2007 INTERNATIONAL IMAGE SENSOR WORKSHOP

June 7-10, 2007
The Cliff House Resort & Spa
Ogunquit, Maine USA

Organized by:

ImageSensors Inc.
www.imagesensors.org

Technical Co-Sponsors:

IEEE Electron Devices Society
Institute of Television Engineers of Japan (ITEJ)
Jet Propulsion Laboratory
Siimpel Corporation
Walter Kosonocky Award

Welcome to the 2007 International Image Sensor Workshop

It is a pleasure to extend a hearty welcome to all of you to the 2007 International Image Sensor Workshop at The Cliff House Resort & Spa in Ogunquit, Maine USA. As you have noticed the workshop (formerly titled IEEE Workshop on Charge Coupled Devices and Advanced Image Sensors) has a new name – International Image Sensor Workshop. It is organized by ImageSensors Inc., a non-profit Public-benefit organization.

It is 21 years since the first workshop took place in 1986 at Columbia University's Arden House in Harriman, New York. Much has changed in these 21 years. Electronic imaging has undergone an explosive growth. The workshop (held every other year) has firmly established itself as the key forum on image sensor technology – discussing recent research results on a wide variety of image sensors, providing in-depth discussion and insight on technical issues of common concern, and stimulating thinking about new research directions and activities. The 2007 workshop – 11th in the series – continues in the same tradition, but with a new name. Considering the world-wide popularity and stature of this forum, and the breadth of image sensor related topics covered in the workshop, the International Image Sensor Workshop is certainly a more appropriate name for this forum.

For the statistically minded, we had a record number of abstracts submitted to the 2007 workshop – 110 in total. It will also have a record number of papers presented - 88 in all, consisting of 32 regular papers, 38 poster papers, 12 short papers, and 6 discussion/tutorial papers. 32 of these papers are from the continent of Asia, 26 from North America, and 30 from Europe, including a number of papers that consist of authors from multiple continents.

We have a diverse and exciting program. We have added an extra day to the 2007 workshop to permit longer discussions and more informal meeting time. In addition, we have introduced a new category of papers called discussion/educational papers. The purpose of these presentations is to stimulate discussion in areas of emerging technologies and/or in areas of common interest that are just outside the normal scope of the workshop. To further facilitate discussion, we have devoted 10 minutes for Q&A after each regular paper. There is also a period devoted entirely for poster viewing and discussion with the authors. We hope that active interaction and exchange of information among the participants will only make the workshop even more exciting.

The workshop will feature the 5th Walter Kosonocky Award that was established in memory of a great contributor to the field, who passed away on November 2, 1996.

As in previous years, we have tried to limit attendance to less than 150 people, based on the desire of the organizing committee to keep the workshop small and more personal. Although previous workshops have always sold out, what happened this year was quite unprecedented. Registration got filled up within just a couple of days of opening the pre-registration. Due to this overwhelming demand, we could not offer seats to a number of people who had sent in their

requests. We sincerely apologize to those who could not attend, and hope to see you at next workshop in 2009.

We would like to acknowledge our technical co-sponsors: IEEE Electron Devices Society, Institute of Television Engineers of Japan, Jet Propulsion Laboratory, Siimpel Corporation, and the Walter Kosnocky Award. We are extremely grateful to the Jet Propulsion Laboratory for its financial support in organizing the workshop.

This workshop could not have been organized without contribution from a number of people. I would like to thank Dr. Eric Fossum, Dr. Nobukazu Teranishi, and Dr. Albert Theuwissen of Organizing Committee for their support and guidance in planning the workshop. I would also like to thank all members of the technical program committee for soliciting papers, for ranking them, and for serving as session chairs, and especially Dr. Alex Krymski, the technical program committee chairman, for assisting me with the difficult job of selecting the papers, and putting the together an outstanding program. I am grateful to Ms. Angela McNamee of Siimpel Corporation for her time and enthusiastic support, as well as to my colleagues at the Jet Propulsion Laboratory for their efforts in making this workshop a success. Finally, I would like to express my sincere gratitude to Dr. Eric Fossum - not only for taking care of the local arrangements, and but for supporting and advising me through every detail of the workshop planning and organization.

Best wishes for a great and memorable workshop.

Bedabrata Pain
General Chairman

2007 International Image Sensor Workshop

organized by ImageSensors Inc.

Workshop Organizing Committee:

Eric Fossum (Siimpel, USA)
Nobukazu Teranishi (Matsushita, Japan)
Albert Theuwissen (DALSA, The Netherlands)

Workshop Chairman:

Bedabrata Pain (Jet Propulsion Laboratory, USA)

Workshop Technical Program Chairman:

Alex Krymski (Alexima, USA)

Workshop Local Arrangements Chairman:

Eric Fossum (Siimpel, USA)

Workshop Program Committee:

Bart Dierickx (Caeleste, Belgium; IMEC, Belgium)
Eric Fossum (Siimpel, USA)
Boyd Fowler (Fairchild Imaging, USA)
Robert Henderson (University of Edinburgh, UK)
Jerry Hynecek (Magnachip, USA)
Shoji Kawahito (Shizuoka University, Japan)
Craig Keast (MIT/Lincoln Labs, USA)
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Terry Lomheim (Aerospace Corp., USA)
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Dan McGrath (Eastman Kodak, USA)
Junichi Nakamura (Micron, Japan)
Tetsuo Nomoto (Sony, Japan)
Bedabrata Pain (JPL, USA)
Johannes Solhusvik (Micron, Norway)
Hidekazu Takahashi (Canon, Japan)
Nobukazu Teranishi (Matsushita, Japan)
Albert Theuwissen (DALSA, The Netherlands)
Shou-Gwo Wuu (TSMC, Taiwan, ROC)

Workshop Secretary:

Angela McNamee (Siimpel, USA)

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Ogunquit, ME
June 6-10, 2007

PROGRAM

June 6 (Wed)

18:00-20:00	**Early Registration**	

June 7 (Thu)

9:00-10:00	**Registration**	
10:00-10:15	**Opening Remarks** Eric Fossum – Remarks on behalf of the Organizing Committee Bedabrata Pain – Chairman's remarks	
Session 01	**Discussion Session – I** *Session chair: Alex Krymski*	
10:20-11:00	Image Sensors and Image Quality in Mobile Phones *Juha Alakarhu (Nokia, Tampere, Finland)*	1
Session 02	**Image Sensors with Super-Small Pixels – I** *Session Chair: Johannes Solhusvik*	
11:00-12:10	A 3 Mega-Pixel Back-illuminated Image Sensor in 1T5 Architecture with 1.45 µm Pixel Pitch *Jens Prima[1], Francois Roy[1], Perceval Coudrain[1], Xavier Gagnard[1], Josep Segura[1], Yvon Cazaux[1], Didier Herault[1], Nicolas Virollet[1], Norbert Moussy[2], Benoit Giffard[2], Pierre Gidon[2] ([1]FTM Imaging, STMicroelectronics, Crolles, France; [2]CEA Léti-MINATEC, Grenoble, France)*	5
11:20-11:40	A 1.75µm Square Pixel IT-CCD using Gate Oxide Insulator Composed by a Single Layer Electrode Structure *Junji Yamane, Yoshiaki Kitano, Keita Suzuki, Keita Hondo*, and Nobuhiro Karasawa (Semiconductor Business Group, Sony Corporation; *Sony Semiconductor Kyusyu Corporation, Japan)*	9
11:40-12:00	Optoelectronic Investigation for High Performance 1.4 µm pixel CMOS Image Sensors *Seong-Ho Cho, Gibum Kim, Hyunpil Noh, Chang-Rok Moon, Kangbok Lee, Kwangok Koh, and Duckhyung Lee (Samsung Electronics Ltd, Yongin-city, Korea)*	13

June 8 (Fri)

	USA)	
11:30-11:50	High Sensitivity of Dielectric films Structure for Advanced CMOS Image Sensor Technology *Chung-Wei Chang[1,2], Shou-Gwo Wuu[1], Dun-Nian Yaung[1], Chien-Hsien Tseng[1], Han-Chi Liu[1], David Yen[1], Yi-Jiun Lin[1], Chun-Ming Su[1], Chun-Yao Ko[1], C.Y. Yu[1], C.H. Lo[1], F.J.Hsiu[1], C.S.Tsai[1], Chung S. Wang[1], Mingo Liu[1], Chrong-Jung Lin[2], Ya-Chin King[2] ([1]Taiwan Semiconductor Manufacturing Company, Taiwan, R.O.C.; [2]Department of Electrical Engineering, National Tsing Hua University, Taiwan, R.O.C.)*	207
11:50-12:10	Reliability of CMOS image sensor with polymer lightpipe *J. Gambino, K. Ackerson, B. Guthrie, B. Leidy, W. Abadeer, S. Mongeon, D. Meatyard, J. Adkisson, R. J. Rassel, J. Ellis-Monaghan, and M. Jaffe (IBM Micoelectronics, Essex Junction, USA)*	211
12:10-12:16	Integrated Processes for Detector Back Illumination *Richard C. Westhoff, Robert K. Reich, Andrew H. Loomis, and James A. Gregory (MIT Lincoln laboratory, Lexington, USA)*	215
12:20-17:30	**Lunch Pick-up + Afternoon Activities**	
17:30-19:00	**Poster Viewing (incl. Hors D'oeuvres)**	
19:00-21:00	**Dinner**	

June 9 (Sat)

Centre for Scientific and Technological Research, Trento, Italy)

11:30-11:50	A TOF Range Image Sensor with an Ambient Light Charge Drain and Small Duty-Cycle Light Pulse *Tomonari Sawada[1], Shoji Kawahito[1], Masakatsu Nakayama[1], Kana Ito[1], Izhal Abdul Halin[1], Mitsuru Homma[2], Takeo Ushinaga[2], and Yasunari Maeda[3] ([1]Shizuoka University, Hamamatsu, Japan; [2]Sharp Corporation, Nara, Japan; [3]Suzuki Motor Corporation, Hamamatsu, Japan)*	254
11:50-11:56	Dynamic Quenching for Single Photon Avalanche Diode Arrays *Justin Richardson[1,2], Robert K. Henderson[1], David Renshaw[1] ([1]The University of Edinburgh, Institute for Integrated Micro and Nano Systems, Edinburgh, U.K; [2]STMicroelectronics Imaging Division, Edinburgh, UK)*	258
11:56-12:02	A Compact Low-Voltage Electron Bombarded Array *Shouleh. Nikzad, Todd.J. Jones, Michael.E. Hoenk, Chris. Martin, Steve. Kaye, and Patrick. Morrissey* (Jet Propulsion Laboratory, Pasadena, USA; *California Institute of Technology, Pasadena, USA)*	261
12:05-13:40	**Lunch**	
Session 15	**Discussion Session – V** *Session Chair: Boyd Fowler*	
13:40-14:20	Color Processing Pipeline *Albert J. P. Theuwissen (DALSA, The Netherlands)*	
Session 16	**Alternative On-Chip Color Capture Approaches** *Session Chair: Shoji Kawahito*	
14:20-14:40	High Sensitivity Color CMOS Image Sensor with White-RGB Color Filter Array and a Novel Color Separation Process Using Edge Detection *Hiroto Honda[1], Yoshinori Iida[1], and Yoshitaka Egawa[2] ([1]Corporate Research and Development Center, Toshiba Corp., Japan; [2]Semiconductor Company, Toshiba Corp, Japan)*	263
14:40-15:00	IR/Color Composite Image Sensor with VIPS (Vertically Integrated Photodiode Structure) *Jeong-Ho Lyu, Seok Choi[1], Jae Heon Choi, Jung Hyun Nam[1], and Jin Bok Jung[1] ([1]Miru Data System Co., Suwon, Korea; Maru LSI Co., Suwon, Korea)*	267
15:00-15:20	Gr Gb difference in 3M CMOS Image Sensor with 1.75μm pixel *Bumsuk Kim, Yoonho Jang, Kyoungsik Moon, Eun-Gyu Lee, Alexander Getman, JungChak Ahn, and YongHee Lee (Samsung Electronics Co. Ltd, Yongin-City, Korea)*	271
15:20-15:40	CMOS Color Image Sensor with Overlaid Organic Photoconductive Layers: Depression of Dark Current *Shunji Takada, Mikio Ihama, and Masafumi Inuiya (Fujifilm Corp, Kanagawa, Japan)*	275

June 10 (Sun)

Session 18	**Image Sensors with Super-Small Pixels – II**	
	Session Chair: Robert Henderson	
9:00-9:20	Super Small, Sub 2µm Pixels For Novel CMOS Image Sensors *G. Agranov, R. Mauritzson; S. Barna, J. Ladd, J. Jiang, A. Dokoutchaev, and X. Fan (Micron Technology Inc, Boise, USA)*	307
9:20-9:40	Stratified Photodiode a New Concept for Small Size High Performance CMOS Image Sensor Pixels. *Younsub Lim, Kyunglak Lee, Heejeong Hong, Jaeyeong Kim, Seunghoon Sa, Juil Lee, Daebyung Kim and Jerry Hynecek (MagnaChip Semiconductor Ltd., Cheongju, Korea)*	311
9:40-10:00	Improved Design of 1T Charge-Modulation Pixel Structure for Small-Size and Low-Dark-Current Achievements *Arnaud Tournier[1,2], François Roy[1], Guo-Neng Lu[2], Benoît Deschamps[1] ([1]STMicroelectronics, Crolles, France; [2]Université de Lyon, Institut des Nanotechnologies de Lyon, Villeurbanne, France)*	315
10:00-10:20	**Coffee break**	
Session 19	**Scientific Image Sensors**	
	Session Chair: Craig Keast	
10:20-10:40	A 28M 43 cm^2 Full-Frame CCD Imager for Medical and Scientific Applications *Jan T. Bosiers, Bart Dillen and Louis Meessen (DALSA Professional Imaging, Eindhoven, The Netherlands)*	319
10:40-11:00	Orthogonal Transfer Arrays for Wide-Field Adaptive Imaging *Barry E. Burke*, John L. Tonry**, Michael J. Cooper*, Peter E. Doherty*, Andrew H. Loomis*, Douglas J. Young*, and Peter Onaka** (*MIT Lincoln Laboratory, Lexington, USA , **Institute for Astronomy, University of Hawaii, Hawaii, USA)*	323
11:00-11:20	High Performance CMOS Image Sensor for Low Light Imaging *Xinqiao (Chiao) Liu, Boyd Fowler, Hung Do, Steve Mims, Dan Laxson, and Brett Frymire (Fairchild Imaging, Milpitas, USA)*	327
11:20-11:26	2.5 µm Pixel Linear CCD *Nixon O, Lei Wu, Melanie Ledgerwood, John Nam, and Jonathan Huras (DALSA Inc, Waterloo, Canada)*	331
11:26-11:32	Performance of NIR InGaAs Imager Arrays for Science Applications *S. Seshadri[a], D.M. Cole[a], B. Hancock[a], P. Ringold[a], C. Peay[a], C.Wrigley[a], M. Bonati[b], M.G. Brown[c], M. Schubnell[c], G. Rahmer[b], D. Guzman[b], D. Figer[d], G. Tarle[c], R.M. Smith[b], and C. Bebek[e] ([a]Jet Propulsion Lab., USA, [b]California Inst. of Tech., USA, [c]Univ. of Michigan, USA, [d]Rochester Inst. of Tech., USA and [e]Lawrence Berkeley National Lab., Department of Physics, USA)*	335
11:35-11:40	**Closing Remarks**	