Imaging Conference

J.-L. Jaffard
Consultant & Advisor
Red Belt SA, Plan-les-Ouates, Switzerland

Biography

Jean-Luc Jaffard was born in Alès (France) in 1956
He studied Electronic and Microelectronic and has been graduated from Ecole Supérieure d'Electricité of Paris in 1979.
He started his career 1980 joining Thomson- Semiconductor Bipolar Integrated Circuits Division as Analogue and Mixed Designer dedicated to Consumer applications.
In 1987 after the creation of SGS Thomson Microelectronics he became TV Design Manager coordinating the development of the entire product family dedicated to Analog TV and VCR.
From 1996 to 1999 Jean-Luc Jaffard paved the way of Imaging activity at STMicroelectronics managing the first internal projects and being at the forefront of the acquisition and integration of VLSI Vision Limited.
He was then appointed Imaging Division Research Development and Innovation Director managing a large multidisciplinary and multicultural team spreaded around the world with responsabilities covering imager technology coordination, image sensors, image processing controllers and camera module development and industrialisation and the coordination of cooperative programs with partners and research institutes
In 2007 Jean-Luc Jaffard was promoted Imaging Division Deputy General Manager and Advanced Technology Director in charge of identifying, selecting, sourcing or developing the breakthrough Imaging Technologies and Applications to transform them into innovative and profitable products
In 2010 he moved to STMicroelectronics Headquarter to develop a new business line exploiting the wide range of Intellectual Assets. Multiple Licensing agreements have been concluded demonstrating the benefits of such business model
Jean-Luc Jaffard owns multiple patents in semiconductor and Imaging domains and has been invited speaker in many conferences worldwide.
In January 2014 he created the Technology and Innovation branch of Red Belt Conseil, to support High Tech actors like SME, Research Institutes, Start-ups, Analyst, Investors and public authorities

Depth imaging the engine of the renaissance of Virtual Reality

G. Yahav
General Manager of AIT (Advanced Imaging Technology) group
Microsoft, Haifa, Israel

Abstract

When scientist and futurist Jaron Lanier cooked up the term "virtual reality" in the 1980s, it was little more than a marketing device. It explained the new virtualization and simulation system he and his team at VPL Research built to help them develop a new programming language.

It was the first VR boom. Consumer VR, however, never quite achieved liftoff.
So what will it take for mainstream consumers to embrace the traditionally cumbersome technology? As with any emerging technology, consumers are only interested in VR as so far as it measurably improves their lives (or enjoyment of their lives) and is easy and affordable.
Microsoft's 3D-imaging system, Kinect, which was introduced in 2010, has done more than any other product to introduce virtual reality experiences to the masses. The motion and depth detection device, which was developed at Microsoft is a "virtual reality breakthrough." Kinect performed better than anything similar at any price, the depth camera measuring human motion in real time was a breathtaking experience.
Kinect's ability to measure a room and everything in it is transforming gaming and VR experiences alike, was the drive for more immersive experiences like Oculus Rift and Hololens.

Biography
Dr. Giora Yahav was appointed in June 2009 as the General Manager of AIT (Advanced Imaging Technology) group at Microsoft R&D Israel, as part of the acquisition of 3DV Systems. Dr. Yahav previously served as Senior VP R&D and CTO of 3DV Systems. Dr. Yahav is a one of 3DV's founder and Inventor of the basic technology.

He is a leading expert in imaging technologies and is regarded as an opinion leader in advance imaging technologies especially in novel CMOS based imagers. He is an active member of IEEE and SPIE, lecturing on various international conferences and academic conventions. He published over 22 papers and contributed to several fundamental researches in the field of imaging with an emphasis on active 3D imaging.

He has over 16 years experience in Research and Development project management at Rafael, the Israeli Armament Development Authority, as the Head of active Electro-Optical Systems department. He has extensive experience in Electro-Optical projects and holds over 20 patents. Previously, he spent eight years in academic research at the Hebrew University in Jerusalem, the Technion in Haifa and the Max-Plank Institute in Germany. Dr. Yahav holds a Ph.D. in Physical Chemistry, an M.Sc. in Inorganic Chemistry and a B.Sc. in Chemistry & Physics.

Embedded cameras on consumer and professional drones

B. Pochon
Image, Video and Control Group Leader
Parrot, Paris, France

Abstract
Images from drones that are capable of flying a few metres above the ground fill a gap between expensive images provided by satellites and phone or action-camera based images limited to human-level perspectives.

The field of applications of quadcopters or fixed wing drones is huge, and lead to a need for embedding various imaging systems, from high resolution camera, stabilizing system, multispectral camera or stereo and other depth sensors.
As the regulation evolves, light weight drones (below 500g) becomes an important target, leading to new challenges in the integration of such imaging systems.

Parrot, as a strong player in the field of consumer and professional drones, has gained experience in the integration of innovative camera systems, addressing the problem of weight, stabilisation, vibration, while optimizing image quality.
The presentation will cover topics such as:
- the design of high-end camera systems for drones
- computer vision applications to assist piloting and gives autonomy to drones
- other types of camera integration

Biography
Benoit Pochon has joined Parrot is 2002. During 7 years he worked in the audio field developing new technologies in voice processing and active noise cancelling. When Parrot pioneered the drone consumer market, he redirects in the field of image processing and specialized in the integration of cameras on drones. He is now leading a team of research engineers in the area of computer vision, image quality and control. He and his team are responsible for the definition and design of the whole image pipe, with a focus on the tight integration of multi-cameras with inertial sensors.

Camera systems for ADAS applications

M. Punke
Manager - Camera Technology
Continental AG, Lindau, Germany

Abstract

Today's traffic environment, such as traffic and information signs, road markings, and vehicles, is designed for human visual perception. This is done by different shapes, colors, or a temporal change of the signals. It is therefore a good choice to use a system similar to the human eye for machine perception of the environment. Camera systems are ideal candidates as they offer a comparable spectral, spatial, and temporal resolution. In addition to the "replica" of human vision, specific camera systems can provide other functions, including imaging in infrared spectral regions for night vision or a direct distance measurement. This presentation covers details on specific applications of camera-based driver assistance systems and the resulting technical needs for the camera system. Use cases covering the outside and inside of the vehicle are shown. Basic camera architectures including mono and stereo systems are presented.

Biography

Dr. Martin Punke is leading the Camera Technology group at Continental. He is working on concepting, engineering and productization of forward looking camera systems for ADAS applications. In his previous positions at Nokia he was responsible of camera, flashlight and illumination technologies in mobile phones.

Martin received the Dipl.-Ing. and Ph.D. degrees in electrical engineering and information technology from the University of Karlsruhe, Germany, in 2003 and 2007, respectively. In his Ph.D. thesis he worked on organic semiconductor devices for microoptical applications.

Wafer-scale CMOS image sensors for fast, low dose X-ray imaging

E. Bullard
VP of Business Development, Marketing and Sales
PerkinElmer Medical Imaging, London, United Kingdom

Abstract

X-ray detectors are used in medical imaging for static, dynamic and 3D imaging. The most common technology in use today for digital X-ray imaging is indirect detection in which an image sensor is combined with a CsI scintillator. The scintillator converts X-ray photons into green light, which can be detected by an image sensor. A-Si photodiode arrays are the dominant technology in use today and are well suited to static X-ray applications, where their read noise is not a major problem. However, in dynamic applications their read noise is a problem, because the X-ray dose per frame is far lower. CMOS sensors offer an alternative with much lower read noise of ~1/10 of a-Si. This reduction in read noise results in a significant reduction in radiation dose in low dose fluoroscopy. CMOS sensors also permit higher frame rates, smaller pixel sizes and exhibit almost no image lag. This makes them well suited to orthopaedic and vascular surgery and other applications where fast, low dose imaging is required. The latest wafer-scale CMOS sensors for use in surgery have a pixel pitch of 100 µm and incorporate on-chip 14 bit column parallel ADCs. These sensors must provide multiple gain modes to support various different X-ray protocols and have a frame time of 15 ms. Although the fibre optic plate and scintillator block most of the X-ray radiation, the image sensor should be tolerant of X-ray radiation. The major challenge in producing an X-ray detector using CMOS sensors is producing a large active area without large gaps between modules. The largest die from 20 cm wafers is about 13 cm2. However, an active area of 30 cm2 is required for vascular surgery. To achieve this, Dexela developed a method of butting wafer-scale dies closely together and permanently attaching them to a fibre optic plate. To make a detector for vascular surgery a 2 X 3 array of 15 X 10cm2 sensors is used. Needless to say, this must all be achieved with a very high yield!

Biography

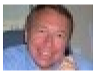
I am responsible for global business development, marketing and sales for PerkinElmer Medical Imaging, a leader in flat panel X-ray detectors using both a-Si and CMOS image sensor technologies.
I was a founder and CEO of Dexela from 2005 until its acquisition by PerkinElmer in July 2011. Dexela developed X-ray detectors using wafer-scale CMOS image sensors for applications including mammography and breast tomosynthesis, orthopaedic surgery, angiography, dental CBCT, scientific imaging, electronics inspection and industrial NDT. Dexela also developed acquisition methods and reconstruction and visualisation software for breast tomosynthesis.
ISDI is an innovative semiconductor design business specializing in wafer-scale image sensors and other ASICs for medical, industrial and scientific imaging including the design of devices for X-ray, electron, proton, optical luminescence and optical fluorescence imaging. I am a founder and director of ISDI.

Good Reasons to go with CMOS based Camera Technology

R. von Fintel
Head of Product Management
Basler AG, Product Management, Ahrensburg, Germany

Abstract
Sony will discontinue their CCD sensor line! This was "shock" in the industrial camera market. But not only this is a good reason to consider CMOS based camera Technology.
Get an insight about the latest sensor Technology and what Advantages you will have when designing or choosing a new Vision System based on CMOS technology.

Biography
René von Fintel is responsible for the Basler ace camera platforma department in the Product management and coordinates the market launch of new technologies such as USB3 Vision. After completing his studies in industrial engineering, he worked for eight years in sales and marketing for a well known German medical technology company. Since 2012 René von Fintel has been employed in product management at Basler.



B. Mourey
CTO
CEA / Leti, Grenoble, France

Biography

Graduate from Ecole Supérieure de Physique et Chimie (Paris) and PhD in Electronic and Instrumentation (Université de Paris VI)
Bruno Mourey had different positions in relation with display applications from research to manufacturing in the Thomson group. He was Managing Director of Thomson LCDs for more than 10 years
He joined CEA/LETI in 2003 as Program manager for multimedia applications (display, optical recording.),
In 2006 He was in charge of the start of a 200mm technological platform for Microsystems applications
From 2009 to 2014 He was Vice president, managing Mems division followed by Photonics division
Since 2015 he is CTO of CEA /LETI

Highlights of the International Image Sensor Workshop 2015

A. Theuwissen
CEO
Harvest Imaging, , Belgium

Abstract
This presentation will give an overview of the highlights of the IISW2015, recently held in Vaals, the Netherlands. The IISW2015 is being known at the world's top conference/workshop in the field of solid-state imagers. Many excellent papers are presented and published on a wide variety of topics related to solid-state imaging. During the presentation, the main focus will be on small-pixel devices and how their performance is further improved.

Biography
Albert J.P. Theuwissen was born in Maaseik (Belgium) on December 20, 1954. He received the degree in electrical engineering from the Catholic University of Leuven (Belgium) in 1977. His thesis work was based on the development of supporting hardware around a linear CCD image sensor.

From 1977 to 1983, his work at the ESAT laboratory of the Catholic University of Leuven focused on semiconductor technology for linear CCD image sensors. He received the Ph.D. degree in electrical engineering in 1983. His dissertation was on the implementation of transparent conductive layers as gate material in the CCD technology.

In 1983, he joined the Micro Circuits Division of the Philips Research Laboratories in Eindhoven (the Netherlands), as a member of the scientific staff. Since that time he was involved in research in the field of solid state image sensing, which resulted in the project leadership of respectively SDTV- and HDTV imagers. In 1991 he became Department Head of the division Imaging Devices, including CCD as well as CMOS solid state imaging activities.

He is author or coauthor of over 160 technical papers in the solid state imaging field and issued several patents. In 1988, 1989, 1995 and 1996 he was a member of the International Electron Devices Meeting paper selection committee. He is co editor of the IEEE Transactions on Electron Devices special issues on Solid State Image Sensors, May 1991, October 1997, January 2003 and November 2009, and of IEEE Micro special issue on Digital Imaging, Nov./Dec. 1998.
In 1995, he authored a textbook "Solid State Imaging with Charge Coupled Devices" and in 2011 he co-edited the book "Single-Photon Imaging". In 1998 and 2007 he became an IEEE ED and SSCS distinguished lecturer.

He acted as general chairman of the International Image Sensor Workshop (formerly IEEE International Workshop on Charge-Coupled Devices and Advanced Image Sensors) in 1997, 2003, and 2009. He is member of the Steering Committee of the aforementioned workshop and founder of the Walter Kosonocky Award, which highlights the best paper in the field of solid-state image sensors.
During several years he was a member of the technical committee of the European Solid-State Device Research Conference and of the European Solid-State Circuits Conference.
From 1999 till 2010 he was a member of the technical committee of the International Solid-State Circuits Conference. For the same conference he acted as secretary, vice-chair and chair in the European ISSCC Regional Committee and since 2002 he was a member of the overall ISSCC Executive Committee. He has been elected to be International Technical Program Chair vice-chair and chair for respectively the ISSCC 2009 and ISSCC 2010.

In March 2001, he was appointed as part-time professor at the Delft University of Technology, the Netherlands. At this University he teaches courses in solid-state imaging; coaches MSc and PhD students in their research on CMOS image sensors.

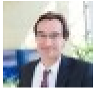
In April 2002, he joined DALSA Corp. to act as the company's Chief Technology Officer. In September 2004

he retired as CTO and became Chief Scientist of DALSA Semiconductors. After he left DALSA in September 2007, he started his own company "Harvest Imaging", focusing on consulting, training, teaching and coaching in the field of solid-state imaging technology (www.harvestimaging.com).
In 2006 he co-founded (together with his peers Eric Fossum and Nobukazu Teranishi) ImageSensors, Inc. (a California non-profit public benefit company) to address the needs of the image sensor community (www.imagesensors.org).

In 2008, he received the SMPTE's Fuji Gold medal for his contributions to the research, development and education of others in the field of solid-state image capturing. He is member of editorial board of the magazine "Photonics Spectra", an IEEE Fellow and member of SPIE.

In 2011 he was elected as "Electronic Imaging Scientist of the Year", in 2013 he received the Exceptional Service Award of the International Image Sensor Society and in 2014 he was awarded with the SEMI Award.

Technological developments in infrared imaging : a fast growing market



F. SIMOENS
Marketing & Strategy Manager - Imaging Sensors
CEA-LETI, Grenoble, France

Abstract

First developed for defense applications, infrared imaging technologies have rapidly matured and come into the civilian market for security and surveillance, industrial process controls, science and enhanced vision system both military and civil.

The growing variety of applications has stimulated innovation driven by the SWAP3 criteria: Size, Weight and Power, Performance and Price. For example, running development of CMOS-based Single Photon Avalanche Diodes paves the way to Time-Of-Flight-based near-infrared 3D imaging suitable for many consumer applications. Advances in heterogeneous integration of III-V on silicon to build InGaAs photodiodes arrays allow one to envisage active eye safe shortwave IR imaging operation for improved safety in automotive and aviation transportation.

Today, infrared imaging technologies offer from Near-IR (0.7 - 1.4µm) to Far-IR (>14µm) improved sensitivity, embedded image processing, advanced functionalities like 3D vision or hyperspectral information, but also significant cost reduction as illustrated by the recent introduction of thermal imagers for smartphones.

Thanks to these advances, infrared imaging technologies can now address a fast growing commercial market -in particular home automation, EVS for transportation, robotics- and take its first step into the mass-consumer market. This talk will present and illustrate this current trend of infrared imaging to spread in our daily lives.

Biography

Dr François Simoens received his PhD degree in electronics from the French Pierre & Marie CURIE University (Paris 6) in 2002 in the field of particle accelerating cavity.

He first got involved in electromagnetic compatibility modeling at ONERA, microwave and ultra-sound radar prototyping in ESCPI (Paris High school) and optoelectronics for phased-array antennas in Dassault Electronique. After seven years of research in the accelerator field at CEA Saclay, he joined CEA-Leti in Grenoble in 2003, where he was first involved in the development of the sub-millimeter PACS focal plane array (for the ESA Herschel satellite) and then in uncooled infrared bolometer technology with the French company ULIS. In 2005, he became project manager (FP7, Euripides projects) before taking the position of program manager and expert in infrared and THz detection. Since the beginning of 2015, he acts as the Marketing and Strategy Manager for the Imaging Technologies and systems developed at Leti from X-ray to Far-Infrared.

SPAD Image Sensors in All-Digital Imaging

E. Charbon
Chair of VLSI Design
TU Delft, Microelectronics, Delft, Netherlands

Abstract

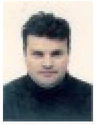
The integration of single-photon avalanche diodes (SPADs) in a conventional high voltage CMOS process has paved the way to scalable photon counting image sensors for use, for instance, in time-of-flight 3D cameras, LIDARs, (time-of-flight) positron emission tomography (TOF-PET), single-photon emission computed tomography (SPECT), and near-infrared optical tomography (NIROT). These sensors are revolutionizing several biomedical diagnostics techniques, like fluorescence lifetime imaging microscopy (FLIM), Förster resonance energy transfer (FRET), and super-resolution microscopy, just to name a few. SPAD sensors have many embodiments, whereas in some the pixels are small, made of a single SPAD, while in others the pixels are large, made of a large number of SPADs. The latter are generally known as silicon photomultipliers (SiPMs) or multi-pixel photon counters (MPPCs). Multi-channel digital SiPMs (MD-SiPMs) represent the forefront development in SiPMs; they are a fusion of SPAD image sensors and digital SiPMs, thanks to the increased number of pixels, whereas each pixel retains the properties of SiPMs, while enabling one to compute a very large number of timestamps in multi-photon showers.

In this talk, we focus on recent developments in SPAD image sensors and SiPMs, including the increase of fill factor, reduction of crosstalk and noise, and the management of high data rates originated in the newest digital sensors. We will introduce the concept of all-digital imaging based on photon quanta detection that is enabled by SPAD image sensors and SiPMs. We will discuss how the tremendous amount of data generated by these sensors will be handled by processors operating in situ thanks to 3D integration, where SPADs and processors will be on separate chips. We will also outline present and future enabling technologies, such as optical and electrical photon concentration, silicon-on-insulator (SOI) SPADs, and backside-illumination, as well as emerging applications.

Biography

Edoardo Charbon received the B.S. from ETH Zurich in 1988, the M.S. from U.C. San Diego in 1991, and the Ph.D. from U.C. Berkeley in 1995, all in EECS. From 1995 to 2000, he was with Cadence Design Systems, where he was the architect of the company's IP protection and information hiding technologies; from 2000 to 2002, he was Canesta Inc.'s Chief Architect working on time-of-flight cameras for the consumer electronics market; Canesta was sold to Microsoft Corp. in 2010. Since 2002 he has been a member of the Faculty of EPFL and in 2008 he has become chair of VLSI Design at TU Delft. Dr. Charbon is the initiator and coordinator of MEGAFRAME and SPADnet, two EC funded projects for CMOS photon counting image sensors that yielded several consumer products and biomedical diagnostics tools. He has published over 250 articles in technical journals and conference proceedings and two books, and he holds 17 patents. Dr. Charbon is the co-recipient of the European Photonics Innovation Award.

Computer vision on manycore processor



S. Cordova
Marketing & Business development Director
Kalray, Montbonnot, France

Abstract

Kalray, Supercomputing on a chip technology, brings one of the most efficient processor that fits perfectly with the constraints of the future computer vision used in the future semi or fully autonomous vehicle industry.

Kalray with its MPPA manycore processor proposes a disruptive processing solution to address the huge demand of computer vision application.

Innovative architecture of the MPPA processor allows multiple applications with mixed criticality level to run on the same IC without any perturbation between the different kernels. Such feature provides to our customer the capability to save cost and merge many different functions on a single chip instead having it spread over the vehicles with communication and data streaming capability issues.

MPPA Manycore is a C/C++ fully programmable processor capable to evolve with the sensor technologies and the algorithm research. Software engineers will modify their application on purpose with minimum time proposing with the same hardware different level of options/functions saving development time and cost.

Biography

Stéphane Cordova (Director of Marketing & Business Development for Embedded market). Prior to joining Kalray, Stéphane held several senior marketing and business development positions at ST-Ericsson and STMicroelectronics.

At Kalray, Stephane is in charge of the business development particularly for embedded application such as Automotive, Aerospace, Medical and Industrial.

Novel optical materials: answer for various market requirements

J. Saarinen
Professor
University of Eastern Finland, Institute of Photonics, Joensuu, Finland

Abstract

For centuries optics manufacturing has been based on processing glass or other transparent or reflective solid materials by grinding and polishing. Thermoplastics (and moldable glass materials) enabled low-cost volume production by injection molding. In micro-optics and silicon photonics various kinds of microelectronics manufacturing methods are used, such as etching and coatings.

In this presentation we talk about UV curable materials, better known as adhesives. Applying ultraviolet light liquid resin can be transferred to solid form. When this is combined with molds, various kinds of optics, especially miniature-sized structures, can be fabricated. This has opened path for mass-manufacturing of micro-optics: roll-to-roll UV casting, that is optics on thin foil, and wafer-level manufacturing, that is optics added on solid wafers. We briefly present advantages of these new methods as well as how they have opened doors for optics into new applications and markets.

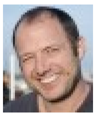
Catalogue components have been the only cost-effective solution for low and medium volumes, when time and money excludes any custom manufacturing. Additive manufacturing (also known as 3D printing) is expected to solve this problem. However, there is no progress of 3D printing in glass or thermoplastics for optics. While 3D printing typically struggles with surface roughness order of microns, optics needs three orders of magnitude better quality, that is nanometers. Any postprocessing (polishing, coating, or painting) easily destroys delicate lens forms.

The solution for 3D printed optics comes from UV curable materials. Because of liquid form, the material can be processed in tiny droplets before curing. There will not be almost no limitation to build miniature or macroscopic optics. 3D printed optics will also open door for fast and low-cost manufacturing of truly freeform optics. We will present various visions for 3D printed optics.

Biography

Jyrki Saarinen received his D.Sc. (Tech.) degree from Helsinki University of Technology (TKK) in 1995 followed by MBA degree from TKK Executive School of Business. He is Adjunct Professor on Micro Optics at TKK, today known as Aalto University. He spent 15 years in photonics industry as co-founder, entrepreneur and business executive growing a one-man company Heptagon to the world-leader in micro-optics with over one thousand employees. He worked 7 years in Silicon Valley before taking the professorship on photonics applications and commercialization in the Institute of Photonics (University of Eastern Finland UEF) in Finland in 2013. His current main research topic is 3D printed optics. He is also Executive Director of the European Optical Society, and Vice Chairman of Photonics Finland society and Chairman of Finnish Physical Society. He also works for high-tech SME's and large corporations as business consultant including a Board position in three European companies.

Scene-driven pixel-individually auto-sampling image sensors



C. Posch
CTO
Chronocam, Paris, France

Abstract

The mode of operation of state-of-the-art image sensors is useful for one thing: photography, i.e. for taking an image of a still scene. Exposing an array of pixels for a defined amount of time to the light coming from a static scene is an adequate procedure for capturing its visual content. However, as soon as change or motion is involved, the paradigm of visual frame acquisition becomes fundamentally flawed. If a camera observes a dynamic scene, no matter where you set your frame rate to, it will always be wrong. Because there is no relation between scene dynamics and the chosen frame rate, over-sampling or under-sampling will occur, and both will usually happen at the same time. As different parts of a scene have different dynamic contents, a single sampling rate governing the exposure of all pixels in an imaging array will naturally fail to yield adequate acquisition of these different scene dynamics present at the same time.

The solution is an image sensor that samples parts of the scene that contain fast motion and changes at high sampling rates and slow changing parts at low rates - with the sampling rate going to zero if nothing changes. Unfortunately, the information about where in a scene, and at which speed, things change and move is usually not known beforehand. A way to solve this problem is to let each individual pixel adapt and optimize its own sampling rate to the visual input it receives by autonomously reacting to the temporal evolution of light incident to its photosensor. As a consequence, (a) the image sampling process is no longer governed by a fixed timing source but by the signal to be sampled itself and (b) image information is not acquired and transmitted frame-wise but continuously and conditionally only from parts of the scene containing relevant information. These sensors are able to combine ultra-high-speed operation at wide dynamic range with low data rates, outperforming conventional image sensors in many areas of machine vision.

Biography

Christoph Posch is Research Professor at Université Pierre et Marie Curie, Paris VI and founding CTO of Chronocam. He received the M.Sc. and Ph.D. degrees in electrical engineering and experimental physics from Vienna University of Technology, Vienna, Austria, in 1995 and 1999, respectively. From 1996 to 1999, he worked on analog CMOS IC design for particle detector readout and control at CERN, the European Laboratory for Particle Physics in Geneva, Switzerland. From 1999 onwards he was with Boston University, Boston, MA, engaging in applied research and mixed-signal integrated circuit design for high-energy physics instrumentation. In 2004 he joined the newly founded "Neuroinformatics and Smart Sensors Group" at AIT Austrian Institute of Technology (formerly Austrian Research Centers ARC) in Vienna, Austria, where he was promoted to Principal Scientist in 2007. Since 2012, he is co-directing the Neuromorphic Vision and Natural Computation group at the Institut de la Vision in Paris, France and has been involved in founding of two high-tech start-up companies, Pixium Vision and Chronocam. His research interests include neuromorphic analog VLSI, CMOS image and vision sensors, biology-inspired signal processing and biomedical devices and systems.

Dr. Posch has been recipient and co-recipient of eight IEEE awards including the Jan van Vessem Award at the IEEE International Solid-State Circuits Conference (ISSCC) in 2006, the Best Paper Award at ICECS 2007, and Best Live Demonstration Awards at ISCAS 2006, ISCAS 2010 and BioCAS 2011. He is member of the Biomedical and Life Science Circuits and Systems, the Sensory Systems and the Neural Systems and Applications Technical Committees of the IEEE. Christoph Posch has authored more than 90 scientific publications and holds several patents in the area of artificial vision and image sensing.

Single-Photon detectors for real-time 3D-ToF imaging

L. Carrara
CTO
Fastree3D SA, Ecublens, Switzerland

Abstract

The availability of Single-Photon Avalanche Diodes (SPADs) in standard high-voltage CMOS and CIS processes offers great flexibility in the conception and design of real-time direct Time-of-Flight (dToF) imagers. The scalability of CMOS, paired with the digital nature of SPADs and their outstanding timing performance, lends itself to the conception of innovative, all-digital solutions to the problem of real-time depth sensing.

Among existing techniques, Time-Correlated Single-Photon Counting (TCSPC) in particular benefits from the massive parallelism, high speed, and low power consumption of digital CMOS solutions.

In this talk we focus on the core architecture of a TCSPC system and on the impact that highly integrated CMOS technologies have on speed, power consumption, and costs of the overall 3D ToF solution. We will introduce the concept of digital d-ToF pixel, and analyse two possible architectures: a pure ASIC and a mixed ASIC-FPGA.

Biography

Co-Founder & CTO, Fastree3D
Senior development engineer for electronics and integrated circuit design. Expert in CMOS singlephoton avalanche diodes (SPAD) for 3D time-of-flight imaging. Over 7 years' experience in IC design, test, and fabrication, 5 of which were spent in industrial design of 3D cameras (ESPROS Photonics Corp). Education: Master Degree in Micro and Nanotechnologies for Integrates Systems (Politecnico di Torino, IT; Institut National Polytechnique de Grenoble, FR; École Polytechnique Fédérale de Lausanne, CH); Bachelor in Electrical Engineering, Politecnico di Torino (IT)

3D printed optics

E. Tierie
CEO
Luxexcel, Kruiningen, Netherlands

Abstract
Luxexcel is the only company in the world able to 3D print optics. Directly from a cad-file to proprietary printers, without the need for any post-processing.
High transparency, high accuracy, high speed. Based upon ink jetting of acrylics and soon also silicones.
Serving a wide range of industries including photonics, lighting, automotive, medical, aerospace & defence.
Not just for prototypes but also for small/medium volume series, within just days instead of weeks or months.

Biography
Eric Tierie has a MSc degree in process engineering from Technical University Delft and a secondary degree in business economics. With international management experience in polymers, metals, energy, aerospace & defence, chemicals and packaging he worked for multinationals such as Unilever, Exxon and Arcelor Mittal. Since 2014 he joined Luxexcel as CEO in the Netherlands.

3D Light Field Cameras for Machine Vision

C. Perwass
CEO
Raytrix GmbH, Kiel, Germany

Abstract
Light Field cameras are a new type of 3D-cameras that capture a standard image together with the depth information of a scene. Metric 3D information can be captured with a single light field camera through a single lens in a single shot using just the available light.

Raytrix has specialized on developing light field cameras for industrial applications. A patented micro lens array design allows for an optimal compromise between high effective resolution and large depth of field. Raytrix cameras are already in use in applications like volumetric velocimetry, plant phenotyping, automated optical inspection and microscopy, to name a few.

The talk will introduce the technology, show a number of applications and discuss the redundant and important aspects of a light field image for applications.

Biography
Christian Perwass received his Ph.D. in engineering from Cambridge University, UK and his habilitation in Computer Science from Kiel University, Germany. He then worked in R&D at Robert Bosch GmbH developing automated optical inspection systems before founding the company Raytrix GmbH to develop and market 3D light field cameras for research and industrial applications. He developed the award winning multi-focus plenoptic camera, which became a unique enabling technology for a number of applications in research and industry.

M. Verhoeven
Co-Founder and Managing Director
aSpect Systems, , Germany

Biography

Marcus is Co-Founder and Managing Director of aSpect Systems.
aSpect is a vendor for image sensor test services (wafer- & final test), test- and illumination equipment, prototype package- and camera development, as well as production equipment for lens adjustment.

Marcus started his professional career as a lab assistant in 1987 at Spectro Analytical Instruments, a vendor for optical spectrometers. He studied physics at the University of Wuppertal. From 1998 he headed for five years the semiconductor test floor of Silicon Vision. In 2003 Marcus founded together with Philipp Gottesleben aSpect Systems GmbH.

Micro-technologies for 3-D depth sensing systems

M. Rossi
Chief Innovation Officer
Heptagon Advanced MicroOptics, Rueschlikon, Switzerland

Abstract

Optical depth sensing technologies in consumer electronics, in particular mobile devices, are driven by an increasing number of applications, such as enhanced imaging, gesture control, user interfaces, augmented reality, vital sign measurements, etc. The depth sensing technologies range from passive and active stereo-vision over triangulation technologies to time-of-flight concepts. This talk will focus on the micro-systems technologies of the different depth sensing concepts, in particular the miniaturization aspect, as well as some selected used cases.

Biography

Formerly head of CSEM Zurich Replicated Micro-Optical Elements, Markus became CTO of Heptagon after CSEM's microoptics division was acquired by Heptagon in 2000. He is an expert on design and fabrication of diffractive and refractive micro-optic components and subsystems for industrial applications in the European and US markets. Markus holds a Ph.D. in Micro-Optics from the University of Neuchatel, Switzerland and a master's degree in physics from ETH Zurich.

3D Time-of-Flight Image Sensor Solutions for Mobile Devices

B. Buxbaum
CEO
pmdtechnologies gmbh, Executive Board, Siegen, Germany

Abstract

Since William Gibson's visions* of VR and AR finally get omnipresent in mobile devices, sensing technologies are confronted with new requirements to solve the problems of Human-Machine-Interfaces. Neither VR nor AR can rely on classical input media like mouse or keyboard - special controllers are barely accepted while natural interface methods are the key. Proximity information has to be provided to augment real or virtual scenes or to assist the user for security and guidance reasons (environmental awareness). Moreover mobile systems have strong limitations in terms of form factor and power consumption. pmd's ToF (Time-of-Flight) based 3D-sensor camera systems will push this trend further due to their scalability, tiny form factor and low power capabilities. They enable touchless interaction in the near-field as well as 3D environmental awareness - already today even on mobile devices. No need for a baseline, robust and reliable calibration, operation from pitch black to bright sunlight are valuable criteria for pmd depth sensors to be a key component of an emerging mobile ecosystem.

* (Neuromancer, Virtual Light)

Biography

EDUCATION
- Technical University of Darmstadt, University of Siegen
- Master of Engineering, PhD in Micro-/Optoelectronics, MBA

CAREER
- Founding CEO/CTO of pmd in 2002
- pmd today is world's leading 3D ToF chip technology provider
- 1st products launched 2005, more than 1 Million devices shipped up to date
- More than 100 employees
- Revenue with pmd-based products over 30 Million USD expected 2015
- Besides other design wins, pmd is partner in Project Tango as the 3D technology provider
- Lecturer at the University of Siegen
- Member of Advisory Boards

Digital integration: a path to lower system cost in imaging systems

B. Dupont
Business Development
Pyxalis, Moirans, France

Abstract
In many fields of imaging applications, the image is not at the destination of a human being. Instead, imaging data is used by machines to interpret a data, for instance: shape, thickness, color, intensity, etc. As a consequence, imagers are usually coupled to a rather complex digital system that configures the image sensor to acquire the correct data (window size, frame rate, sequence, gains,...) and perform post processing and image treatment on the acquired data. With nowadays technologies, it is possible to lower the total camera cost by integrating more on the sensor itself or on a dedicated digital chip.

In this paper, and after considering various possible options, we describe a general approach using integrated microprocessors, sometimes dual core, to achieve more compact, more affordable cameras. We also present how this integration can also lead to a significant gain in camera development time and cost as the flexible digital sensors become easier to integrate. In particular, we will discuss how digital processing can be used to reconstruct High dynamic range directly at the sensor output. Finally, we will demonstrate that digital integration does not come at the expense of performance with measurements of a 2e- noise sensor using dual-CPU architecture on-chip.

Biography
Benoit Dupont received his PhD in physics from the University of Paris-Sud in 2008 and an IC design engineering degree from ISIM, Montpellier in 2002. He worked as digital system engineer and cmos image sensor designer at FillFactory from 2002 and 2005. He made his PhD research in partnership with the LETI and ULIS, Grenoble, in the field of infrared image sensors from 2005 to 2008. He worked as chief designer at Caeleste until 2015 where he joined Pyxalis Image Sensors, as business development manager.

Panono Panoramic Ball Camera

J. Pfeil
President
Panono GmbH, Berlin, Germany

Abstract
The Panono is a grapefruit-sized, ball-shaped camera with 36 camera modules embedded around it that fire simultaneously to capture fully spherical, 108-megapixel panoramic images. Viewing Panono panoramas on a mobile device with the free Panono App offers a unique immersive experience in which the viewer moves through images simply by tilting their device up and down, left and right, and all around as if inside the image.

Biography
Jonas Pfeil is a co-founder and the president of Panono GmbH, the company that builds the Panono Panoramic Ball Camera.

He graduated with a Diplom (M.Sc.) from the TU Berlin, worked as a visiting researcher in Japan and participated several times in the German contest for young scientists "Jugend forscht" while still at school. There his team won the second place at the national level in 2002.

He loves problems and climbing.

Integration Technologies for Image Sensors

M. Toepper
Business Development Manager
Fraunhofer IZM, BDT, Berlin, Germany

Abstract

Packaging is a dominant part for the integration of image sensors into electronic systems for ultra-small and/or high performance applications. This presentation will focus on the packaging and system integration aspect of image sensors. Two different approaches will be presented and discussed in detail: One approach is a wafer level packaging concept using TSV (Through Silicon Vias) technology and the other is an image sensor on a small PCB with embedded image processor. Both technologies are a versatile step for new and advanced systems.

The enabling key technology for wafer level packaging of camera systems based on top-side illuminated imagers are TSV because they allow a redistribution on the backside of the wafer wherefore the active side remains unaffected and can be completely used for the optic assembly. The wafer level camera having a size of about 1mm x 1mm will be presented.

Another packaging process was made possible by an embedding technology. At a size of only 16x16x12 cubic millimeters, including, the microcamera module is an extremely small system. A total of 72 passive and 13 active components (such as oscillators, DC-to-DC converters, memory chip and image processor) have been embedded inside the module and the image sensor is mounted on top. The main system advantage is the fact that the image material is directly inside the camera, since it is equipped with an integrated processor for image processing. In addition it is fully encapsulated. After the image sensor has recorded the image, the integrated processor evaluates the frame. The video itself no longer has to be sorted and analyzed by an interposing system. Instead, only the relevant signals are transmitted.

Biography

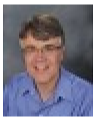
Michael Töpper has a M.S. degree in Chemistry and a PhD in Material Science. Since 1994 he is with the Packaging Research Team at TU Berlin and Fraunhofer IZM. In 1997 he became head of a research group. In 2006 he was also a Research Associate Professor of Electrical and Computer Engineering at the University of Utah, Salt Lake City. The focus of his work was Wafer Level Packaging applications with a focus on materials. Since 2015 he is part of the business development team at Fraunhofer IZM. Michael Töpper is Senior Member of IEEE-CPMT and has received the European Semi-Award in 2007 for WLP. He has published several book chapters and is author and co-author of over 200 publications.

P. Cambou
Activity Leader Imaging
Yole Développement, Villeurbanne, France

Biography

From 1999 Pierre Cambou has been part of the imaging industry. He has earned an Engineering degree from Université de Technologie de Compiègne and a Master of Science from Virginia Tech. More recently he graduated from Grenoble Ecole de Management's MBA. Pierre took several positions at Thomson TCS which became Atmel Grenoble in 2001 and e2v Semiconductors in 2006. In 2012 he founded a start-up called Vence Innovation (now Irlynx) in order to bring to market a disruptive Man to Machine Interaction technology. He joined Yole Développement as Imaging Activity Leader in 2014.

InVisage, the camera in a whole new light



R. Lacombe
VP Sales & Marketing
InVisage Technologies Inc., Menlo Park, United States

Abstract
QuantumFilm is a light-sensitive layer of quantum dots that takes the place of silicon, the conventional material used in digital camera sensors. It has 80% quantum efficiency in the visible range and absorbs 8 times more light than silicon in an equivalent thickness. In fact, it's so sensitive that 0.5um of QuantumFilm can detect colors more accurately than a 3um layer of silicon, enabling lower lens height and much thinner cameras. In addition, by changing the size of the quantum dots, we can tailor their sensitivity to specific wavelengths. This means QuantumFilm can be dynamically optimized for a variety of applications, from visible to infrared. Not only that, but the dots' sensitivity can also be turned on and off electronically, resulting in our proprietary global shutter and dynamic zoom mechanisms.

The design of the QuantumFilm camera sensor maximizes the film's higher sensitivity by incorporating it in a continuous layer closer to the top surface of the sensor. Thus, the entire area of the pixel is sensitive to light (100% fill factor), and more light can be absorbed faster. Thanks to added room in the silicon circuitry underneath, a significantly higher full well capacity allows more of that light to be stored, which in turn produces images with enhanced details in both dark and bright areas-also known as higher dynamic range.

QuantumFilm is a truly remarkable breakthrough, freeing digital cameras from the technical limitations of silicon. You'll see the camera in a whole new light.

Biography
At InVisage, Remi leads the sales & marketing team. He joined InVisage in 2013 bringing 20+ years of international business development and marketing experience with a focus on multimedia and imaging hardware and software technologies. Before InVisage, he was the Vice President of Business Development at DxO Labs where, as an early employee, he created the mobile imaging business, won imaging technology design wins at all major device manufacturers and helped grow the 120+ staff company to sustainability and multi-year profitability. Previously, Remi led several entrepreneurial ventures including CEO of Zandan and co-founder of PAS International. Remi's previous companies also include C-Cube Microsystems, Chorus Systems, and Sun Microsystems. Remi received his MS degree in Engineering Management from Stanford University as well as applied science and engineering degrees from Ecole Polytechnique and Ecole Nationale Supérieure des Télécommunications both in Paris, France.

Low power image sensors at CEA LETI : from mature to advanced process nodes

A. Verdant
Analog design
CEA LETI, Grenoble, France

Abstract
In the last decade, CEA-LETI has investigated the fields of low power image sensors in the context of highly power constrained environments for surveillance applications.
With power budgets as low as 100µW and below, new read-out and processing strategies has been developed for always-on visible CMOS image sensors.
The recent and fast growing market of IoT offers new opportunities for this technology adoption.
Although these strategies were oriented towards a drastic reduction of the amount of data to process by adapting the resolution of the acquired image, recent works tend to explore the benefits of event-driven asynchronous readout modes with multiple wake up levels. These acquisition concepts are also closely linked to the technological target and integrations schemes.
In this presentation, we will show developments conducted at CEA-LETI in relation to the state of the art and future perspectives.

Biography
Arnaud Verdant joined the CEA LETI in 2008 at the Circuit Design, Architecture & Embedded Software Department. His works focus on analog design for CMOS image sensor, including analog to digital converters and low level image processing. He is involved in several project dealing with medical imaging (X-rays and acousto-optic) . He received the PhD degree from the Université Paris Sud in 2008. He is the author and co-author of 15 publications and 10 patents.

Quantum random number generator using a mobile phone's CMOS camera

B. Sanguinetti
Product Manager
ID Quantique, Geneva, Switzerland

Abstract

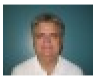
Random number generators (RNGs) play an essential role in the generation of cryptographic keys. Purely mathematical (software) RNGs do not guarantee the uniqueness, and therefore the security, of the keys, so that in cryptographic applications it is essential to use RGNs based of physical principles. The randomness of certain quantum mechanical effects can be demonstrated from first principles, and the entropy generated by these effects can be precisely quantified, making quantum random number generators an attractive solution. These however have typically relied on specialized, power hungry, and "large" hardware devices, such as single photon detectors.

Here we show that it is possible to generate random numbers of a quantum origin using a standard mobile-phone camera. Besides its economical and practical advantages in mobile applications, this method allows for a more precise estimation of the entropy than previous methods, and is resilient to a larger class of attacks.

Biography

Bruno Sanguinetti has studied for his PhD in cavity quantum electrodynamics at the Universities of Sussex and Leeds (UK), and at the Max Planck institute for quantum optics (Germany). After his PhD, Bruno joined the group of applied physics of the university of Geneva. Now Bruno works at the company ID Quantique where he is product manager. His interests are in applied quantum photonics, sensors and detectors.

Key Technology Trends and Emerging Applications for Compact Thermal Imagers



M. Walters
Vice President of Micro Camera Product Management
FLIR, Goleta, United States

Abstract

The FLIR Lepton LWIR camera module, which was introduced in January 2014, has demonstrated that compact, cost-effective thermal imaging modules are achievable for consumer electronics applications. The FLIR ONE which turns a mobile phone into a complete thermal camera solution has further started the process of putting thermal imaging in the hands of many consumers. The open question is, "What is the killer application for consumer thermal imaging?" This paper presents an overview of some key technologies and technology trends that will enable consumer thermal imaging applications. This paper also discusses the range of potential future applications for thermal imaging and how the market and use cases might evolve over the next 3-5 years.

Biography

BA Physics and BS Electrical Engineering, University of Southern California 1984
MS Electrical Engineering, Stanford University, 1988

31 years of professional optoelectronic experience at Hewlett Packard's components group, Flextronics/Vista Point and FLIR. Co-founded Hewlett Packard's CMOS camera module business for mobile phones in 2001.

Related areas of interest: Integrated circuit design, sensors, semiconductor processing, mobile phones and Internet of things

I joined FLIR in May of 2012 where I am Vice President of Micro Camera Product Management. I am responsible for the Lepton LWIR camera module family and the FLIR ONE smart phone thermal attachment camera family at FLIR.

Voltage-Domain BSI Global Shutter Pixels

J. Raynor
Principal Technologist
STMicroelectronics, Imaging Division, Edinburgh, United Kingdom

Abstract
The selling point for many image sensors is the number of pixels and the overall size or cost of the device. Consequently, most imaging pixels are of the "rolling blade" type, as their small size is a significant advantage in this regard. However, rolling blade pixels will create artefacts if the object is moving, and while a human is able to dismiss these artefacts as ugly or curious, these artefacts are a significant problem for machine vision algorithms, hence global shutter (GS) pixels are preferred if data is to be extracted from a moving image.

Global shutter pixels include storage elements which allow all of the pixels to simultaneously sample the image and then be read out on a row-by-row basis. Charge domain pixels store the photo-generated charge and were preferred due to their smaller size and lower readout noise. Voltage domain pixels convert the photo-charge into a voltage and then store the voltage. This presentation will describe the operation of both rolling blade and global shutter pixels and examine their performance. It will show how the advances in process technology such as back side illumination (BSI) have allowed the size of voltage domain GS pixels to be reduced in size, as well as improve performance so that voltage domain sensors have larger dynamic range than charge domain pixels. Also discussed are the new features and functionality that voltage domain global shutter pixels offer which are not possible in either rolling blade or charge domain global shutter sensors.

Biography
Jeff Raynor is Principal Technologist at STMicroelectronics Imaging Division. He has designed pixels and imaging systems for many machine vision applications such as optical mice, touchscreens, wearables and biosensors with a diverse range of specifications from high frame rates, low frame rates, operating in UV / visible / IR and X-ray. He has authored more than 20 papers and is inventor on more than 40 granted patents.

W. Mierau
Director Quality & Operations
pmdtechnologies gmbh, Dresden, Germany

Biography
- born in 1950
- 1969 - 1980 studies (information technology), PhD and work at Technical University of Dresden/Faculty Electrical Engineering)
- since 1981 in microelectronics, years of experience in engineering management, longterm at Zentrum Mikroelektronik Dresden AG, but also at International Electronics & Engineering S.A. Luxembourg (IEE) and since 2011 at pmdtechnologies gmbh
- intermediate (5 years) Professor (information technology) at the Technical University of Dresden/Faculty Electrical Engineering
- since 2001 working in the field of development of optical sensors (ASIC-development), especially 3D-sensors (time-of-flight sensors)

Towards the use of CMOS detectors for space applications

A. Bardoux
Head of department
CNES, Toulouse, France

Abstract
For 20 years, optical instrument of satellites have been using CCD detectors for all applications Earth observation, Astronomy, and also for the star trackers that serve to know the satellite attitude. CCD's exhibit good performances and event very good ones for backthinned devices. But they suffer of degradation under radiations, inherent to space environment, and require quite complex proximity electronics (high voltage bias, clock drivers, signal processor). The incoming of CMOS detectors in the 90's have push a new paradigm, allowing the design of detectors customized for each application, and making possible some mission that we cannot envisage before: high speed readout, windowing, smart pixels, and more.
Performances of the pixels, that were relatively poor in the beginning of the story become more and more better, so that CMOS detectors are now used for satellite flight models productions both for star tracker and optical telescope. Two types of detectors are used: COTS for medium performance missions, where cost is the driver, and custom devices where performances are the key elements.
Obviously, the choice of the foundry is very important in the case of custom devices, to ensure the required performances, and also to guarantee the procurement. A few criterions of choice will be given.

Biography
Alain Bardoux has been working for 15 years as Head of "Detection chain " department , dealing with optoelectronic detectors and associated electronics for all wavelength from X-ray to submm., for Space mission in which CNES is involved : High resolution Earth remote sensing, Atmospheric sounding, Astronomy, planetology
Formerly, He has been responsible for the development and the procurement of flight models for several space missions: SPOT 5, Helios 2 Corot.
Today, he manages particularly the setting up of CMOS detectors European supply chain, and large/very large infrared large format detectors

Kirana: millions of frames per second with a megapixel CMOS image sensor

R. Turchetta
CMOS Sensor Design Group Leader
STFC, Rutherford Appleton Laboratory - Technology, Didcot, United Kingdom

Abstract
CMOS image sensors are the preferred imaging technology for high-speed imaging. The technology has been slowly improving in terms of pixel rate since their invention and nowadays it is possible to have megapixel sensors achieving a speed of Over 10,000 frames per second.
In order to get a step change in speed for the same type of resolution, a new approach was needed. At the Rutherford Appleton Laboratory, we developed a novel sensor. Starting from a standard 180 nm CMOS image sensor (CIS) technology, we developed CCD cells. The combination of these two imaging technologies allowed us to create a megapixel sensor that can both work as a conventional image sensor and continuously output images at a thousand frames per second as well as a framing camera recording almost 200 frames at 5 millions frames per second. In burst mode, the equivalent pixel rate is in excess of terapixels per second, i.e. over 2 orders of magnitude higher than any conventional CMOS image sensor. The talk will review the technology challenges and solutions and the performance achieved. It was also show how the collaboration between industry and a research laboratory could create a unique product that pushes forward the frontier of ultra-high speed imaging.

Biography
Renato Turchetta received the Laurea (Master degree) in Physics at Milan University (Italy) in 1988 and the Ph.D. in Applied Physics from the University of Strasbourg (France) in 1991. He was Assistant Professor there until 1999 before moving to the Rutherford Appleton Laboratory, near Oxford (UK), where, since 2005, he leads the CMOS Sensor Design group, which specialises in CMOS image sensors for scientific and other high-end applications. He is co-author of over 100 papers on solid-state detectors, low-noise, microelectronics and CMOS image sensors in international journals as well as of 8 patents on CMOS image sensors. He was on the technical committee of IISW2009 and is a member of the programme committee of Image Sensor Europe since 2011.

SILICON PARTICLE DETECTORS: FROM THE DAWN OF THE UNIVERSE TO BIOMEDICAL APPLICATIONS (AND BEYOND...)

M. Caccia
Full Professor
Universita' dell'Insubria, Scienza ed Alta Tecnologia, Como, Italy

Abstract

The discovery of the Higgs boson at the CERN Large Hadron Collider represents the most recent result of the activity of the community of scientists and technologists that conceived, designed, engineered and commissioned what is possibly the largest experiment ever built. What is peculiar of experimental particle physics is the development of instruments and methods well beyond the state-of-the-art, often seeding and anticipating technologies and solutions with a value beyond curiosity driven fundamental research.
In particular, the reconstruction of the elementary particle trajectories in events resulting by the interaction of accelerated particle beams has pushed the development of high spatial resolution solid state detectors and the design of extremely sophisticated front-end electronics. And the resulting know-how fostered cross-disciplinary research & development activities in a loop that starting from the dawn of the Universe addressed therapy, diagnostics, bio-science and imaging techniques.

In my talk, I will introduce the different classes of position sensitive Silicon detectors (microstrips, pixels and drift chambers) across their historical development and through exemplary experiments. Then, a few significant applications resulting by the exploitation of this know-how will be analysed, namely:
- radiotherapy optimization, by a verification of the dose deposition and beam quality assurance
- autoradiography of radio labelled biological samples
- energy resolved radiography for spectral molecular imaging
- electron microscopy.

Biography

Massimo Caccia is full professor of experimental Physics, currently at Universita' dell'Insubria in Como, Italy.

Particle Physicist, Massimo scientifically grew up at CERN, the house of the LHC rings where the Higgs particle was recently discovered. He was based at CERN for 10 years and he's collaborating with Research teams at the labs since 1985.
His Research focuses on Silicon detectors of ionising radiation and light, for basic science and beyond. Supported by the European Commission, he lead projects addressing applications of particle physics detector technologies to dosimetry, beam profilometry, environmental science and lately homeland security. Since 2006, he is involved in the development and use of Silicon photomultipliers, in partnership with producers and industrial end-users.

New perspectives for CMOS image sensors in harsh radiative environments

P. MAGNAN
HEAD OF IMAGE SENSOR GROUP
ISAE, DEOS, TOULOUSE, France

Abstract

There is a fast growing interest in a strong enhancement of image capture capabilities in very harsh radiative environments. The Fukushima Nuclear Power Plant accident in Japan has strongly exacerbated the civil society sensitivity to Nuclear Facilities potential weaknesses and dangers highlighting especially the lack of vision capabilities in very harsh radiative environments, e.g. required for rescue robots actions.
Consecutively, ability to capture images from radiation-resistant cameras in such environments has been identified as a critical issue for monitoring and remote handling in highly radioactive areas of nuclear facilities including power plants and nuclear waste repository sites but also in next generation particle physics research facilities such as the ITER. Imaging system withstanding dose above 1 MGy (100 Mrad) of Total Ionizing Dose are required for such applications. Available Rad-Hard cameras have been using imaging tubes technology limiting the miniaturization and functions integration capability that full solid-state solutions would allow. In the past, the radiation hardness of Radiation-Hardened CMOS Image Sensors has been demonstrated up to several hundreds of kGy (several tens of Mrad).
Recent developments performed at ISAE using CMOS technology have demonstrated spectacular improvements in radiation tolerance of sensors and image capture capability over 1 MGy, paving the way to integrated compact Radiation-Hardened camera suited to the MGy range applications.
In this presentation, we will present the key technical challenges to be faced related to radiation-hard photodiodes and circuits to achieve imaging capability in the MGy dose range. Additionally, we will also describe how CMOS image sensors have proven to be a key solution in experiments ("diagnostics") of Inertial Confinement Fusion (FCI) facilities (e.g. Mega Joule Laser class) where neutrons flash is a killer issue. Based on the obtained results, new perspectives will be drawn.

Biography

Pierre Magnan graduated in E.E. from ENS Cachan and University of Paris in 1982 After being a research scientist involved in analog and digital CMOS design up to 1993 in LAAS-CNRS, he moved to image sensors research in SUPAERO, now called ISAE-SUPAERO, in Toulouse, France. Since 2002, he is Full Professor there and Head of Image Sensor Research Group involved in CMOS Image Sensor basic and applied research. He has supervised 15 PhDs and co-authored more than 70 scientific papers. He has served in IEEE IEDM Display Sensors and MEMS subcommittee in 2011, 2012, and in the International Image Sensor Worshop (IISW) TPC in 2007, 2009, 2011, being the General Technical Chair of 2015 IISW.

Imager Testing, Solutions from Wafer Level Test up to Camera End of Line Testing

M. Verhoeven
Co-Founder and Managing Director
aSpect Systems, , Germany

Abstract
Testing is not a negligible cost factor in the image sensor world. Compared to other semiconductor products it requires on top of the mixed signal test system optical resources which yield into much more complex test setups.
The ATE market offers solutions for consumer imager with significant volume, but these test systems are a cost overkill for niche markets and products with medium volume. aSpect Systems offers cost effective test solutions for all types of high end imager and medium volume camera chips.
The presentation will give an brief overview about the necessary core components for image sensor testing (Test Head, Illuminator and Software).
Further it will contain test setup examples for Wafer-, Final- and Camera End of Line Testing.

Biography
Marcus is Co-Founder and Managing Director of aSpect Systems.
aSpect is a vendor for image sensor test services (wafer- & final test), test- and illumination equipment, prototype package- and camera development, as well as production equipment for lens adjustment.

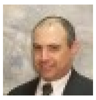
Marcus started his professional career as a lab assistant in 1987 at Spectro Analytical Instruments, a vendor for optical spectrometers. He studied physics at the University of Wuppertal. From 1998 he headed for five years the semiconductor test floor of Silicon Vision. In 2003 Marcus founded together with Philipp Gottesleben aSpect Systems GmbH.

L. Grant
Technical Director - Fellow
STMicroelectronics, Imaging Division, Edinburgh, United Kingdom

Biography

Lindsay Grant is a Pixel Technology Expert in the Imaging Division of STMicroelectronics. He was born in Glasgow, Scotland and has a degree in Physics from St.Andrews University. Following university he moved into semiconductors and worked in product, device and process engineering with STC and Seagate. He joined STMicroelectronics, Edinburgh in 1999 at the time of their acquisition of VLSI Vision. With STM he has worked on the development of multiple generations of CMOS Image Sensor pixel & process technology from 5.6um to 1.1um pitch. For 5 years from 2007 he held the position of Process Development Manager for ST Imaging Division. Since 2006 he has managed R&D of Spad devices in CMOS. He has been a member of the steering committee for two European funded programs in Spad development. He has authored or co-authored more than 50 technical papers and conference presentations in imaging technology. He was an invited speaker at the ISSCC Forum on Image Sensors 2005, at the Fraunhofer IMS Workshops in 2006 & 2010, and at ESSDERC 2008; he has been on the Technical Program Committee for International Image Sensors Workshop 2009 - 2015 and between 2008 - 2014, has co-chaired the Image Sensors conference in London. Currently he manages a team working on Spad and pixel development, runs a program of sponsored PhD studentships and is a Director of STMicroelectronics R&D, UK Ltd.

Specialty CIS process in a foundry environment



A. Strum
Vice President, GM of CIS BU
TowerJazz, Migdal Ha'Emek, Israel

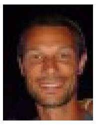
Abstract
Although CIS process is basically CMOS based, the process flow is unique to each type of imager. For example, a process flow for X-Ray medical sensor in completely different than the one used for high end photography and both are completely different than the one required for 3D gesture recognition sensors for the gaming market.
In addition, unlike very high volume CMOS digital products, the volume per each process flow is significantly lower and thus, creates flow diversity within the fab and makes the production line control a very challenging task.
The talk will focus on how a specialty foundry such as TowerJazz can support fabless customers with state of the art imaging technology alongside with high flexibility of customizing the process flow to the customers' needs, allowing it to compete well with leading sensor IDMs. The talk will focus on the main specialty markets such as high end photography, medical X-Ray sensors, industrial global shutter market, automotive and security and the new, fast growing 3D gesture recognition sensor market.

Biography
Dr. Strum is the VP and GM of the CIS business unit at TowerJazz. Previously he was VP and GM of the Specialty Business Unit since September 2008. He joined Tower in 2004 and served as GM of Tower's design center in Netanya and Device and Integration Department Manager.

Prior to joining Tower, Dr. Strum served as the President and COO of TransChip Inc. and from 1996 to 2001, he served in various positions with Intel Corp., both in Israel and the US. From 1990 to 1996, he was the R&D Manager of SCD and was in charge of all the Infrared Detectors development in SCD.

Dr. Strum received his Ph.D. and B.Sc. in Electrical Engineering from the Technion - Israel Institute of Technology in 1990 and 1985 respectively.

CMOS imaging offers novel solutions to common application dilemmas



V. Prevost
Technical Marketing Engineer
e2v, Saint-Égrève, France

Abstract
The tides have turned on CCD based imaging solutions as CMOS pixels have come of age. Combined with higher electro-optical pixel performance the system-on-chip nature of CMOS enables novel application features and image processing to be performed with much lower cost. A number of innovative features that include extremely low-light scene capture, colour detection beyond human vision capability, and distance perception for 3D vision or range-gated active imaging are presented both from both technical and business aspects. This presentation will cover some of the ground-breaking application solutions with some projection on the market expanding impacts as the cost of ownership enables deployment in more mainstream markets such as industrial, automotive and security cameras.

Biography
Bringing life to technology, e2v partners with its customers to improve, save and protect people's lives. Delivering innovative technology for high performance systems and equipment, e2v leads developments in communications, automation, discovery, healthcare and the environment.

e2v employs approximately 1700 people worldwide, has design and operational facilities across Europe, North America and Asia, and has a global network of sales and technical support offices.

Challenges and opportunities for wafer-scale CCD and CMOS image sensors

J. Bosiers
R&D Director
Teledyne DALSA Professional Imaging, R&D, Eindhoven, Netherlands

Abstract

Wafer-scale imagers are used in applications like photogrammetry, scientific, astronomy, and X-ray medical imaging.

The talk will focus on the design and manufacturing challenges, but also aspects related to testing, assembly and operation of these very large imagers will be presented.

The commonalities and differences between CCD- and CMOS- based technologies will be explained.

The presentation will start with some examples of existing wafer-scale imagers for various applications, from different vendors.

Then the challenges related to wafer-scale CCD imagers will be analyzed. Several design and technology concepts will be presented by using the example of a 250M-pixel 10cm x 8cm CCD developed by Teledyne DALSA for photogrammetry applications.

The second part of the presentation will focus on the development of, and applications for, wafer-scale CMOS imagers. A 11cm x 15cm CMOS imager with 99x99 μm^2 pixels developed for medical applications will be used to illustrate how very large CMOS imagers, with the right design and technology choices, have become the leading technology for dynamic medical X-ray imaging systems.

Biography

Jan Bosiers graduated as Electronic Engineer from the Catholic University in Leuven (Belgium) in 1980. He worked at the ESAT Laboratory of the University and at the Naval Research Laboratory in Washington D.C. before joining Philips Research in Eindhoven, the Netherlands, in 1986. At Philips, he worked on CCD development and project management. He became R&D Director of DALSA Professional Imaging in 2002, after the acquisition of the Philips professional CCD business by DALSA. Since the acquisition of DALSA by Teledyne in 2011, his responsibilities as R&D Director include the R&D of CCD and CMOS imagers and CMOS-based X-ray detectors.

PISTON: a production platform for high-end imagers

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Abstract

This paper presents the PISTON test head. PISTON stands for Pretty Image Sensor Tester from ON Semiconductor. It has been designed to support production test for the full CMOS image sensor product portfolio with a unique focus on high-speed and high-performance CMOS imagers. For these high-end imagers no existing tester solution was found to be available on the market.

The PISTON test head can be used for both device as for wafer sort test. Device test is done in dead-bug mode, such that the optical area of the imager faces the light source system that is integrated in the test head. A single loadboard PCB design can accommodate both sort and device test. This reduces the development effort and cost for new DUT boards. The loadboard requirements have been minimized to contain only passive components.

The tester resource modules consist of commercial PXI(e) modules in combination with proprietary PXIe frame grabbing, synchronization, timing engine, and light source modules. All tester modules are calibrated to a golden standard. Calibration term violations are managed and monitored by the proprietary 64-bit SW framework. An overview of the tester module configuration will be presented.

One of the benefits of the PISTON test head is the ability to support custom interface protocols. It does this for interfaces up to 500 MHz while maintaining per pin pintest on all digital IO and reference voltages. PISTON makes use of a single PCIe (x16) communication link to the host machine controller providing a high-BW data link for image and result data transfer to the host pc. The PISTON supports DMA link setup from frame grabber to machine controller, GPU, and between frame grabbers to optimize data transfer times and test time performance. In the paper a comparison on key performance parameters with commercially available testers will be presented. The key differentiators that justified ON Semiconductor to invest in this custom PISTON development will be highlighted.

Biography

Gerd Van den Branden received the Master's degree in Electronics from the KULeuven (campus De Nayer), Belgium, in 2003. He started his career at the Erasmushogeschool Brussel as a scientific researcher on a project on dynamic reconfiguration with FPGA technology. In 2004 he became assistant professor at Erasmushogeschool and joined the ETRO research group of the VUB. In 2007 he joined the CMOS image sensor group of Cypress Semiconductor as a test engineer, working on the completion, release and deployment of an image sensor test platform and responsible for transferring production test to South-East Asia. Since 2011 he is leading the System Development group of the Industrial image Sensor Division of ON Semiconductor where he is responsible for providing all HW, SW, firmware and infrastructural tools and equipment to characterize and test high-end CMOS imagers.

Alternative Hardware Architectures for Digital Imaging

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Abstract

Computer vision and smart imaging are becoming part of many advacned electronic systems. The latest digital cameras and smartphones incorporate a range of face tracking, analysis and even dynamic 'beautification' of facial regions. The same technologies can be extended to high performance scene analysis, pedestrian detection, video stabilization and dynamic distortion correction.
GPU based chipsets can provide some of these capabilities, but they are not energy efficient. The technology was developed for high-quality gaming applications and when adapted into handheld devices retains high power requirements of the order of a watt per GPU core.
Energy is currently the limiting factor of performance in handheld devices and is becoming increasingly important in the automotive sector where the latest stop/start and hybrid technologies need to carefully conserve and manage battery power. There is a need for solutions to dramatically increase the energy efficiency of advanced computer vision systems.
In this presentation several alternative hardware architectures are presented to solve several fundamental image processing challenges 'at the edge'. This is the optimal place to processing image data - in the main pipeline as it is clocked off the image sensor and before compression for storage or transmission over a network. Solutions are provided for (i) a template matching engine for multi-object detection; (ii) a programmable distortion correction engine; (iii) a hierarchical registration engine for inter and intra-frame motion analysis that can distinguish device from object motion; (iv) a system-on-chip design that can integrate the above and other support hardware on a platform that is 10% of the size of a typical GPU core and with power requirements of 10s of milliwats, rather than a watt per GPU core.
Some practical evaluation tests will be presented to demonstrate the scalability of these architectures beyond full-HD to 4k and even 8k video streams.

Biography

IEEE Fellow (class of 2010); more than 250 technical publications, 70+ peer reviewed journal papers, 100+ International conference papers & publications; co-inventor on 250+ granted US patents, 100+ corresponding international patents, with another 100+ patents currently pending.

Irish Inventor of the Year (joint award) 2014; Inducted into the National Inventors Hall of Fame, 2014. PI on new Science Foundation Ireland (SFI) funded Industry/Academic partnership to develop "Next Generation Smartphone Imaging"; Former Vice-Dean of Research & Graduate Studies in the College of Engineering & Informatics at NUI Galway (7 year tenure from 2005-2012). Board level appointments in IEEE CE Society and IEEE Biometrics Council;

Research interests include (i) computational-imaging/advanced digital imaging; (ii) biometrics for handheld devices; (iii) connectivity & internet of things; (iv) cloud computing & CE devices;

Co-Founder of various start-up companies including FotoNation, now operating again under its original name & branding - see www.fotonation.com for more details! Industry consultant & expert witness.