Final Call for Papers

The SID International Symposium, Seminar & Exhibition

May 19–24, 2013

SID DISPLAY WEEK

Vancouver 2013

Announcing

Special Topics of Interest

OLED TV ♦ Oxide TFTs

♦ 3D ♦ Lighting ♦ Touch and Interactivity

SID
SOCIETY FOR INFORMATION DISPLAY

www.displayweek.org

Vancouver Convention Center
Vancouver, British Columbia, Canada

Format and Submissions Requirements: Technical Summary

Submissions must consist of two separate parts. The first part should consist of a single page containing a 35–50 word abstract. The second part should contain a 4-page technical summary that follows the outline below. Please follow the following instructions for the preparation of the Abstract and Technical Summary.

35-50 Word Abstract: Your submitted 35-50 word abstract, highlighting the key details of your paper, will be published in the Advance Program if your paper is accepted. The abstracts are usually edited to accommodate the program format.

Technical Summary: Include the first author's name and the title of the paper on each page. Please include the information listed below in the Technical Summary.

(1) Objective and Background: Briefly describe the goals and intent of your project. and give background factors that led to the new results.

(2) Results: Describe the specific results that will be presented at the SID 2013 Symposium. Please provide a technical description of how the results were achieved. Sufficient detail (quantitative and/or graphical data) should be included so the Program Committee can properly evaluate your submission.

(3) Impact: Discuss the significance of your work and compare your findings with previously published work.

(4) References: List a few main references covering projects in related areas.

(5) Prior Publications: Generally, Symposium papers must be original contributions. If your organization has published or presented material on similar work in English, please explain how the present material differs. The only exception to this rule is that papers submitted to the Applications Subcommittee need not be original.

The Technical summary must be no longer than four pages. Material beyond four pages will not be considered in evaluating the paper.

All authors are required to upload their Abstract and Technical Summary to http://www.sheridanprinting.com/pcm/sid.

Additional information must be provided in the online submission form.

Authors must

    (A) Indicate if you wish to have your paper considered for oral or poster presentation, if you have a preference.

    (B) Indicate the closest matching Symposium Topic from the list provided

    (C) Include the 35-50 word abstract

    (D) Include a minimum of three keywords for the submission;

    (E) Indicate whether the presenter of the paper is currently a student; and

    (F) Include the names of all authors with their affiliations, addresses, telephone numbers, and e-mail addresses. Please underline the name of the presenter when there are two or more authors.

Please follow the instructions on the URL site (**http://www.sheridanprinting.com/pcm/sid**). If you need help, contact Bill Klein at wklein@pcm411.com.

Timetable

The deadline for receipt of abstracts and technical summaries is December 1, 2012. Notification of acceptance will be e-mailed by February 15, 2013 (February 22 for Late-News papers). Authors of accepted papers will be directed to an on-line "Authors Kit" with instructions for the preparation of the paper to be published in the Symposium Digest. The paper shall consist of four pages, including all illustrations and is due March 8, 2013 (March 15 for Late-News papers).

Points of Contact

For further information contact:

Shin-Tson Wu (Technical Program Chair)
University of Central Florida
College of Optics & Photonics
Orlando, FL, USA
telephone 1(407) 823-4763
e-mail: swu@mail.ucf.edu

Sergei Yakovenko (European Subcommittee Chair)
LensVector, Inc.
Mountain View, CA, USA
telephone 1(914) 263-3544
e-mail: sergeiyakovenko@yahoo.com

Chang Hee Lee (Asian Subcommittee Chair)
Seoul National University
Seoul, Korea
telephone +81-2-880-9093
e-mail: chlee7@snu.ac.kr

Bill Klein (Symposium Coordinator)
Palisades Convention Management, Inc.
New York, NY, USA
1(212) 460-8090 x204 (fax -5460)
e-mail: wklein@pcm411.com

Jay Morreale (Symposium Coordinator)
Palisades Convention Management, Inc.
New York, NY, USA
1(917) 301-5194
e-mail: jmorreale@pcm411.com

Format of Presentations

Oral presentations will conform to a 20-minute format (15 minutes for presentation and 5 minutes for questions and answers). This year's Poster Session will be held late Thursday afternoon, May 23, between 4:00 and 7:00 pm. Accepted papers will be assigned to either oral or poster presentation at the discretion of the program committee.

Student Travel Grants

A limited number of student travel grants, up to $1000 each, will be made available to student presenters of accepted papers. A student travel grant must be requested upon submission of abstracts by checking off the appropriate box on the online submission site. A questionnaire will automatically be generated. Please complete the questionnaire and e-mail it to Mark Goldfarb at mark@sid.org. Only the students who complete and return the questionnaire will be eligible to receive a student travel grant. The deadline for the submission of abstracts is December 1, 2012; February 25, 2013 for late-news submissions. Students receiving travel grants will be informed via the acceptance letter.

Poster Session

Poster sessions present the opportunity for a more interactive dialog between authors and the audience. A successful poster paper should be a high-quality innovative paper where the poster presentation format would promote the exchange of detailed information between specialists. Papers where the demonstration of a new technology, concept, or phenomenon can complement the presentation are particularly suitable for the poster format and are encouraged.

Submission requirements and review criteria are the same for both oral presentation and poster formats, and these two formats receive equivalent publication in the SID Digest of Technical Papers. As indicated under "Format of Submissions," authors may state their preference for a poster or an oral paper presentation; however, the final assignment of accepted papers will be at the discretion of the program committee. Poster presenters are requested not to distribute handouts other than business cards.

Late-News Papers

A portion of the Symposium schedule will be reserved for Late-News Papers. These papers should describe the results of late-breaking and significant developments that merit special consideration for attention at the Symposium.

The deadline for Late-News Papers is March 15, 2013. Late-News Papers must follow the format described for regular submissions to the Symposium (see page 1). Additionally, authors should include a statement describing why their paper deserves late-news status. **Only a limited number of late-news papers will be accepted.** Authors of accepted presentations must also submit a paper for inclusion in the SID Digest. Papers accepted for oral presentation will have 10-minute slots (8 minutes for presentation, 2 minutes for discussion).

Deadlines and Key Dates

Technical Summary	Dec. 1, 2012
Accept/Reject Letters	Feb. 15, 2013
Late-News Technical Summary	Feb. 25, 2013
Late-News Accept/Reject Letters	Mar. 21, 2013
Digest Paper Submission	Mar. 8, 2013
Late-News Digest Submission	Mar. 15, 2013
Seminar Notes Submission	Mar. 31, 2013
Display Week 2013	May 19–24, 2013
Sunday Short Courses	May 19, 2013
Monday Technical Seminars	May 20, 2013
Business Conference	May 20, 2013
Investors Conference	May 21, 2013
Exhibition / I-Zone	May 21–23, 2013
Vendor Forum	May 21–23, 2013
Symposium	May 21–24, 2013
Market Focus Conferences	May 22 & 23, 2013

Special Topics

The Display Week 2013 Symposium will be placing special emphasis on five Special Topics of Interest to address the rapid growth of the field of information display in the following areas: ***OLED TV, Oxide TFTs, 3D, Lighting, and Touch and Interactivity*** Submissions relating to these special topics are highly encouraged.

SPECIAL TOPIC ON OLED TV: *This Special Topic will cover OLEDs specialized for TV applications. Submissions on all aspects of advanced OLED TV technologies are encouraged, including novel device structures, backplane technologies, manufacturing processes, deposition techniques, mask fabrication, encapsulation, driving methods, and next-generation applications.*

- **Device Structure of OLEDs (Specialized in High Efficiency, Reliability, etc.)**
- **Backplane Technologies for OLED TV**
- **Novel OLED Manufacturing Processes for OLED TV**
- **Deposition Technology for OLED TV**
- **Mask-Fabrication Technology for OLED TV**
- **Novel Encapsulation Technology for OLED TV**
- **Driving Methods for OLED TV**
- **Next-Generation TV Applications (Flexible, Transparent, etc.)**

SPECIAL TOPIC ON OXIDE TFTs: *Advancements and manufacturing issues related to oxide semiconductors thin-film transistors, along with new opportunities for increased device performance, greater TFT integration at the systems level, and innovative applications and products. Submissions on all aspects of oxide TFTs are encouraged, including, but not limited to:*

- **Novel Oxide Materials**
- **Device Structures and Processing Techniques**
- **Solution Processing of Oxides and Ink-Jet Printing of TFTs**
- **Bias, Thermal, Optical, and Environmental Stability and Reliability of TFTs**
- **TFT Device Physics, Compact Modeling, and Parameter Extraction Circuits**
- **Design and Compensation Techniques for Instability and Non-Uniformity in Pixelated Arrays**
- **Oxide TFT Sensors and Applications**
- **Integration on Flexible Substrates and Novel Applications**
- **Towards Systems-on-Panel and Very-Large-Scale Integration**

SPECIAL TOPIC ON 3D: *Display technologies for enabling depth perception in viewers, applications for 3D displays, 3D content generation, measurement and characterization of 3D systems, and their human factors. This year a stereoscopic projection system will be available in the 3D sessions to enable presenters to show 3D footage to complement their talks.*

- **3D TV**
- **Mobile 3D Systems**
- **Autostereoscopic and Multi-View Displays**
- **Directional Backlights**
- **Volumetric Displays**
- **Holographic Display Technologies & Algorithms**
- **Integral Imaging**
- **Novel 3D Display Approaches**

- **Glasses-Based Stereoscopic Displays: Shutter, Polarization, and Color-Separation Based**
- **Characterization of 3D Displays: Crosstalk, Luminance Uniformity, etc.**
- **Human Depth Perception, Comfort, or Performance When Viewing Displays**
- **Applications for 3D Displays**
- **3D Cinema**
- **3D Gaming, and Interactivity**
- **3D Content Generation and Conversion: Animated Films, Games, etc.**
- **Light-Field Displays and Computation**
- **Capturing 3D: Stereoscopic Cameras, Plenoptic Cameras, and Multi-Camera Systems**

SPECIAL TOPIC ON LIGHTING: *Advancements in the LED and OLED industries open up new opportunities to increase the perception of reality. Submissions on all aspects of solid-state lighting are encouraged, including:*

- **Novel Lighting Systems and Sources**
- **Solid-State Lighting including OLED and LED**
- **Optical Methods**
- **Flat Illumination Panels**
- **Illumination Systems**
- **Ambient Lighting and Display Interaction**
- **Lighting Measurements**
- **Display Backlights**
- **Novel Lighting-Control Electronics**

SPECIAL TOPIC ON TOUCH AND INTERACTIVITY: *Advances in touch-screen technologies, applications, driving electronics, system integration, and human interactions. The advanced materials and process technologies associated with touch design and applications will also be covered.*

- **Advanced User Interfaces**
- **Multi-Touch Systems**
- **Novel Touch Configurations & Applications**
- **Materials and Process Technologies**
- **Driver Electronics, Subsystems, and Algorithms**
- **Touch-Performance Evaluation, Methodology, and Standardization**

As growing and multi-faceted fields, work relating to these topics can fit under a number of different topics, including Active-Matrix Displays, Applied Vision/ Human Factors, Display Applications, Display Electronics, Display Manufacturing, Display Measurements, Display Systems, Emissive Displays, e-Paper and Flexible Displays, Liquid-Crystal and Other Non-Emissive Displays, OLEDs, Projection, and Touch and Interactivity. While the special topics sessions will be arranged in a unified program for the benefit of attendees, authors should indicate the appropriate topical track for their abstract in addition to special topic designation (if any).

Symposium Topics

The Society for Information Display (SID) encourages the submission of original papers on all aspects of the research, engineering, application, evaluation, and utilization of displays. Display Week 2013 will feature topical sessions that focus specifically on selected issues or key developments. Paper submissions are welcome for any of the general symposium topics or any of the specific topical sessions listed below.

The Society plans to include coverage of every aspect of display technology and applications, especially the emergence of 3D TV. Special attention will also be given to all aspects of novel input technologies for displays. Papers are solicited in all aspects of motion-image technology, including device technology (LCD, OLED, PDP, projector, etc.) and related system technology. Papers are also solicited in the area of technology development that enables lower-power-consumption and higher-performance display devices for battery-powered applications (mobile phones, tablets, e-books, etc.).

Active-Matrix Devices: Advances in the innovative development and implementation of active-matrix electronics into displays and other devices. Differences between each subcommittee have become blurred because novel technologies involve various aspects. Active-Matrix Devices focus on TFTs themselves, their circuit design and application, including TFTs electrical/optical characteristics, reliability, new structures, and processing.

Applications: Papers are sought to discuss unique and innovative applications of all varieties of display technologies for consumer, industrial, commercial, and military fields.

Applied Vision / Human Factors: All aspects of vision, perception, and human factors as they apply to the design, image quality, and usability of all types of visual display systems.

Display Electronics: Circuits (integrated or otherwise) for displays, image- and video-processing algorithms, and electronic components for displays.

Display Manufacturing: Materials, process, and equipment developments for the manufacturing and assembly of display panels and display components.

Display Measurement: Characterization and measurements of displays and display components.

Display Systems: Novel integration of displays into specialized devices, as well as system-level aspects of electronic displays.

Emissive Displays: All aspects of emissive displays, including PDPs, field-emission displays, light-emitting diodes, quantum-dot displays, inorganic EL displays, and field-emission lamps. Advances in materials and processing of such devices including phosphors, quantum-dot materials, and field emitters are also sought.

e-Paper and Flexible Displays: All aspects of e-paper and flexible-display technologies, including organic electronics and printed electronics, e-paper covers electrophoretic/electrochromic/electrowetting displays, flexible Ch-LCDs, and other novel reflective displays. The scope is to capture display and display components related to paper-like display technologies on novel materials. Advances directed at the development of substrates, fabrication, transistors, printing, and novel deposition techniques, drive techniques, electro-optical effects, devices, manufacturing, and applications for flexible-display technology, electronic paper, and emerging display technologies are sought. Work focusing on materials is also welcome. This interdisciplinary topic will highlight emerging technologies outside the paradigm of established LCD technologies.

Liquid-Crystal and Other Non-Emissive Displays: Advances in the development of liquid-crystal and other passive-matrix displays, including electro-optical effects, materials, and devices.

Organic Light-Emitting Diodes (OLEDs): Papers are sought on display design and performance of small– to–large-area panels, including OLED displays utilizing poly-Si, a-Si, microcrystalline silicon, CMOS crystalline silicon, and emerging areas of organic TFTs and mixed oxide transistors, including ZnO-based materials. Papers that discuss the progress and challenges for OLED display performance and manufacturing issues as compared to LCDs and plasma displays are of particular interest. Furthermore, papers on OLED signage and OLED lighting solutions are welcome.

Projection Displays: Applications for projection displays continue to grow as they continue to dominate the large-screen market and become more common even for small images. Authors are invited to submit papers on all aspects of projection displays, including components, finished projectors, complete projection systems, and projection applications. Projectors of all types will be covered, including pico/micro/nano projectors, mainstream projectors, large-venue projectors, rear-projection-based cubes, short-throw projectors, consumer rear projection, and other designs for specific applications. Components of interest include microdisplays (SLMs), light sources, optical components, projection screens, etc.

Touch and Interactive Displays: Advances in touch-screen technologies, applications, driving electronics, system integration, and human interactions. The advanced materials and process technologies associated with touch design and applications will be also covered.

As part of the technical symposium covering the broad range of information-display topics listed, SID 2012 will feature topical sessions which focus specifically on selected issues or key developments. Paper submissions are welcome for any of the general symposium topics or for any of the specific topical sessions described below.

ACTIVE-MATRIX DEVICES

Fine, Slim, High, or Wide: At the Physical Limits of Active-Matrix Displays

Developers of active-matrix displays continue to push the limits of the physical design and manufacturing on both small and large extremes. Papers are solicited on displays at the limits of our design and fabrication abilities.

- Ultra-High-Pixel-Density Active-Matrix Displays; those with resolution greater than 300 dpi (pixels < 85 μm).
- Ultra-High-Addressability Active-Matrix Displays; those with greater than 4000 lines.
- Ultra-Slim Active-Matrix Displays; those with very slim borders (relative to the total display size).
- Ultra-Large Active-Matrix Displays; those with diagonals greater than 70 in. (> 1.78 m).

Oxide TFTs and Display Circuits

Oxide-semiconductor technology is emerging as a strong competitor to thin-film silicon technologies for active-matrix backplanes. However, there are several critical issues related to oxide materials and these are associated with the overall characteristics of mass-produced devices, including stability (over time, temperature, and light), uniformity, mobility, *etc.* Clearly, to be viable these devices need to be made at costs comparable to that of conventional Si-based TFTs. Papers related to oxide-based TFTs and displays driven by oxide-based TFTs are solicited.

Sensor-Integrated Active-Matrix Devices

Active-matrix displays with in-cell touch sensors have recently become important. Papers that advance the state of the art of active-matrix displays with integrated sensors are solicited. Moreover, flat-panel image sensors can be manufactured with processes similar to those for active-matrix displays. They are used for medical x-ray imaging and other sensor systems, including embedded sensors (*e.g.*, image sensors integrated inside an LCD panel and an ambient-light sensor using some display pixels). Papers that describe the process, design, pixel circuits, and readout electronics for achieving the required performance and wide dynamic range are solicited.

High-Frame-Rate Driving for Field-Sequential-Color and 3D Displays

Field-sequential-color displays are of considerable interest because of their high efficiency and low power. Similarly, field-sequential stereo 3D displays are of considerable interest for 3D TV. Both these displays require high-frame-rate driving. Papers on technologies and active-matrix backplane architectures for high-frame-rate driving for field-sequential-color and field-sequential 3D displays are solicited.

Novel TFTs and Processing Techniques

The growing emphasis on higher-quality displays has led to numerous development efforts for devices, driving circuits, and techniques. Papers are invited which address new device structures, active-matrix driving methods, and the resulting improvements in the following display characteristics, including image enhancement, gray scale, power consumption, response time, contrast ratio, lifetime, driver cost, *etc.* Papers addressing a novel pixel structure coupled with a required new driving scheme are especially encouraged.

Active Matrix for Flexible Displays

Active-matrix displays produced with low-temperature processes on flexible substrates can provide increased durability, better shock resistance, decreased weight and thickness, and unique product shapes. Active-matrix-display contributions are sought on low-temperature a-Si:H, poly-Si, oxide-semiconductor, and organic TFT devices on flexible-substrate material. These contributions may include process issues such as chemical compatibility or dimensional-tolerance control due to shrinkage, compaction and/or warping, substrate material, and cost.

Ultra-Low-Power Active-Matrix Displays

Ultra-low power consumption is extremely important for any portable displays, including handhelds and notebook PCs. Ultra-low-power technologies include, but are not limited to, super-high-aperture TFTs, high panel transmittance, highly efficient backlighting, dynamic backlighting, low-V_{th} LC material, charge sharing or recycling, step charging, new driving schemes, low digital voltage, bistable display devices, pixel memory, partial updating, highly reflective displays, *etc.* Papers are particularly encouraged in this area.

New AMOLED Pixels and Backplanes

Organic LEDs have been a focal point in the display industry because of their superb image quality and slim form factor. However, AMOLEDs must overcome the following obstacles in order to achieve high-volume production: differential aging, image burning, power consumption, backplane consistency, manufacturability, and cost. Progress is being made on many of these fronts and on improving maximum brightness for daylight readability. Papers related to AMOLED technologies, such as pixel structure, circuitry, and driving scheme, with an emphasis on its backplane advances, are solicited.

Active-Matrix Mobile Displays

Active-matrix displays are enjoying rapid growth in smart phones, e-Readers, tablets, and other handheld applications. Special requirements for mobile displays include low power consumption, sunlight readability, slim form factor, image quality, and video performance. Papers on advancements in active-matrix mobile displays using all types of display media including AMLCDs, AMOLEDs, electrophoretic displays, electrowetting displays, photonic crystal pixels, and MEMS pixels are solicited. Contributions are particularly sought on novel pixel designs and addressing and integration methods for handheld displays.

System-on-Glass (SOG)

The high performance of new TFT processes (LTPS, of course, and now even a-TFTs) enables the monolithic integration of analog and digital display driver circuits as well as other peripheral functions on the active-matrix-display substrate. The resultant display modules have increased display functionality, performance, and reliability. Papers that advance the devices, circuits, or

systems that allow for integration of row and column drivers, controllers, D/A converters, dc-to-dc converters, *etc.*, into active-matrix backplanes are solicited. Issues to be addressed are yield and performance of these advanced circuits, as well as their integration in display systems.

Solid-State Lighting

The solid-state-lighting market has been gaining momentum against incandescent and fluorescent lighting and is expanding its realm from backlights for displays, billboard displays, flashlights, and small-sized specialty lighting into mainstream markets for home and office bulb replacements, street lighting, and automotive headlamps among other applications. Energy efficiency, minimal heat, and long luminance life have been driving these markets despite the higher costs. Furthermore, solid-state-lighting technology advancements are permitting users more choices of illumination spectrum and even color-adjustable lighting. Prices have been coming down rapidly, further accelerating market growth. The U.S. Department of Energy has been encouraging solid-state-lighting technology and product growth in a variety of general-lighting focus areas, and many new product categories have begun to enter the market. How will the technical issues of thermal management, improved reliability, and power supplies currently being addressed affect the development and deployment of higher efficiency and lower-cost LED and OLED solid-state-lighting applications? What new product designs and applications will be made practical by super-long-life lighting products (*e.g.*, products not designed for bulb replacement) and how will the CFL, LED, OLED, and other solid-state-lighting technologies likely play out against each other?

Touch and Interactive Display Applications

Touch screens have become common place from grocery check-outs to handheld phones, covering a broad range of industrial, commercial, and consumer applications. It has been estimated that the market for touch screens has been growing over 10% CAGR. Touch screens are now being adopted in home computers and laptops. Unseen applications might arise outside the current scope. What are some of the likely new market applications, and what not-so-obvious novel applications for touch screens might be coming? What technologies best fit some of these growing applications?

3D, Stereoscopy, and Holography

Three-dimensional display systems are currently in use in medical modeling and CAD applications and are continuing to evolve and seek new markets. Major entertainment studios are currently pushing 3D content, opening the door for a new cinema experience. How is 3D or stereoscopic imaging impacting entertainment and gaming? The television industry is following suit at the heels of the movie industry. What is the likely path by which this technology will be implemented and what are the current barriers to mainstream product applications? What is necessary for 3D to become a "must have"? Holography has also been quietly finding increasing applications over the past several years. What are some of these new instrument and imaging applications, and what are the technology solutions and potential killer applications needed for holography to reach into the mass markets other than non-video images on novelty items and product packages?

Environmentally Friendly (Green) Displays

Display technology has been advancing to provide better resolution, larger size, and performance for less cost. Energy efficiency becomes especially important for large-screen and, on the other hand, mobile applications. Materials of construction and end-of-life disposal have already created major issues for CRTs already, so how do we make the new displays more environmentally friendly at end-of-life? The continually changing and varied regulations around the world to protect the environment can be challenging. Will shifting from mercury-containing CFLs to solid-state-lighting backlights or OLEDs improve customer acceptance of "green" displays? How will consumers relate product price to energy savings, except as it affects mobile-product battery life? What are the anticipated initial production and end-of-life issues for the display industry and how can these be better addressed? Will there be new display applications to replace non-display means of information dissemination with new, environmentally friendly displays?

Mobile Displays (Smartphones, Tablets, e-Readers, etc.

With flat-panel-display technology becoming increasingly mobile, the need for improved energy efficiency and ruggedness also becomes more important. Applications already range from many types of handheld devices and laptop computers to electronic reading devices and micro-projectors. Most applications are moving toward higher resolutions and higher performance, creating unique issues to be resolved for small-format displays and virtual-image applications as pressure mounts to create more energy-efficient devices. What are the hottest "emerging" mobile-display applications? What new requirements must be satisfied to drive current displays through their next developmental steps for existing applications at higher added value to customers? What are probable future power requirements per square centimeter by application? How will improved mobility play out in entertainment and games? How to differentiate displays and avoid becoming a commodity in the future market?

Near-to-Eye Displays

As we reach the practical limits of data content on our handheld devices and as laptops get smaller for improved portability, a thirst remains for more data content and higher resolutions driven by increasing bandwidth, faster processors, increased memory, and high-definition movies becoming mainstream. Near-to-eye displays offer a way for users to see large, high-definition images in the smallest format package. The information-display capabilities of PDAs, HMDs, cell phones, and handheld games, to name a few personal display applications, are expanding rapidly. Full-color improved-performance 3D head-tracking compatibility for surround-view and reduced cost are key display parameters to support the growth of the personal-electronics markets. What technical market and consumer-perception hurdles are needed for near-to-eye applications to move from mostly military and medical applications and become true consumer products?

Virtual and Augmented Reality

Virtual reality (VR) has been thought of as the ultimate display technology for over 30 years. Augmented reality (AR) has the power to overlay data and even animation over your view of the natural world. Both VR and AR are best when combined with visualization, tactile, and other feedback mechanisms. Many attempts have been made, and some reasonable levels of success have been achieved in simulators and head-mounted systems, especially by the military. Still, practical virtual-reality systems for the

home PC platform have eluded the typical consumer. What is the status of the technology and what advances are on the horizon? What are the primary barriers to mass-market implementations of VR and AR? What are some of the most likely initial commercial and consumer applications? When might we see market entries? What is the market potential for various less-glamorous near-term applications?

Avionics, Military, Automotive, and Ruggedized Display Applications

Demands for greater functionality in automotive military and avionics displays are growing. Other outdoor applications require special displays or ruggedized commercial displays. Full-color wide-screen formats, headset and see-through displays, flexible displays, higher resolution, and increased brightness and contrast, as well as lower costs, are needed to meet these demands. How are we approaching the utilization of new and enhanced display technologies to meet emerging vehicular applications? What applications drive the development of advanced displays for avionics and automotive use? What display technologies are most suitable for harsh conditions? What new applications and environments are and can, in the future, be available for displays when suitably engineered devices are available?

Kiosks, Signage, Transparent, and Tiled Displays

Papers on the application of mid- or large-sized displays for signage, kiosks, or advertising and information messages are solicited. The technology can be LCD, OLED, plasma, projection (rear or front), or any other evolving technology. The application can on one hand involve a monolithic display or a transparent screen, or on the other, several tiled flat-panel displays or projected images. Applications can be for indoor, outdoor, or bright illuminated indoor conditions. Papers on the tiling of displays with seamless abutting for command-and-control rooms, for example, are also solicited. What is coming next to excite us, and how far will electronic signage likely penetrate our supermarkets, malls, buildings, and roadways?

Digital Cinema, Entertainment, Gaming, and TV

The era of e-cinema is upon us, with major studios releasing their features in digital form. The possibility for major cost reductions in digital production and distribution may restructure the entire industry. We are now seeing some of these transmission and media formats being implemented. Flat-panel TVs are now available at affordable prices, and viewing area and performance are steadily improving. What will be the future of entertainment and gaming displays? Which display technologies will share in these markets? How might they be implemented? Which will dominate and in what time frame? Digital cinema is an opportunity to make optimal use of the strengths of digital display technologies. Multiple commercial and home-cinema applications exist. What are the best solutions to the data transmission and presentation issues? How to improve stereoscopic 3-D in future of digital cinema? What new features can be provided to improve the entertainment or communications experience?

Medical Displays

Displays are broadly used in the medical profession to enhance information transfer and access medical histories, to enable broader use of "telemedicine," and to enhance diagnostics. The full range of emerging medical-display products and systems, from head-mounted systems to aid in surgery to high-resolution displays for x-ray diagnosis, will be discussed. What are likely formats for the role for 3D in tomography imaging and endoscopy? What new applications are enabled in medicine by adoption of advanced display technology?

Multi-Modal Display User Interface (*e.g.*, Auditory Displays)

Displays for mobile applications, tablets, PCs and entertainment are using interactive man-machine interfaces. Whereas personal information devices (PIDs) use single touch, smartphones and other mobile applications use multi-touch and gestures interactivity such that touch has become the dominant communication means to the devices. Recently, other modes of inputs are progressing such as voice (auditory displays), gestures, and facial expressions (coming soon). Any mode of multi-modal displays, including "out of the box" concepts, will be considered for this category.

Display Software Applications (*e.g.,* image enhancement)

Some applications of displays require enhancement of the displays performance. Increasing the number of gray levels and controlling their separation is one way to do that. Methods of dynamic backlight and algorithms of controlling gray levels will be part of these applications. Motion-blur compensation for LCDs and image-enhancement techniques for quasi-static displays are becoming differentiating aspects in mobile markets. Optimization in variable ambient lighting conditions or image-processing methods such as edge enhancement will improve the visual experience. The use of dynamic backlights is a method to improve contrast and save energy, involving different methods and algorithms. Combinations of hardware, firmware, and software to improve image properties are welcome for this category.

Novel and Emerging Applications

Novel, emerging, and/or other unique display-related technology can offer an opportunity to solve issues that many may not even realize as issues until a solution is presented. What unique imaging applications can be brought to reality and what opportunities exist for displays and virtual imaging that have eluded the common path of display technology development? From microdisplays and handhelds to wall displays to projection systems, all sizes and approaches are of interest. All areas of display technology applications from point-of-sale information screens to advanced social media enablers belong in this category. In particular, display-related technologies might have non-display applications, some of which to date have been revolutionary. What new applications are enabled for technologies that stem from display industry?

APPLIED VISION / HUMAN FACTORS

Stereoscopic and 3D Display Perception

Current stereoscopic or 3D display technologies and content often provide visual cues that differ significantly from the visual cues in our natural viewing environment. Submissions which discuss the impact of 3D and head-mounted display technologies on viewer performance, engagement, enjoyment, comfort, and fatigue are encouraged. Included are proposals and evaluations of novel evaluation techniques, novel technologies for improving specific aspects of the human experience, and studies quantifying the effect of display parameters, system configurations, content-generation technologies or 2D–to–3D conversion algorithms on user performance when using stereoscopic and 3D displays.
  • Methods for quantifying comfort and eye strain
  • Methods for quantifying the usefulness of 3D
  • Novel technologies for improving the human experience

- Evaluations of display parameters and system configurations on user performance
- Evaluations of the interaction of display parameters with content generation or 2D–to–3D conversion methods

Lighting and Adaptation

Submissions are sought which explore the impact of display illumination, interactions of ambient and display illumination, and novel methods for producing luminance from a display on user performance and comfort. Of particular interest are papers that discuss the interaction of a display with the ambient-lighting environment. Submissions should concentrate on the design and evaluation of illumination sources for enhancing the human experience. Included are models and metrics of human perception, novel system designs that demonstratively enhance the impact of these systems on user performance and comfort, and studies quantifying the effect of lighting and illumination conditions on the user experience.

- Perception of displays in dynamic or bright ambient conditions
- Design of display lighting systems based upon user performance models and metrics
- Impact of ambient conditions on display performance
- Evaluation of the impact of display lighting systems on human performance

Display-Centric Interaction

Advances in touch screen, gesture, and haptic systems provide the user the ability to interact directly with displayed information. Submissions are sought which discuss advances in user interaction paradigms and advances in input devices, which improve user performance. This area further includes development and evaluation of interaction paradigms involving the impact of cross-modal display or sensing technologies. Submissions within this area are expected to explicitly demonstrate the impact of the relevant technology on user performance, enjoyment, engagement, or comfort.

- Development or evaluation of user paradigms involving touch, gesture, and haptic input
- Cross-modal interaction (display or sensing of touch/sound/smell with visual information
- Usability evaluations or comparisons of display-centric input devices

Display Perception and Image Quality

Papers are sought discussing all aspects of display perception and image quality. Topics in this category include papers concerning color management, models of human tone and color perception, perception of high-dynamic-range displays, image-quality metrics and human-vision models, and impact of video artifacts on display quality.

- Models of human tone and color perception, including color-appearance models
- Quality management in the imaging chain (*e.g.*, from camera to display)
- Color management, including gamut expansion and gamma
- Perception of high dynamic range
- Image-quality metrics and human-vision models
- Impact of video artifacts on perceived quality

Display Drivers, TCONs, and New Driving Schemes

Despite the maturity of matrix-driven displays, there is no limit to improvements in the driving convention, particularly with new demands such as high refresh rate and large-area driving, high bit-depth, and crisp rendition of moving images. In addition, emissive displays, such as LEDs, PDPs, OLEDs, and FEDs, have some major advantages over non-emissive displays, such as LCDs and LCoS displays. However, these displays require different driver performance and driving schemes than non-emissive displays. Papers should cover the advancements in drive schemes, intra-panel interconnects, and novel features, architectures, or circuits of driver and timing-controller ICs required to provide the best image quality for various types of displays.

Driving Schemes, Algorithms, and Systems for Low-Power and Low-Cost Systems (Green Technology)

The need for lower-power displays has been the major driving force behind the development of many FPD technologies, mainly in the portable/mobile display area. But low power is also gaining importance in large-display applications while display performance requirements are intact or required to be even better. Besides, low-power mobile applications present constraints for display-system design that is entirely different from most other applications. This leads to ICs that are designed specifically for mobile displays, dealing, for example, with different display specifications, a broad application space, optimizations for varying ambient conditions, micro-power circuits for systems with super-low-power reflective displays, and, of course, low cost. Papers are solicited that deal with system architecture, interface design, and driving circuits and algorithms that will reduce display power consumption and implementation cost, as well as the latest developments in mobile-display electronics, ranging from ICs and system integration to specific electronic components.

Advanced Driving Scheme and Architecture for Higher Resolution Displays

Displays with resolution that is higher than F-HD (1920×1080) have been one of the biggest issues for next-generation TVs and mobile devices. Displays are evolving to have more image contents. Newly generated issues need to be solved to implement displays with the higher resolution. Papers are solicited that deal with system architecture, interface design, and driving circuits and algorithms that will enable higher-resolution displays regardless of the display size.

Advanced Driving Scheme and Architecture for AMOLED Displays

AMOLED displays have been greatly improved and have impacted mobile applications. Moreover, panel makers are focusing on large-size television applications of AMOLED displays. They are facing many issues, such as V_{th} compensation, low-power operations, 3D applications, high resolution, large-size implementation, *etc.* Papers are solicited that deal with system architecture, interface design, and driving circuits and algorithms that will enable higher-resolution displays regardless of the display size.

Color-Correction and Gamma-Tuning Technologies for Better Optical Performance

Because both television and new computer operating systems are placing new demands on unit-to-unit color and gamma accuracy,

there are numerous schemes emerging that provide solutions. Moreover, users typically prefer some form of color enhancement, but this enhancement also requires good control of the displayed color. And, also, the measurement and LUT programming speed per unit basis affects product throughput significantly. Especially the emergence of non-standard (wide) color gamuts and multi-primary displays pose new challenges for color conversion, enhancement, and control. Papers are solicited that describe improved electronics or algorithms (optimizations) and simplified and fast measurement methods related to color and gamma control.

High-Refresh-Rate Displays for Motion-Blur Reduction and 3D Display Implementation

Demands for higher-refresh-rate displays have been focused on motion-blur reduction in the past. But nowadays, a 3D display system also demands a higher-refresh-rate system to transfer and display multiple sub-fields. Papers are solicited that deal with interface technology, panel driving scheme, image processing, artifact-free algorithms, and display/platform architecture.

Video and Image Processing

Image quality remains the most important market driver for any display application, and it can be optimized by improving the display as well as by applying suitable image- and video-processing algorithms. This processing depends on the nature of the content as well as the characteristics of the display used. Papers are solicited that address general or display-specific video-processing algorithms and circuits. General processing includes, but is not limited to, MPEG (de)coding, noise reduction, de-interlacing, scaling, contrast, sharpness and color enhancement, and frame-rate conversion. In particular, papers are solicited that go beyond this general video and image processing and address various display-specific aspects, such as motion-artifact reduction, viewing-angle improvement, lifetime improvement, *etc*.

Backlight-Control Electronics

Over the past several years, the LCD backlight has evolved to an advanced adaptive component that results from highly co-optimized design with the LCD panel. In particular, LED backlighting has prevailed not only for notebook displays, but also for TV applications for higher contrast, motion-blur reduction, and ultra-slim module design. Papers describing these novel backlight driving technologies and slim module design for any type of lighting device are solicited.

High-Dynamic-Range Technologies

Ongoing advances in panels and backlight technologies have dramatically increased display contrast ratios over the past years. This has led to the new area of high-dynamic-range technologies, which presents numerous new challenges and opportunities to optimize the quality of information display. Moreover, this is a highly multi-disciplinary area that requires expertise from display-system design, signal processing, and human-vision science. Authors are encouraged to submit electronics-related papers specifically in the area of high-dynamic-range display systems. This can range, for example, from driving-circuit design to image-processing algorithms, or from image acquisition to advanced drive schemes.

System-on-Panel and Integrated Circuits on Panel Using TFTs (a-Si:H, LTPS, HTPS, oxide TFTs , *etc.*)

More and more driving circuitry is integrated into the panel fabrication itself, specifically for row drivers. And, also, integrated row drivers consume more power than standalone drivers due to high clock voltage swing with heavy capacitive loading. Papers should address the design and performance of integrated drive circuits for flat-panel displays using all types of TFTs including amorphous/poly-crystalline/single-crystal silicon TFTs, organic TFTs, and oxide TFTs, *etc.*. Papers dealing with architectural and system-partitioning issues, yield and cost impact, low-power circuit structure, vertical stack-up for less capacitive loading, and performance limitations as well as detailed circuit design approaches are encouraged.

Electronics for Emerging Displays

New display principles keep emerging, sometimes addressing new market segments, and sometimes directly competing with established technologies. Typically, a different display technology also requires a different drive scheme and corresponding electronics. Papers are encouraged that describe the challenges and solutions that are found while developing electronics for emerging display technologies.

DISPLAY MANUFACTURING

Advances in Manufacturing Materials and Processes (including Thin Glass, Roll-to-Roll, Ink-Jet Printing) to Enable New Applications as well as Cost-Down of OLED TVs and 3D Displays

The advent of new display technologies, form factors, and the incorporation of added functionalities in the display mandate the development of new materials, processing equipment, and techniques. These sessions will focus on the manufacturing developments enabling new display applications such as 3D displays, large-sized OLED displays, transparent displays, sensor-integrated display panels (*e.g.*, touch sensing, optical sensing, *etc.*), as well as novel approaches for manufacturing of existing displays or display components.

Manufacturing of OLED and Other Emissive Display Panels (including PDPs, PLEDs, ELs, and FEDs)

These sessions will cover advances enabling the manufacture of emissive displays. In particular, papers on lowering manufacturing costs of OLED panels are encouraged - equipment, process, and materials advances as related to TFT backplanes, pixel-array fabrication, high-resolution patterning, packaging solutions for ensuring long lifetime, *etc.* More generally, manufacturing investigations or analysis papers relating to other emissive technologies, such as PDPs and other technologies, are of interest. The future success of the new emissive technologies requires the development of robust, cost-effective manufacturing processes to yield defect-free displays at competitive prices.

Manufacturing of AMLCDs and Other Non-Emissive Display Panels (including LCOS, MEMS-based displays, other LCDs, *etc.*)

Papers are solicited on topics related to manufacturing of active-matrix backplanes, including innovations in traditional a-Si and poly-Si, as well as in the newer area of oxide TFTs. Examples of manufacturing innovations include process and equipment optimization, mask/complexity reduction, TACT time or yield improvements, and reduction of materials consumption. In addition, the logistics of substrate handling and processing, and overall factory layout, present significant manufacturing challenges. In addition to

the above topics, papers describing advances in the manufacture of other non-emissive displays, such as DLP and other MEMS-based displays, are solicited.

Manufacturing of E-Paper and Other Reflective Displays (such as Electrophoretic, Electrowetting, Electrochromic, and direct-view MEMS-based Displays)

Papers are solicited on topics related to manufacturing of rigid as well as flexible reflective displays. Particular areas of interest include pixel-array manufacturing and packaging/encapsulation solutions. Additionally, papers describing advances in materials, processes, and equipment that enabling high volume manufacturing for this newer family of displays are encouraged.

Display Manufacturing Processes in Display Panel Assembly, Encapsulation, Interconnect, and Packaging, as well as Display Module Assembly (Bonding with Cover Glass, Touch)

Emissive, non-emissive, LCOS, DLP, OLED, FED, reflective, and MEMS displays, as well as other display types each have different manufacturing assembly and packaging requirements. Papers describing display module assembly, including plate-to-plate alignment and encapsulation techniques, interconnect technologies such as ACF, and other flex and chip attach methods will be addressed in this session. Further, papers are encouraged on materials, processes, and equipment topics that enable high volume assembly of display panels in the final stack configuration, which could include touch panels, cover glass, *etc.*

Display Materials including Substrates, Films, Adhesives, and Consumables

Material developments to support the efforts of the display manufacturer are appropriate topics for these sessions. These topics include new substrate materials, properties, and handling methods; improvements in consumable materials such as photoresist and sputter targets; and performance-enhancing materials such as sealing frits, dessicants, polarizers (including film and coated polymer types), and optical enhancement films. Of particular interest are papers dealing with materials for roll-to-roll and printing processes that relate to manufacturing improvements and manufacturing analysis.

Manufacturing Equipment for Front- and Back-End Processing, including Packaging, Encapsulation, Interconnect, Assembly, and Roll-to-Roll Processing

The advent of new display types, sizes, and features mandate the development of new processing equipment and techniques. These sessions will focus on the development and application of new designs or unique adaptations of equipment for the manufacture of displays. Possible topics include equipment advances in the areas of robotic handling, thin-film deposition and patterning, roll-to-roll printing, and flexible films, spacer construction, and/or application. Papers applying methods of printing to display manufacturing are encouraged.

Inline Manufacturing Test, Repair, and Metrology

Papers addressing final assembly, test, and repair are subjects of these sessions along with in-line testing and production-yield monitoring. Papers are requested covering technology advances for the manufacturing and handling of very large AMLCD and PDP glass substrates and how this relates to both equipment and factory design, impacting test and repair methods, and yields. Testing of smaller displays such as for the cell-phone market may have a different set of manufacturing test requirements; advances in these areas for yield improvements, new methods, and cost reduction techniques are also encouraged. Also of particular interest are developments in the areas of automated optical inspection (AOI) and array repair.

Manufacturing Productivity

The advent of new display types, sizes, and features mandate the development of new processing equipment and techniques. These sessions will focus on the development and application of new designs or unique adaptations of equipment for the manufacture of displays. Possible topics include equipment advances in the areas of robotic handling, thin-film deposition and patterning, roll-to-roll printing, and flexible films, spacer construction, and/or applications. Papers applying methods of ink-jet printing to display manufacturing are solicited.

DISPLAY MEASUREMENT

Optical Characterization and Measurement of 3D Displays

All aspects of traditional display characterization must be taken into consideration when describing the performance of 3D displays, but additional qualities related to or influenced by the 3D features of this type of display are manifest. Authors are encouraged to submit papers that are unique or of special interest to 3D display characterization.

Optical Characterization and Measurement of Touch-Enabled Displays

Touch and other gesture-input devices are becoming a more prominent part of display systems in a variety of applications. Many touch technologies, however, impart various levels of optical impact on display-system optical performance. The impact includes spectrally varying absorption and reflection which effect luminance, contrast, and color as well as haze and diffusion which effect display MTF and clarity. Papers are solicited that address the optical characterization of touch technologies and their impact at the systems level.

Characterization of Perceptible Display Phenomena

The vastly different physical properties of the various display technologies and types (*e.g.,* LCDs, OLEDs, projectors, reflective, flexible, curved, *etc.*) make it very difficult to design equivalent characterization methods. Papers are solicited which propose and evaluate measurement methods for comparing the perceived performance between display technologies in similar applications in repeatable and understandable ways. Papers on characterization of phenomena such as motion artifacts and perceived daylight contrast, for example, which are strongly dependent on the display technology used, are welcome.

Latest Advancements in Display Measurements and Display-Measurement Standards

With the release of the ICDM, as well as continuing contributions from other organizations such as ISO, IEC, and CEA, the field of display measurement is experiencing a resurgence of new methods and concepts to address difficult problems. Authors are encouraged to submit papers which explore the performance and correlation of proposed methods from any current or future international standard.

Optical Characterization and Measurement of Display Materials and Components

All forms of display technology continue to benefit from advances in materials and components, such as light-steering films, polarizers, color filters, glass coatings, diffusers, touch screens, EMI filters, *etc.* Utilizing these advanced components requires proper optical characterization and a thorough analysis of the completed system in which the components are installed. Authors are encouraged to submit papers which demonstrate how these materials and components can be properly characterized and any advances in measurement technology and techniques that have evolved.

Optical Property Modeling of Display Technologies

Each new type of display requires optical measurements to demonstrate its performance. Usually, numerical models are produced to aid the design process. Papers are solicited which explore the theory of these optical models and then correlate the models against measured results. Authors should carefully describe the physical measurement methods as well as the model details.

Evaluation of Measurement Methods for Display Applications

Demanding applications such as TV, medical imaging, and professional graphics impose unique demands on the chosen displays and the methods used to characterize their suitability. Certain display types such as projection and near-to-eye displays use complex optical systems that require unique characterization considerations. Authors are encouraged to submit papers that explore the performance of accepted measurement methods and evaluate the correlation of these methods to real-life acceptance in situ.

Calibration and Verification of Instrumentation

The field of display metrology continues to benefit from the growing number of instrument developers, along with the ever increasing range of instrumentation designs. Along with this opportunity comes the challenge of verifying the accuracy and trace ability of new instruments, as well as their suitability for a given task. Authors are encouraged to submit papers which describe their recent work in calibrating, testing, and validating new instrumentation.

DISPLAY SYSTEMS

3D, Stereoscopic, Volumetric, and Holographic Displays

Cinemas with stereoscopic projection systems and stereo movies are making record-setting box-office returns. Success in the cinema is creating a demand for stereoscopic home theaters. Stereoscopic displays present two images with binocular disparity, increasing the perception of depth in a scene. Autostereoscopic displays enable glasses-free stereo viewing, and multi-view autostereoscopic displays can provide motion parallax as an additional depth cue. Directional backlights with temporal switching can maintain the full spatial resolution of the panel. Volumetric and holographic displays can create a more accurate light field with correct vergence and accommodation cues, but present a number of technical challenges. Papers are solicited across the full spectrum of 3D display technologies, with particular interest in reduction of cross-talk, improved luminance uniformity, reduced distortion for multiple viewers, reduction in system cost, volumetric or holographic display technologies, as well as approaches to manage the computational load of voxel or holographic data, such as methods to reduce the complexity of 3D images without causing cue conflicts in the visual system.

Wearable, Near-to-Eye, and Augmented-RealityDisplays

In the design of mobile devices, such as cell phones, conflicting criteria are present: on the one hand, there is a demand for increased display size and resolution so more information can be presented; while on the other hand, there is a pressure to reduce the overall size and weight of devices and to increase battery life. Near-to-eye displays offer a compact and low-power solution that can provide large high-resolution imagery to users. Near-to-eye displays include bring-to-eye displays in advanced cell phones, compact systems for head-mounted displays used in mobile computing, electronic viewfinders for cameras, and personal theater systems. Other applications of near-to-eye displays, such as augmented reality, virtual reality, training/simulation, and computer gaming, demand higher resolution and greater field-of-view than mobile devices, yet reducing the size of these larger head-mounted displays is also a priority. Papers are solicited which address novel image sources, optical system designs, and integration of near-to-eye displays into these various devices.

Transparent Displays

As information displays become increasingly ubiquitous, transparent or see-through displays have the potential to enable new and innovative applications. Papers are solicited on transparent display technology and innovative display system designs that effectively integrate transparent displays for new applications.

Novel Displays

New and unconventional display systems of today are sowing the seeds for the products of tomorrow. From microdisplays to handhelds to wall displays to projection systems, all sizes and novel approaches are of interest. Papers are solicited that describe new-concept display systems and may include novel devices, integration, or image processing.

Display Systems

Display systems employ a variety of electronic devices to harness a man to a machine *via* high-bandwidth pathway. The devices are sustained by a wide spectrum of advanced components. Novel developments in display system elevate the quality of communication. Papers on new technologies for display systems, modification or improvements of existing systems, real-time controlling or monitoring of operations, and system evaluations are of interest and solicited.

Ultra-Low-Power Displays

Energy saving is a key issue for display technologies. Decreased energy requirements are vital for mobile applications that run on limited battery capacity. Lower power consumption is also critical for non-mobile display technologies, such as television, to conserve limited environmental resources. Papers are solicited that describe methods of energy saving in displays, reduction of power consumption during display operation, and related topics.

Gaming Displays

Rapid improvements in the performance of gaming systems push the limits of all common display characteristics. Specifically, systems must be optimized for reduced image blur and latency while providing increased refresh rates and resolution. Uniquely, displays for games have access to a broad selection of content that can be rendered with a large gamut, high dynamic range, and increased bit depth. Additionally, stereoscopic or even more advanced light-field-rendering techniques and systems for improved interaction are leading candidates for enhancing immer

sion in the games of the future. For portable gaming, power consumption, high ambient-light performance, and reduced module thickness and weight all demand the development of novel or optimized technologies. Papers that discuss these issues and present novel solutions are solicited.

Ultra-Resolution Home Entertainment Systems

With continued advances in digital cinema and networked connectivity to the home comes the exciting opportunity to introduce home-entertainment systems beyond HDTV (for example, UHDTV1-4K and UHDVT2-8K). This opportunity leads to challenges on display system design to handle increased rate of incoming information and deliver high-quality viewing experiences for both 2D and 3D content. Additional challenges exist in transforming existing professional-grade display solutions into packages suitable for home environment including ease of installation, low maintenance. and reasonable cost. Papers are solicited that describe display systems meeting UHDTV or other ultra-resolution requirements with emphasis on enabling technologies allow scaling to meet volume and cost targets for home market. Papers are also solicited that describe other critical aspects of the ultra-resolution ecosystem including data transmission and compression, color encoding, 3D technology, audio design, and standards required for widespread adoption. Finally, papers are sought to cover the particular challenges of high-frame-rate (120 Hz) ultra-high resolution.

Cell Phones, Music Players, eReaders, and other Mobile Displays

As we move toward an ever-more-connected society, mobile displays with increased size and resolution and improved optical parameters are becoming ubiquitous in smart phones, network-connected eReaders, a wide range of consumer and enterprise communicators, and mobile internet devices. All of these applications require low power, low weight, thinness, small overall volume, and increased mechanical durability while improving display visual performance. Unique system designs that improve and/or optimize any or all of these aspects of mobile displays are solicited.

Avionics, Automotive, Shipboard, Simulator, and Military Displays

With the advances in display technology, the latest avionics and automotive displays are constantly evolving with each new generation of manned and unmanned aircraft, ships, automobiles, and military vehicles to provide better human interfaces and new functions that increase safety, performance, and situational awareness. Modern aircraft, automobiles, ships, and military vehicles share common needs such as helmet-mounted displays (HMDs) and head-up displays (HUDs) for safety and enhanced performance, and navigation aids, such as GPS displays. High-quality on-board entertainment for passengers is also of interest for many vehicular systems. Papers are solicited which describe automotive, shipboard, simulator and cockpit display systems, multimodal interfaces, helmet-mounted displays, head-down displays, head-up displays, enhanced-vision systems, and synthetic-vision systems using highly innovative display solutions.

Signage

Signage represents a primary product category of displays, of equivalent importance to the categories of notebook displays, computer monitors, and TVs. Signage, also referred to as "public displays," can be seen in almost every public area indoors or outdoors. However, picture-quality improvement is needed in order for signage to be enjoyed everywhere, and operation systems need improvement for signage to be enjoyed anytime. Papers are solicited in the field of contrast and luminance improvement for outdoor application of signage, sunlight-readable signage, wide dimming capability, mechanically strong signage to protect from tampering and vandalism, signage with a wide operating-temperature range, effective ways of utilizing a screen for transmission of multiple sets of information, seamless multi-display signage, signage operation systems, and related topics.

Backlight Systems

Backlight designs for LCDs have been undergoing a rapid transition from fluorescent lamps to LEDs, driven by concerns for the environment, power reduction, thickness, and weight reduction. Papers, especially in the following areas, are solicited: (i) slim backlight design for LCD TV and monitors, and improvements related to efficiency and thermal management, (ii) thin, light, and flexible backlight design for mobile display devices, (iii) backlight design for extended color gamut, including the use of RGB LEDs and blue or UV LEDs with narrow-band color-conversion material, (iv) system design for real-time control to maintain color and brightness level over time, and (v) novel backlight systems.

Backlight Components

A wide range of applications for LCDs in cellular phones, notebook PCs, netbook PCs, and TV sets requires a variety of optical components for backlighting units. Moreover, environmental consciousness is now a key factor for all types of future LCDs; thus, maximized optical efficiency by minimized light loss is crucial. Papers on novel optical components are solicited, with particular interest in the following areas: (i) novel optical components that transform a point light source into a planar light source by means of collimation, diffusion, and diffraction including light-guide plates, film-type light guides, diffuser films, diffuser plates, light collimation films, and reflection films; (ii) novel optical components that integrate several functions into one, such as "multi-functional" films that combine multiple light-directing functions into one component; (iii) novel optical components that employ new architectures for lighting systems, *e.g.*, phosphor sheets combined with UV LEDs or blue LEDs; and (iv) any other novel optical components that employ unique optical characteristics to address the issues described above.

Dynamic Backlights / Local Dimming

To achieve power efficiency and a high-quality image on an LCD, real-time dynamic control of the backlight is indispensable. Advancements in LED technology have enabled the industry to move beyond static backlights, synchronizing the backlight with the LCD. The tight integration between LCD panel and LED backlight enables improved dynamic contrast, a reduced blurring effect created by fast-moving images, and, at last, reducing the power consumption of the LCD. Novel or improved technologies that relate to the control of backlights using RGB LEDs, pseudo-white LEDs, hybrids of old and new technologies, and related theory and simulation in each of the areas of optical, electrical, and mechanical design are solicited.

Color Sequential

Temporal color formation by sequentially integrating primary colors enable the removal of the absorptive color filter that is used in conventional spatial color formation. In conjunction with local-dimming approaches and multi-primary LED backlights, the power savings using color-sequential approaches can be substantial.

Papers which describe new concepts in color-sequential display systems, including novel devices, system integration, backlight design, multi-primary LCDs, and image processing, are solicited.

EMISSIVE DISPLAYS

Plasma-Display Panels

With strong competition from LCD TVs in the market and environmental regulations, the power consumption of PDP TVs is of prime interest of research and development. As its power consumption has been reduced by 20–30% annually over the last 5 years, it has reached a level comparable to that of competing devices. But further reduction in powder consumption is required to sustain the growth of the PDP industry. In addition to these aspects, the market of 3D TV is growing rapidly for home theaters in recent years. 3D PDP TVs are well accepted in the market due to their negligible cross-talk and affordability. For this application, its power consumption is still the issue, and new driving schemes are needed to increase the number of sub-fields for natural images. Finally, the manufacturing and materials costs should be reduced further for sustainable growth of the industry. Papers concerning subjects related to the science and technology of power consumption, driving methods, image quality, 3D PDP TVs, advanced materials, and low-cost processing are solicited.

Inorganic EL Displays

The development of efficient full-color inorganic EL displays has been in progress. New panel structures using highly saturated phosphors or color-conversion materials that realize full-color EL displays have been developed. Papers on inorganic EL phosphor materials and processing, EL device structures and modeling, color EL display design, fabrication techniques, performance characterization, and drive electronics are solicited.

Light-Emitting Diodes

Full-color super-large-area displays consisting of LEDs were brought into the marketplace due to the successful development of blue-emitting LEDs for wall and information displays. Papers that describe the science and technology of LED materials, phosphors for LEDs, and characteristics for display applications are solicited.

Field-Emission Displays

The majority of FED research has been on display applications. In recent years, however, new applications of the device, such as backlight units for LCD TVs, are being actively explored. Research and development of new emitter materials, cell design, and the advanced processing route of the device are expected to contribute to the success of such devices in the market. Papers concerning all forms of emitter materials and design, cell and spacer design, driving method and electronics, materials and processing related to FEDs, and field-emission lamps are solicited.

Phosphors and Quantum-Dot Materials

PDPs, inorganic EL displays, LEDs, FEDs, and CRTs are all light-emitting devices that use phosphors. Research and development of phosphor materials for these devices are expected to improve the light-generation efficiency, longevity, and reliability of such devices. Papers concerning the science and technology of phosphors and quantum-dot materials for these devices are solicited.

FLEXIBLE DISPLAYS

Electronic Paper

Electronic paper (e-Paper) combines the benefits of ink on paper with the rewritability of an information display. This category includes both rigid and flexible displays. e-Paper covers electrophoretic/electrochromic/electrowetting displays, flexible Ch-LCDs, and other novel reflective displays. Papers submitted in this category may cover topics such as new materials for e-Paper, characterization and measurement of e-Paper display performance, or integration issues specific to e-Paper displays. Backplane electronics, integrated drive electronics, drivers, applications, and user interfaces for e-Paper displays are included in the topic.

Flexible OLED Materials, Devices and Displays

Flexible OLEDs continue to be of high interest in the display community. Papers describing novel techniques enabling flexible OLED displays, flexible high-efficiency and robust materials, flexible encapsulation/passivation techniques and materials, manufacturing methods suitable for flexible OLEDs, and stable passive- and active-matrix flexible black-and-white, gray-scale, and full-color displays are particularly welcome. In addition, novel architectures for flexible OLEDs such as stacked and top-emitting OLEDs on flexible substrates, simplified device structures, and flexible OLEDs capable of enhancing optical extraction efficiency, etc., are solicited.

MEMS and Other Non-Emissive Flexible Displays

Liquid crystals are the most familiar non-emissive displays. MEMS technology is always important as micromirrors in projection displays, but novel emissive and non-emissive applications for direct-view mobile displays, e-paper, and signage are also under active development. Papers are sought on MEMS, electrophoresis, electrowetting, electrochromism, and other non-emissive technologies, as well as their associated materials for flexible applications.

Organic and Other Solution-Based Thin-Film Transistors (TFTs) and Flexible TFTs and Active-Matrix Backplanes

Organic TFTs are showing great promise as a potential low-cost TFT alternative to Si-based TFTs for a range of display applications, and particularly for flexible-display applications. To ensure success, these devices must show sufficient mobility, low leakage currents, acceptable on/off ratio, good uniformity, and especially good stability, both environmentally and under bias-stress conditions. Papers related to OTFT and printed-electronics performance and papers describing different displays driven by these technologies are solicited. Active-matrix displays produced with low-temperature processes on flexible substrates can provide increased durability, better shock resistance, decreased weight and thickness, and unique product shapes. Contributions are sought on low-temperature a-Si:H, poly-Si, oxide-based, organic, or new TFT processes and performance, flexible substrate material issues such as chemical-attack inertness or dimensional tolerance control due to distortion, compaction and/or warping, substrate material, and processing cost. Contributions are also sought on novel pixel designs, process, high integration, and addressing methods.

e-Paper and Flexible Display Materials, Including Substrates, Films, Adhesives, and Barriers

Material developments to support the efforts of flexible-display development are appropriate topics for these sessions. These topics include new substrate materials, properties, and handling methods; flexible barriers, improvements in consumable materials

such as photoresist and sputter targets; and performance-enhancing materials such as adhesives, polarizers (including film and coated polymer types), and optical-enhancement films. Assembly, module, and interconnect materials such as adhesives, desiccants, and ACF are included. Papers dealing with flexible films, roll-to-roll materials and processes, and ink-jet printing are solicited.

ntegration, Packaging, Testing, and Reliability for e-Paper and Flexible Displays

As new flexible display technology is developed for e-paper, OLEDs, and novel display technologies, key aspects of their commercialization will be the integration and packaging of these displays, and the reliability to both environment and mechanical stressing. Papers are sought that address these issues including package and driver designs, testing results, tools, procedures, and materials.

Flexible-Display and e-Paper Manufacture of and Equipment for Printed Electronics

As new technologies are maturing, novel equipment and processing methods are being developed to take advantage of new materials and substrates. This topic includes low-temperature processing of materials; roll-to-roll manufacturing, printed, and solution-based processing of electronic materials. Papers discussing advances in tools, materials, devices, and displays are sought.

Integrated Flexible Electronics

This includes comprehensive functional systems produced on flexible substrates which utilize organic, inorganic, or hybrid semiconducting materials. Papers on technologies like OTFT, memories, sensors, batteries, SSL, OPV in conjunction with an electronic display (electrophoretic, electrochrome, EL, OLED), its materials, process technology, assembly, functionality, and simulation are welcome.

LIQUID-CRYSTAL AND OTHER NON-EMISSIVE DISPLAYS

LCDs for Advanced Monitors and TVs

Papers related to large-area high-resolution LCDs for advanced monitor and TV applications, with emphasis on displays or key components, including the backlight, driving, and video-processing technologies for high-contrast ratio, high panel transmittance, wide viewing angle, low color washout, fast response, low moving-image blur, and high video qualities are solicited.

Blue-Phase LCDs

Optically isotropic liquid crystals, including polymer-stabilized blue phases, offer several attractive features for next-generation displays, such as submillisecond response time, no need for alignment layer, wide and symmetric viewing angle, and cell-gap insensitivity. However, some technical issues, *e.g.*, high operating voltage, wide temperature range, and hysteresis, remain to be solved before widespread applications can be realized. Papers addressing advanced materials, polymer-stabilization processes, device physics and performances, prototype development, photonic applications, and long-term stability are encouraged.

LCDs for Mobile Applications

Papers on improving the thickness, weight, size, robustness, flexibility, transmittance, contrast ratio, power consumption, sunlight readability, and SOG as well as value-added functions such as touch input, scanning function, direct writing input, TV on the go, and exploratory advances for mobile LCDs are solicited.

Bistable Displays/LC-Based e-Paper

Papers on bistable displays that offer many advantages of no or low cross-talk, high resolution, and low power consumption are solicited. They are ideal for portable and remote displays. Papers focused on the development and application of BTN, FLC, BCD, and other bistable LC technologies are also solicited.

Reflective/Transflective Displays

With the trend to ever-more portable and low-power electronic devices such as mobile phones, DSC, DVC, PDAs, e-books, games, laptops, small TVs, and DVD players, there is a growing need for reflective and transflective displays with improved visual performance. Many of these applications are demanding full-color video performance. Sunlight readability imposes a big technical challenge to mobile displays, such as cell phones, PDAs, and digital cameras. To overcome this issue, reflective, transflective, and high-brightness transmissive displays with adaptive brightness control have been proposed. However, the viewing angle, contrast ratio, color saturation, and color gamut of reflective displays are still inadequate. Papers are solicited to cover this important field from new device physics and materials, electro-optical effects, bio-inspired anti-reflection coating to touch-screen display systems in which all aspects of the visual requirements are addressed.

Ferroelectric/Antiferroelectric LCDs

Ferroelectric liquid crystals have demonstrated a wide variety of effects ranging from binary, bistable, analog, as well as three-state switching observed in antiferroelectric LCs. The microsecond switching speeds afforded by this class of materials have thus far resulted in the commercialization of time-sequential color displays with 24-bit color, with over 23 million cameras incorporating FLC microdisplays sold to date. Papers on the next wave of new displays and products based on FLC/AFLC technology are of interest. Other modes such as those based on the deformable-helix FLC (DHFLC) and SmA electroclinic effect are also welcomed. Papers that describe the latest advances in device fabrication, new FLC structures, modeling, alignment, other novel effects and driving methods for this promising class of materials are solicited.

Alignment and Photoalignment Technologies

Papers on new alignment and photoalignment materials, processes, characterization techniques, stability issues, mechanism, and modeling are solicited. New materials, methods, and manufacturing processes for AMLCDs, wide-viewing-angle LCDs, and defect-free LCDs are particularly welcomed.

Non-Emissive Displays for Digital Signage

Advertising and signage displays are moving increasingly from printed to digital media. Some technologies such as LED and projection displays are already well established in this area, but liquid-crystal displays designed specifically for signage applications have made major penetration in the last year because of their advantages in power consumption and ownership cost. Submitted papers are invited which address specific aspects of technologies associated with signage such as the ability to operate with adequate color reproduction and readability in both sunlit and zero ambients, optimized reflective and transflective technologies, optimum display and pixel size, the ability to tessellate displays into acceptable viewing surfaces, novel technologies to enable viewer interactivity, power efficiency, *etc.*

Microdisplays

Microdisplays are becoming popular in various applications. Handheld LED-based microprojectors are in the marketplace and video goggles have also established a stable market need. This session will focus on recent advances in LCOS, HTPS, as well as LTPS technologies, including panel design, LC modes, and optics. Papers on LED-based system integration are welcomed.

Fast-Switching LCDs

Fast optical response is an essential factor to improve the image quality of LCDs; in particular, for those requiring full-motion-video images without motion blur. It is also of great interest for field-sequential-color displays. Faster frame rate is the most practical method to reduce motion-video image blur in LCD TVs. The session discusses all aspects of fast response in LCDs such as LC materials, cell parameters and fabrication, display driving including over-driving schemes, and novel LC modes.

LCD Modeling

Modeling of LCDs often provides insight into the physics of observed display characteristics. This insight can lead to optimized or entirely new types of display devices. The session will focus on modeling methods and their application toward the understanding and optimization of LCDs. Submission of papers in this area are encouraged.

Wide Viewing Angle

Viewing-angle and gray-scale performances can be enhanced and color washout can be reduced by various means, such as new LC modes, cell designs, driving techniques, illumination |management and ray mixing, novel subpixel designs, improved materials, and optical compensation with films or of LC modes, such as TN, IPS, MVA, and OCB. Contributions on these topics are welcomed.

Display Films

Display films used for LCDs provide significant value and differentiation to display systems. Some films, including compensation films, brightness-enhancement films, light-redirection films, polarizers, mirrors, anti-reflection/anti-glare films, and privacy filters, have optical effects. Other films have functions such as static or thermal dissipation, EMI shielding, front-surface protection, and anti-fouling property. Papers on all films that add value to the LCD are welcomed.

LCD Materials and Components

Enormous efforts have been made to develop advanced materials and components, such as liquid crystals, polymer materials, and optical films, to improve the image quality of conventional LCDs as well as to develop novel LCDs. Display image quality is always required to improve further from a variety of aspects. Papers covering recent developments in materials and components for uses in advanced LCDs are solicited.

Nanotechnology for Non-Emissive Displays

The enhancement of the EO characteristics of LCDs by the doping of nanoparticles and the functionalization of surface alignment layers for LCs using nanotechnology are interesting and useful. Papers furthering this new era in LCD technology in terms of nanotechnology are highly welcomed.

Driving Mechanisms

The interaction between a display device and its drive electronics has long been a fruitful focus for research and invention. Clever addressing schemes underlie improved contrast in passive-matrix LCDs, faster updates of bistable displays, and accelerated switching and lower power in AMLCDs. Reports of new advances in this field are expected and welcome.

Photonics Optical Components for LCDs

Optical components play a very important role in LCD performance and functionality. Papers in the area of optical components that improve LCD performance or enable unique functionality are solicited; for example, retardation film, lens arrays, compensation film, and beam-splitting film.

Polymer Composites

Liquid-crystal/polymer composites have demonstrated very interesting properties, many of which are difficult to achieve with conventional liquid-crystal devices. Examples include large-area displays, flexible displays, and optical effects based on diffraction, light scattering, dichroic absorption, or isotropic to anisotropic transitions. This session will cover recent advances in nematic, cholesteric, smectic, and blue-phase liquid-crystal composite systems.

LC Technology for 3D

After years of development, 3D displays have become part of our daily lives. Papers on applications of 3D using various LCD technologies, such as fast polarization switching, beam steering, fast shutters, *etc.*, are welcomed. Related topics to 3D goggle design, direct-view displays, and projection displays are also solicited.

ORGANIC LIGHT-EMITTING-DIODE DISPLAYS

OLED TV Mobile and Large Area Applications

OLED-based displays have several unique attributes that continue to drive interest for television applications. As well, the explosion in portable video-capable devices such as tablets and smartphones place high demands for the displays. 3D television application puts a higher demand on display power, response times, and high dynamic range. Papers are sought that describe unique OLED display demonstrations that highlight the unique attributes of OLED architectures. In particular, papers are sought for OLED-based displays with unique attributes that include transparent OLEDs, high-resolution displays on novel active backplanes, large-area displays for TV. Papers covering materials (small molecule and polymer), devices, patterning, and unique drive schemes leading to television applications will be considered.

Novel OLED Materials and Architectures Enabling Emerging OLED Displays

Unique solid-state, low-process temperatures are enabling features for full-color flexible emissive displays. In addition, the OLED ultra-fast response times contribute to vibrant 3D displays. Papers describing enabling device architectures and robust thin-film encapsulation that lead to stable passive- and active-matrix flexible full-color displays are particularly welcome. Papers describing novel OLED architectures that contribute to 3D displays will be an important contribution to OLED sessions. Such device architectures may include top and bottom emitters that uniquely enable OLEDs on flexible substrates.

Active- and Passive-Matrix OLED Display Technology

Papers that discuss the progress and challenges for OLED display performance and manufacturing issues generally applied to active- and passive-matrix displays are of particular interest.

Emerging OLED Displays

Papers in the area of OLED devices with rare and exceptional characteristics such as polarized emission and transparency are sought. Papers addressing novel and robust materials and fabrication techniques are especially welcome. Such paper topics include large-area signage, unique passive addressing.

OLED Device and Materials Fundamentals

Papers in the area of OLED and polymer-OLED materials and device architectures with state-of-the-art performance in terms of color chromaticity, high power efficiency, and long operational lifetime at display level luminance are sought. Papers are solicited for novel techniques which enhance out-coupling efficiency of OLEDs. These include areas of microcavity, index matching, optics, simulation, and design of OLED microdisplays. Of particular interest are deep-blue and white devices with high efficiency, color, and long lifetime.

Injection and Transport Mechanisms, Molecular Engineering and Device Structure

The continued improvements of organic materials via molecular engineering and fundamental studies of dynamics of charge carriers and excited states are important to the OLED industry. Papers treating injection, charge generation, transport, and recombination phenomena in individual materials, interfaces, and complete OLED devices are sought, including modeling and computational chemistry techniques. Of particular interest are contributions that apply to the understanding of device and material fundamentals to design OLEDs with high efficiency, low voltage, long lifetime, and saturated color emissions.

OLED Stability and Degradation Mechanisms

Lifetime of OLED devices is one of the most important factors enabling their display and lighting applications. Papers providing insight into degradation mechanism and describing novel materials and device architectures to substantially increase lifetimes and suppress differential aging and image sticking are solicited.

OLED Applications for Lighting

High efficiency, high CRI, and robust white OLEDs for RGBW displays, color-filter approaches, solid-state lighting, and backlighting for LCDs are of special interest to the display and energy-conscious communities. Papers describing novel materials (fluorescent and phosphorescent) and device architectures that are capable of producing efficient and stable white emissions are particularly welcome.

OLED Manufacturing

Novel full-color OLED fabrication and patterning techniques that are capable of producing high-resolution displays are of high interest for the industry. Papers dealing with recent advancements in areas of thermal deposition, ink-jet printing, nozzle printing, other novel small-molecule and polymer deposition techniques as well as development of solution-processed OLED materials and devices are sought. Particularly, approaches to obtain multilayer devices from solution are highly welcome.

OLED Systems Packaging, Integration, and Cost Reduction

Encapsulation is critical to ensure long operational lifetime of OLED displays. Papers describing packaging and thin-film encapsulation advancements for novel designs such as top-emitting and flexible displays are of particular interest to the community.

PROJECTION DISPLAYS

Electronic Projection Systems Based on Microdisplays, Scanned Lasers, or Other Technologies

Papers related to the systems-level design of projection systems and light engines are encouraged, as are papers related to the design of the image-generating elements. In addition, papers related to the miniaturization of a projection system and the reduction of the power consumption of projectors are welcome.

Pico-/Micro-, Mainstream, and Large-Venue Projectors; Multi-Projector Arrays

System-level papers related to individual projectors or projector arrays are welcome. Electronics to drive multi-projector arrays are included. Projection technology has expanded its reach in recent years at both ends: pico-projectors with low output and intended for only a few viewers are at one end and large-venue projectors with ultra-high output and intended for audiences of thousands are both important to the industry.

Emerging Applications for Projection Systems

Emerging applications often require new technologies and designs for the system to fulfill its intended purpose. Papers on unconventional applications of normal projection systems are solicited. 3D projection is an important emerging application for projection for both professional and consumer use. Papers on head-up displays (HUDs) and other systems that project virtual images are also strongly solicited.

Human Factors of Projection Systems and Projection Applications

Studies on how humans perceive projected images and how these projected images fulfill their intended purpose are welcome. Papers related to electronics to provide improved human factors, such as dynamic-range or color-gamut expansion, are also very important. Papers related to the human factors of 3D applications are especially welcome.

Projection-System Components, Including Image-Generating Components, Light Sources, Optics, Projection Screens, and Electronics

Projection systems are built from an extremely diverse set of optical, mechanical, electronic, and electrical components. Component-level developments are the key to advancing projection technology at the system level. Papers on light sources, including lamps, lasers, LEDs, and other approaches are important. Projection screens are a technology that is under represented in the technical literature. Light-management optics such as filters and polarizers are also important.

Opto-Mechanical Design of Projection Systems and Components, Including Lifetimes, Thermal Properties, and Acoustic Noise

This area of projection-system design is often under represented in the technical literature, and additions to the general pool of knowledge are important. Lifetime of components, including image-generating components, light sources, and light-management components such as polarizers are covered.

Other topics Related to the Design, Manufacture, or Application of Projection Systems, Subsystems, or Components

Papers on virtually any topic related to the design, manufacture, or use of projection displays are welcome, even if the topic is not specifically mentioned. System efficiency improvements through co-design of multiple subsystems is a very relevant topic.

TOUCH AND INTERACTIVE DISPLAYS

Advanced User Interfaces

Touch screens are human–interface devices that must cater to the capabilities and limitations of their users. Papers in this session will explore touch systems from the human perspective. This can include topics such as how human factors drive touch-screen specifications; the role of new affordances such as haptic feedback, hover capabilities or directional displays, appropriate gestures for different form-factor devices, or simply how new technologies allow for completely new styles of interaction.

Multi-Touch Systems

Multi-touch systems can combine different elements such as sensors, panels, electronics, algorithms, and user-interface software into systems that provide compelling benefit to users. This session will focus on approaches for combining different technology elements in ways that provide unique benefits. Topics can include novel combinations of different technologies to create new multi-touch systems, unique engineering approaches for predicting and optimizing multi-touch system performance that span the technology elements, and other novel approaches to provide multi-touch systems with compelling benefits.

Novel Touch Configurations and Applications

Touch technology enables a user to interact with a system with a more efficient and intuitive way so that it is widely and rapidly adopted in a wide variety of fields. Papers that cover all aspects of novel touch configurations and applications are solicited. The topics of interest include, but are not restricted to,

- Touch-technology integrated with new features, functions, and applications to achieve a more efficient, robust, and cost-efficient performance.
- Novel applications that emphasize innovative touch-sensing concepts and devices.
- Multimodal approaches utilizing more than one touch technology concept.
- New interactive architectures.
- 3D interaction with displays.

Materials and Process Technologies

The recent rapid evolution of touch-screen technology can be partly attributed to the development of improved materials, processes, and equipment for touch-panel fabrication. Papers are solicited in all aspects of novel material or process technologies for touch screens with improved performance or lower cost. Materials include substrates, such as special glass and plastic films, coatings, including transparent conductors and fingerprint resistant coatings. Improved processes include new fabrication processes of touch panels, patterning methods for touch-panel coatings, interconnect processes to the external electronics, and integration methods with the display, both as an add-on or laminated to the display or the cover glass or as an even more integral part of the display. Touch panels integrated on the cover glass solutions are of interest. Completely novel materials and processes for display/human interaction are solicited as well.

Driver Electronics, Sub-Systems, and Algorithms

Papers in this session should review touch components used for communication between the sensor and the host computer. Examples include:

- Exploring new touch ASICs, which offer a variety of sensing mechanisms and examine the benefits of each type.
- Multi-touch sensor geometries, which have names such as snowflakes, streets and alleys, telephone poles, and diamonds, and discussion of their relative merits.
- Information on the different types of gestures and whether they should originate in the ASIC or in software drivers.
- The "Z" component, its general use, and support by touch-electronics manufacturers.
- Pen-entry as a critical component and its support by the various touch technologies

Touch-Performance Evaluation Methodology and Standardization

Touch-screen technology that has previously been applied mainly to mobile products is now being widely used in almost all applications of displays; this has introduced us to many new touch devices. There are more than 10 touch technologies, more than 100 touch manufacturers, and many thousands of touch products. Accordingly, touch-performance evaluation and standardization has become much more important. Papers are solicited in all aspects of novel evaluation and/or standardization methodology of touch performance and characteristics. Aspects can be considered at the level of the touch panel, the touch module (panel plus controller), and/or finished products that use touch (mobile phones, notebook PCs, *etc.*). The evaluation methodology can include the evaluation criteria; measurement systems; specifications such as accuracy, response, sensitivity, and internal/external noise immunity; new evaluation methodology for matching actual touch performance; and technology to standardize or quantify the evaluation and measurement methods used by each manufacturer.