ontario, Canada.
1 Department of Electrical and Computer Engineering
2 Department of Computer Science

A versatile 3D stacked vision chip with massively parallel processing enabling low latency image
analysis
Stéphane Chevobbe1, Maria Lepecq1, Karim Benchehida1, Mehdi Darouich1, Thomas
Dombek1, Fabrice Guellec2, Laurent Miller2
1 CEA LIST Department, CEA LIST, Centre CEA Saclay, Gif-sur-Yvette, France
2 CEA LETI Department, CEA LETI, MINATEC Campus, Grenoble, France
A 2-Mpixel CMOS Image Sensor with Device Authentication and Encryption Key Generation based on Physically Unclonable Function

Shunsuke Okura¹, Ryota Ishiki², Syohei Takano², Masayoshi Shirahata², Takaya Kubota², Mitsuru Shiozaki², Kenichiro Ishikawa¹, Isao Takayanagi¹, and Takeshi Fujino²
¹Brillnics Japan Inc., Tokyo, ²Research Organization of Science and Engineering Ritsumeikan

A high dynamic range, 1.9 Mpixel CMOS image sensor for X-ray imaging with in-pixel charge binning and column parallel ADC

M. Sannino, A. Bofill-Petit, G. Pinaroli¹ and R. Turchetta
IMASENIC Advanced Imaging S.L., Barcelona, Spain
¹Also with Università degli Studi di Udine, Via delle Scienze 206, 33100 Udine, Italy

A Novel Threshold Calibration Methodology for Quanta Image Sensors (QIS)

Dakota A. Starkey¹, Jiaju Ma², Saleh Masoodian² and Eric R. Fossum¹
¹Thayer School of Engineering, Dartmouth College, Hanover, NH, USA
²Gigajot Technology Inc., Pasadena, CA, USA

DUV Optimized CCD with Oxide Micro-lenses

Joseph Summa, Tom Carducci, Brian Douglas, Eric Meisenzahl, Chris Parks, Dean Seidler, Scott Vanallen
ON Semiconductor, Rochester, NY, USA

Optimization of fully-depleted gated PPD pixel for achieving high-speed charge transfer

Yun-Tzu Chang¹,², Pierre Boulenc², Linkun Wu², Maarten Rosmeulen², Pol Van Dorpe¹,², Chris Van Hoof², Andreas Süss³,⁴
¹KU Leuven, ESAT-TELEMIC, Belgium
²Imec, Leuven, Belgium
³now at OmniVision Technologies, Santa Clara CA, USA

Large Format Global Shutter CMOS Image Sensors

Tomas Geurts, Cedric Esquenet, Stefan Janssens, Anilkumar Prathipati, Mukesh Engla Rao Syam, John McCarten, Hung Doan
ON Semiconductor, Belgium/USA

Leakage Current Non-Uniformity and Random Telegraph Signal in CMOS Image Sensor Floating Diffusions used for In-Pixel Charge Storage

Alexandre Le Roch*,⁴,⁵, Vincent Goiffon*, Philippe Pailler⁴, Jean-Marc Belloir⁵, Pierre Magnan⁴, and Cédric Virmontois⁵
*ISAE-SUPAERO, Université de Toulouse, Toulouse, France
†Centre Nationale d’Études Spatiales (CNES), Toulouse, France
‡CEA, DAM, DIF, Arpajon, France
Demonstration of Monolithically Integrated Pixel Sensors Based on Optical Back Biasing in 28nm node FDSOI Technology

L. Kadura$^1$, O. Rozeau$^1$, A. Ayres$^{1,*}$, L. Grenouillet$^1$, N. Rambal$^1$, A. Chelnokov$^1$ and M. Vinet$^1$

$^1$Univ. Grenoble-Alpes, CEA, LETI, 17 Avenue des Martyrs, 38000 Grenoble, France

* Now with STMicroelectronics, Crolles, France

Imaging by single quantum processing: large pixels with brains or attopixels without?

Rafael Ballabriga, Benedikt Bergmann, Michael Campbell, Vladimir Gromov, Erik Heijne, Thanushan Kugathasan, Xavier Llopart, Petr Manek, Tuomas Poikela, Stanislav Pospisil, Walter Snoeys, Viros Sriskaran, Lukas Tlustos and John Vallerga

CERN EP Department, Switzerland

Nikhef, Science Park 105, Amsterdam, Netherlands

IEAP at Czech Technical University, Prague, Czech Republic

Space Sciences Laboratory at the UC Berkeley, CA, USA

SPAD array sensitivity improvement by diffractive microlens enhancement by diffractive microlens

J. Vaillant$^{*}$, L. Masarotto$^{*}$, R. Paquet$^{*}$, V. Lecoutre$^{*}$, C. Pelle$^{*}$, N. Moussy$^{*}$ and S. Jouan$^{*}$

$^{*}$Univ. Grenoble Alpes, CEA, LETI, DOP, LIS, F-38000 Grenoble

$^1$TR&D, STMicroelectronics, 850 rue Jean Monnet, F-38920 Crolles

SPAD based imaging of Cherenkov light in radiation therapy

A Pétusseau$^{1,2}$, P Bruza$^1$, S Tisa$^3$, S Gioux$^3$, B W Pogue$^1$

$^1$Thayer School of Engineering, Dartmouth College, Hanover NH 03755 USA

$^2$Telecom Physique Strasbourg, University of Strasbourg, Pôle API, 67400 Illkirch-Graffenstaden, France

$^3$Micro Photon Devices srl, Via Stradivari 4, 39100 Bolzano, Italy

A 2.5µm 9.5 Mpixel high framerate CMOS imager with hybrid output multiplexer and 58Gb/s datarate

Jeroen Rotte$^1$, Arnaud Defernez$^1$, Rik Visser$^1$, Ruud van Ree$^1$, Huil van den Heijkant$^1$, Frank van der Wegen$^1$, Klaas-Jan Damstra$^1$, Peter Centen$^2$, Adi Birman$^2$, Dmitry Veinger$^2$, Simon Louwsma$^3$

$^1$Grass Valley a Belden brand, Breda, the Netherlands

$^2$TowerJazz, Migdal Haemek, Israel

$^3$Teledyne DALSA, Enschede, the Netherlands

A CMOS Image Sensor with In-Pixel Temperature Sensors for Dark Signal Non-Uniformity Compensation

Shuang Xie$^1$, Accel Abarca Prouza$^1$, Albert Theuwissen$^{1,2}$

$^1$Electronic Instrumentation Laboratory Delft University of Technol

$^2$Harvest Imaging Bree, Belgium

High speed 25M global shutter image sensor with 2.5um pixel

C. Ma$^1$, Y. Guo$^1$, Z. Li$^1$, G. Xin$^1$, H. Yin$^1$, Y. Liu$^1$, Y. Li$^1$, Q. Zhou$^1$, J. Bogaerts$^{1,2}$, X. Wang$^{1,2}$

$^1$Gpixel INC, Yingkoulu 588, Changchun, China
Sensor Modeling and Benchmarking — A Platform for Sensor and Computer Vision Algorithm Co-Optimization

Andrew Berkovich, Chiao Liu
Facebook Reality Labs

16:55 - Poster Viewing

Tuesday, June 25th 2019

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<td>Session Chair: Hidekazu Takahashi (Canon)</td>
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**08:30-08:45**
Back Side Illuminated, Fully Depleted, Pinned Trench Photo MOS for Imaging Applications

Francois Roy¹, Andrej Suler¹, Jihane Arnaud¹, Yvon Cazaux², Laurent Montes³, Panagiota Morfouli³

R13

¹STMicroelectronics, 850 Rue Jean Monnet, BP. 16, 38921 Colles, France
²CEA Léti, 17 rue des Martyrs, 38054 Grenoble, Cedex 9, France
³Grenoble INP, IMEP-LaHC, 3 Parvis Louis Néel, 38016 Grenoble, France

**08:45-09:00**
Pixel Technology for Improving IR Quantum Efficiency of Backside-illuminated CMOS Image Sensor

Jonghoon Park¹, Yunky Lee¹, Bomi Kim¹, Junsung Park¹, Eunju Yeom¹, Yunji Jung¹, Taehan Kim¹, Hansik Yoon², Yongho Kim², Jinsu Park², Bumsuk Kim³, Chang-Rok Moon¹, and Yongin Park¹

R14

¹System LSI Division, Samsung Electronics Co., Ltd
²Foundry Division, Samsung Electronics Co., Ltd. Yongin-city, Gyeonggi-do, Korea.

**09:00-09:15**
An 8-tap CMOS Lock-in Pixel Image Sensor for Short-Pulse Time-of-Flight Measurements

Yuya Shirakawa¹, Keita Takahashi¹, Keiichiro Kagawa², Satoshi Aoyama³, and Shoji Kawahito²,³

R15

¹Graduate School of Medical Photonics, Shizuoka University, Hamamatsu, 432-8011, Japan
²Research Institute of Electronics, Shizuoka University, Hamamatsu, 432-8011, Japan

**09:15-09:30**
A technique for phase-detection auto focus under near-infrared-ray incidence in a back-side illuminated CMOS image sensor pixel with pyramid textured interfaces for diffraction

Tatsuya Kunikyo, Yotaro Goto, Fumitoshi Takahashi, Hidenori Sato, Takeshi Kamino, Koji Izuka, Yutaka Akiyama and Tomohiro Yamashita

R16

Renesas Electronics Corporation
751 Horiguchi, Hitachinaka, Ibaraki, 312-8504, Japan

**09:30-09:45**
Electrical characterization of the backside interface on BSI global shutter pixels with Tungsten-shield test structures on CDTI process

C.Doyen¹,², St.Ricq¹, P.Magnan², O.Marcelo², M.Barlas¹, S.Place¹

R17

¹STMicroelectronics, 850 rue Jean Monnet, 38920 Crolles, France
²ISAE-SUPAERO, Université de Toulouse, 10 Avenue Edouard Belin, 31055 Toulouse, France
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<th>Time</th>
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<th>Title</th>
<th>Authors</th>
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| 09:45-10:00  | Image Artifacts in Backside Illumination CMOS Image Sensors Associated with Electrostatic Charge | Tom Frank, Tom Carducci, Bill Desjardins; ON Semiconductor, Rochester, NY, USA  
David Price, Rick Jerome, Jeff Gambino; ON Semiconductor, Gresham, OR, USA  
Rusty Winzenread; ON Semiconductor, Santa Clara, CA, USA  
Thad Smith; ON Semiconductor, Pocatello, ID, USA | R18                                                                 |
| 10:00-10:25  | Break                                            |                                                                      |                                                                                               |
| 10:45-11:00  | Photon-Counting Imaging with Multi-Bit Quanta Image Sensor | Jiaju Ma, Yu-Wing Chung, Abhiram Gnanasambandam, Stanley H. Chan, Saleh Masoodian  
Gigajot Technology Inc., Pasadena, CA 91107, USA | R19                                                                 |
| 11:00-11:15  | Dual Layer 3D-Stacked High Dynamic Range SPAD Pixel | University of Edinburgh, Edinburgh, UK, EH9 3JF  
Tarek Al Abbas¹, Danial Chitnis, Francesco Mattioli Della Rocca, and Robert K. Henderson  
School of Engineering, Institute for Integrated Micro and Nano Systems,  
University of Edinburgh, Edinburgh, UK, EH9 3JF  
¹ now with Sense Photonics, Edinburgh, UK | R20                                                                 |
| 11:15-11:30  | Iterative Image Reconstruction for Quanta Image Sensor by using Variance-based Motion Estimation | Kiyotaka Iwabuchi, Tomohiro Yamazaki and Takayuki Hamamoto  
Graduate School of Engineering, Tokyo University of Science  
6-3-1 Niijuku, Katsushika, Tokyo, 125-8585 Japan | R21                                                                 |
| 11:30-11:45  | Crystalline Selenium-Based Stacked CMOS Image Sensor with in-Pixel Pulse-Generating Operation Suitable for Single-Photon Counting | Shigeyuki Imura, Masahide Goto  
NHK Science and Technology Research Laboratories, 1-10-11 Kinuta, Setagaya-ku, Tokyo 157-8510, Japan | R22                                                                 |
| 11:45-12:00  | High Dynamic Range Imaging using Quanta Image Sensors | Abhiram Gnanasambandam¹, Jiaju Ma² and Stanley H. Chan¹  
¹School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN 47907  
²Gigajot Technology Inc., Pasadena, CA 91107, USA | R23                                                                 |
| 12:00-       | Lunch / Social Event                             |                                                                      |                                                                                               |
08:30-08:45  
A Direct TOF Sensor with In-Pixel Differential Time-to-Charge Converters for Automotive Flash LiDAR and Other 3D Applications  
Yibing M. Wang¹,², Lilong Shi¹, Chunji Wang¹, Kwang Oh Kim¹, Iliya Osviannikov¹,², and Sungwoo Hwang²  
¹Samsung Semiconductor, Inc., Pasadena, CA, USA  
²Samsung Advanced Institute of Technology, Suwon, Korea  

R24

08:45-09:00  
1kFPS Time-of-Flight Imaging with a 3D-stacked CMOS SPAD Sensor  
Istvan Gyongy¹, Sam W. Hutchings¹, Max Tyler², Susan Chan², Feng Zhu², Robert K. Henderson¹, Jonathan Leach²  
¹The University of Edinburgh, Institute for Integrated Micro and Nano Systems, Edinburgh, U.K.  
²Heriot-Watt University, Institute of Photonics and Quantum Sciences, Edinburgh, U.K.

R25

09:00-09:15  
A Close-in LiDAR for Diffusive Media based on a 32 × 32 CMOS SPAD Image Sensor  
Scott Lindner¹,², Chao Zhang³, Alexander Kalyanov², Martin Wolf², Claudio Bruschini¹, Edoardo Charbon¹  
¹EPFL, Neuchâtel, Switzerland  
²University of Zurich, Zurich, Switzerland  
³TUDelft, Delft, The Netherlands

R26

09:15-09:30  
Analysis of a modular SPAD-based direct time-of-flight depth sensor architecture for wide dynamic range scenes in a LiDAR system  
Preethi Padmanabhan¹, Chao Zhang² and Edoardo Charbon¹,²  
¹Advanced Quantum Architecture Laboratory (AQUA), EPFL, Neuchâtel, Switzerland  
²Applied Quantum Architecture Laboratory (AQUA), Delft University of Technology, The Netherlands

R27

09:30-09:45  
A Time-Resolved Lock-in Pixel Image Sensor Using Multiple-Tapped Diode and Hybrid Cascade Charge Transfer Structure  
Shoji Kawahito¹,², Keita Kondo², Keita Yasutomi¹,², Keiichiro Kagawa¹,²  
¹Research Institute of Electronics, Shizuoka University, Hamamatsu, 432-8011, Japan  
²Graduate School of Engineering, Shizuoka University, Hamamatsu, 432-8011, Japan

R28

09:45-10:00  
Pandion: A 400 × 100 SPAD sensor for ToF LiDAR with 5 Hz median DCR and 11 ns mean dead-time  
Darek Palubiak¹, Salvatore Gnechi¹, Carl Jackson¹, Silei Ma², Orit Skorka², Radu Ispasoiu²  
¹SensL Division, Intelligent Sensing Group, ON Semiconductor, Cork, Ireland  
²Intelligent Sensing Group, ON Semiconductor, Santa Clara, USA

R29

10:00-10:25  
Break
<table>
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<tr>
<th>Session 7</th>
<th>HDR</th>
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Daniel A. Van Blerkom, Steve Huang, Sam Bagwell, David Estrada, Tim Lu, Barmak Mansoorian, Ken Costello*, Verle Aebi*  
Forza Silicon, 2947 Bradley St, Suite 130, Pasadena, California, 91107, USA  
*Intevac, 2560 Basset St, Santa Clara, California, 95054, USA |
| 10:40-10:55 | A High Optical Performance 2.8µm BSI LOFIC Pixel with 120ke- FWC and 160µV/e- Conversion Gain  
Ken Miyauchi†, Shunsuke Okura†, Kazuya Mori†, Isao Takayanagi†, Junichi Nakamura† and Shigetoshi Sugawa‡  
†Brillnics Japan Inc., 6-21-12 Minami-Oi, Shinagawa-ku, Tokyo, 140-0013 Japan  
‡Graduate School of Engineering, Tohoku University, 6-6-11-811, Aza-Aoba, Aramaki, Aoba-ku, Sendai, Miyagi, 980-8579 Japan |
| 10:55-11:10 | Sub-pixel Architecture of CMOS Image Sensor Achieving over 120 dB Dynamic Range with less Motion Artifact Characteristics  
T. Asatsuma1, Y. Sakano1, S. Iida1, M. Takami2, A. Yoshioka1, N. Ohba2, H. Mizuno2, T. Oka1, K. Yamaguchi1, A. Suzuki1, K. Suzuki2, M. Yamada1, Y. Tateshita1, and K. Ohno1  
1Sony Semiconductor Solutions, Kanagawa, Japan  
2Sony Semiconductor Manufacturing, Kumamoto, Japan |
| 11:10-11:25 | A 1280x960 2.8µm HDR CIS with DCG and Split-Pixel Combined  
Johannes Solhusvik1, Trygve Willassen1, Sindre Mikkelsen1, Mathias Wilhelmsen1, Sohei Manabe2, Duli Mao2, Zhaoyu He2, Keiji Mabuchi2, and Takuma Hasegawa2  
1OmniVision Technologies, Oslo, Norway  
2OmniVision Technologies, Santa Clara, USA  
3OmniVision Technologies, Yokohama, Japan |
| 11:25-11:40 | A scalable 12b-16b charge-domain multi-slope column ADC for HDR imagers with 86dB DR at 1µs conversion time  
Simon Louwsma1, Rinus Boot1, Paul Veldhorst1, Jeroen Beijer1, Martin Vasterink1, Daniel Groeneveld1, Jeroen Rotte2, Rik Visser2, Peter Centen2  
1Teledyne DALSA, Enschede, The Netherlands  
2Grass Valley, Breda, The Netherlands |
11:40-11:55  3.0um Backside illuminated, lateral overflow, high dynamic range, LED flicker mitigation image sensor

Minseok Oh¹, Steve Nicholes², Maheshwar Suryadevara³, Lin Lin¹, Hung-Chih Chang¹, Daniel Tekleh¹, Michael Guidash¹, Shaheen Amanullah¹, Sergey Velichko², Manuel Innocent², Scott Johnson²

R35
¹ ON Semiconductor, Santa Clara, CA, USA
² ON Semiconductor, Meridian, ID, USA,
³ ON Semiconductor, Bangalore, India
⁴ ON Semiconductor, Mechelen, Belgium

11:55-13:30  Lunch

**Session 8**  High Speed
Session Chair: Alex Krymski (Alexima)

13:30-13:45  Over 100 Million Frames per Second 368 Frames Global Shutter Burst CMOS Image Sensor with In-pixel Trench Capacitor Memory Array

Manabu Suzuki, Rihito Kuroda, and Shigetoshi Sugawa

R36
Graduate School of Engineering, Tohoku University 6-6-11-811, Aza-Aoba, Aramaki, Aoba-ku, Sendai, Miyagi, Japan 980-8579

13:45-14:00  Multi-tap macro-pixel based compressive ultra-high-speed CMOS image sensor

Keiichiro Kagawa¹, Tomoya Kokado², Yuto Sato¹, Futa Mochizuki³, Hajime Nagahara⁴, Taishi Takasawa¹, Keita Yasutomi¹, Shoji Kawahito¹

¹ Research Institute of Electronics, Shizuoka University
² Graduate School of Integrated Science and Technology, Shizuoka University
³ Formerly, Shizuoka University
⁴ Institute for Datability Science, Osaka University

14:00-14:15  Evolution of BSI Multi-Collection-Gate Image Sensors - From Light-in-Flight imaging to Giga-fps Continuous Imaging -

T. Goji Etoh¹, Nguyen Ngo¹, Anh Quang Nguyen³, Yoshiyuki Matsunaga¹, Taeko Ando¹, Kohsei Takehara², and Kazuhiro Shimonomura³

¹ Ritsumeikan University
² Kindai University
³ Hanoi University of Science and Technology

14:15-14:30  Image Sensor with Panel Readout and Serialization using Multiple PLLs

Alex Krymski

R39
16850 Collins Ave Suite 112-529, Sunny Isles Beach, FL

14:30-14:45  16.7Mpixel 8000fps sparse binarized scientific image sensor

Peng Gao, Sampsa Veijalainen, Jente Basteleus, Gaozhan Cai, Bert Luysaert, Bart Dierickx Caeleste, Hendrik Conscienciestraat 1 b, 2800 Mechelen, Belgium

14:45-15:10  Break
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tr>
<td>15:10-15:30</td>
<td>Invited</td>
<td>Invited Presentation II</td>
<td>Dave Shafer, Intuitive Surgical - &quot;Image Sensor Applications in Minimally Invasive Surgery&quot;</td>
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<td>3 Department of Information and Image Sciences, Chiba University, Chiba, 263-8522, Japan</td>
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<td>2 STMicroelectronics Imaging Division, Edinburgh, UK</td>
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<td>16:00-16:15</td>
<td>Presentation</td>
<td>Advanced Fundus Camera with Innovative NIR Multispectral Color Imaging System - Application Field Development of Dynamic Intelligent Systems Using High-Speed Vision</td>
<td>Hiroyuki Sumi, Hironari Takehara, Daiki Shirahige, Takahiko Kondo, Kiyotaka Sasagawa, Takashi Tokuda, Norimasa Kishi, Jun Ohta, and Masatoshi Ishikawa</td>
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<td>1 Graduate School of Information Science and Technology, The University of Tokyo</td>
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<td>2 Graduate School of Materials Science, Nara Institute of Science and Technology (NAIST)</td>
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<td>16:15-16:30</td>
<td>Presentation</td>
<td>Organic- and QD-based image sensors integrated on 0.13 µm CMOS ROIC for high resolution, multispectral imaged imaging</td>
<td>Epimitheas Georgitzikis, Pawel E. Malinowski, Yunlong Li, Jiwon Lee, Andreas Süss, Fortunato Frazzica, Jorick Maes, Sam Gielen, Frederik Verstraeten, Pierre Boulenc, Ming Mao, Stefano Guerrieri, Wouter Maes, Zeger Hens, Paul Heremans, and David Cheyns</td>
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<td>3 Center for Nano- and Biophotonics (NB-Photonics), Ghent University, 9000 Ghent, Belgium</td>
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<td>4 Hasselt University – IMO, Diepenbeek, B-3590 Belgium</td>
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<td>5 now at OmniVision Technologies, Santa Clara, CA 95054 Belgium</td>
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<tr>
<td>16:30-16:45</td>
<td>Presentation</td>
<td>A VGA Optical Filter-less CMOS Image Sensor with UV-selective and Visible Light Channels by Differential Spectral Response Pixels</td>
<td>Yhang Ricardo Sipauba Carvalho da Silva, Rihito Kuroda, and Shigetoshi Sugawa</td>
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<td>1 Graduate School of Engineering, Tohoku University, 6-6-11-811, Aza-Aoba, Aramaki, Aoba-ku, Sendai, Miyagi, Japan</td>
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</table>
UV Photon Counting Detectors for High-Altitude Balloon and Sounding Rocket Experiments

Shouleh Nikzad1, April D. Jewell1, John Hennessy1, Erika Hamden2, Gillian Kyne1,3, Sam Cheng1, Chris-tophe Basset1, Michael E. Hoenk1, Chris Martin3, Walter Harris2, and Todd J. Jones1

1Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109
2University of Arizona, Tucson, AZ 85721
3California Institute of Technology, Pasadena, CA 91125

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Dinner / Award Session

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Thursday, June 27th 2019

**Session 10**  
**Specialty Imaging**  
Session Chair: Shouleh Nikzad (JPL)

08:30-08:45  
A Radiation Hardened CMOS Image Sensor with Almost Zero Dark Current Increase During Radiation

Takashi Watanabe1, Tomoaki Takeuchi1, Osamu Ozawa2, Hirohisa Komanome3, Tomoyuki Akahori1, Kunihiiko Tsuchiya1

1Brookman Technology, Inc. 125 Daikumachi, Naka-ku, Hamamatsu, Shizuoka, 430-0936, Japan
2Japan Atomic Energy Agency, 4002 Narita, Oarai, Higashiibaraki, Ibaraki 311-1393, Japan
3Ikegami Tsushinki Co., Ltd, 3-5-16 Ikegami, Ohta-ku, Tokyo, 146-8567, Japan

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08:45-09:00  
Multi-spectral High-Speed Backside Illuminated TDI CCD-in-CMOS Imager

Pierre Boulenc1, Steven Thijs1, David San Segundo Bello1,2, Jonas Bentell1, Vasyl Motsnyi1, Linkun Wu1, Marco Müller3,4, Pilar Gonzalez1, Klaas Tack1, Celso Cavaco1, Maarten Rosmeulen1, Stefano Guerreri1 and Piet De Moor1

1imec, Kapeldreef 75, B-3001 Leuven, Belgium
2now at Pyxalis, 170 Rue de Chatagnon, 38430 Moirans, France
3ETH Zurich, Rämistrasse 101, 8092 Zürich, Switzerland

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09:00-09:15  
Partially Pinned Photodiode Performances in for Emerging Space and Nuclear Applications

S. Rizzolo1, V. Goiffon1, F. Corbière1, R. Molina1, S. Rolando3, S. Girard6, P. Paillet3, P. Magnan1, A. Boukenter2, T. Allanche2, C. Muller2,3, C. Monsanglant Louvel1, H. Desjonqueres4, J-R Macé5, J. Rousson6, J-M Barbier6, J-P Bauda6, A. Saravia Flores7 and S. Catherin7

1ISAE-SUPAERO, Université de Toulouse, 10 avenue E. Belin, F-31055, Toulouse, France
2Université de Lyon, Laboratoire Hubert Curien, UMR-CNRS 5516, Saint-Etienne, France
3CEA, DAM, DIF, F-91297 Arpajon Cedex, France
4IRSN, Centre de Saclay, F-91129 Gif-sur-Yvette, France
5ORANO, 1, place Jean Millier – 92400 Courbevoie - France
6OPTSYS, 7 rue Salvador Dali, F-42007 Saint Etienne, France
09:15-09:30  Image Sensor Capable of Analog Convolution for Real-time Image Recognition System Using Crystalline Oxide Semiconductor FET
Seiichi Yoneda, Yusuke Negoro, Hidetomo Kobayashi, Kosei Nei, Toshihiko Takeuchi, Masashi Oota, Takuya Kawata, Takayuki Ikeda, and Shunpei Yamazaki
Semiconductor Energy Laboratory, Hase, Atsugi-shi, Kanagawa 243-0036, Japan

09:30-09:55  Break

Session 11  Global Shutter
Session Chair: Assaf Lahav (TowerJazz)

09:55-10:10  Back Side Illuminated High Dynamic Range 4.0µm Voltage Domain Global Shutter Pixel with Multiple Gain Readout
Brillnics Japan Inc., 6-21-12 Minami-Oi, Shinagawa-ku, Tokyo, 140-0013 Japan
† Brillnics Inc., Guangming 6th Rd., Zhubei City, Hsinchu County 302, Taiwan

10:10-10:25  A High Performance 2.5µm Charge Domain Global Shutter Pixel
Ikuo Mizuno, Toshifumi Yokoyama, Masafumi Tsutsui, Yoshiaki Nishi, Veinger Dmitry and Assaf Lahav
1 TowerJazz Panasonic Semiconductor Co., Ltd, 800 Higashiyama, Uozu City, Toyama, Japan 937-8585
2 TowerJazz, 23105 Migdal Haemek, Israel

10:25-10:40  Near Infra-Red Enhanced 2.8µm Global Shutter Pixel with Light Pipe Structure and High Resistivity P-type Substrate
Masafumi Tsutsui, Toshifumi Yokoyama, Tatsuya Hirata, Ikuo Mizuno, Dmitry Veinger, Adi Birman and Assaf Lahav
1 TowerJazz Panasonic Semiconductor Co. Ltd., 800 Higashiyama, Uozu City, Toyama, Japan 937-8585, Japan
2 TowerJazz, 23105 Migdal Haemek, Israel

10:40-10:55  Global Shutter Efficiency Improvement to >100dB in Advanced Global Shutter Imager with Correction Processing
Kai Shen, Scott Johnson, Radu Ispasoiu
ON Semiconductor, USA

10:55-11:10  A BSI Global Shutter Pixel with Background Light Suppression for Multi-Frame Differential Imaging
Xiaoliang Ge, Guy Meynants, Pascale Francis, Karen Feyen, Sahitya Janardhan, Adi Xhakoni
ams, Building 8, Borsbeeksebrug 36, 2600 Berchem, Belgium

11:10-11:15  Closing Remarks