An Overview of Color Detection Schemes for Electronic Image Sensors

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Electronic image sensors used for nearly all imaging purposes today rely on measuring electrons produced by the photoelectric effect. An inherent limitation of counting electrons produced by the photoelectric effect is that chrominance information is lost. Each measured photoelectron indicates only that *a* photon was absorbed – current electronic photodetectors have no intrinsic process by which to discriminate absorbed photons of the 400nm wavelength variety (blue light) or the 700nm variety (red light), or any other wavelength in its response spectra, and therefore regards them as the same - thus the basic electronic image sensor is inherently monochromatic. A number of schemes are currently used with electronic image sensors to derive color, each with advantages and tradeoffs. New schemes and modifications of existing ones seek to lower cost; improve resolution and color accuracy; and decrease light-loss relative to the base monochromatic sensor.

Superlens Contact Lithography overcoming the diffraction limit

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In optics, the diffraction limit is one of the most critical factors to determine the performance of the system. Recently, overcoming the conventional optical system such as superlens and hyperlens have been developed, thus now we have many possibilities to apply them into the nano scale technology. Especially, I propose a novel method of superlens contact lithography (SCL) to achieve ultra-high resolution while maintaining high throughput. The method utilizes cheap broad-band or UV light and is compatible with conventional semiconductor processes. Because SCL utilizes a thin immersion layer, it offers the advantage of avoiding residues, as is usually the case with contact lithography. The cost of such a system is also very attractive: it is simple and easy to implement, without the use of exotic materials.

Why can we watch 3D movie?

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Movies of nowadays in the theater have three-dimension or higher technology can create four-dimension. When we go to IMAX, for example, to watch the movie, we can feel like that we are in that circumstances, the screen is not as two-dimension in the past. How do they make it? What technology do they use now? Three-dimensional movie is not really a three-D film but just cheating our vision which let us feel like the object is three-dimension as real. The goal of this project is to analyze what the three-dimensional devices do and why they can cheat our sense of sight.

CCD and CMOS Digital Image Sensors

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When a photon of enough energy interacts with the periodic lattice of a material such as a semiconductor, it may create a pair of free electron and hole. Manipulations of these pair then can be used to store information regarding the incident light, and, through electronic means, can be read back to reconstruct intensity information. Digital image sensors take advantage of this property of semiconductors. Two mainstream sensor technologies today detect light either with a photodiode or a photogate. These technologies are based off different design philosophies and make use of distinct features of their respective devices. Neither of these devices is perfect: they both have areas where they shine, and other that are since as flaws.

It was not long ago when film cameras were ubiquitous in the consumer market, and digital represented but a niche market of special needs. Film started in the late nineteenth century, and remained as the only form capturing past events for almost a century. However, advances in semiconductor fabrication set up the stage for the eventual displacement of the century-old technology. Today, digital systems are the basis for imaging in mission critical systems, as well as consumer electronics. The mainstream image sensors fall into two categories: charge-coupled device (CCD), and complementary MOS (CMOS) sensors. Demise of both technologies has been prophesized by the proponents of the other camp; the deadlines of these predictions have come and gone, while the two devices are still very much alive in the market. The two will continue to grow due to breakthroughs in fabrication technology and increasing demand in various markets.

Description of the working principles of Superlens in order to achieve sub-diffraction-limited resolution imaging in the near field, and Hyperlens systems for magnification of sub-diffraction limited imaging and projection into the far field.

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In this paper the operation principles of superlenses and hyperlenses optical systems are presented and described. In a conventional lens the sharpness of the image is always limited by the wavelength of light. An unconventional alternative to a lens, a material of negative refractive index can allow the recovery of evanescent waves in an image via the excitation of surface plasmons. This material baptized, superlens, is described and it demonstrated sub–diffraction-limited imaging by proper design of its geometrical characteristics. Optical Hyperlens systems are capable of forming a magnified optical image of a subwavelength object in the far field. This is achieved by using metamaterials that with careful design can support propagating waves with very large wave numbers. Thus the magnification of subwavelength features of imaged objects is possible so that these features are above the diffraction limit at the Hyperlens output. The output of the Hyperlens consists entirely of propagating waves, which can be processed by conventional optics making possible the projection of a subwavelength object in the far field.

Review of Anti-Reflection Coatings and Light Trapping Surfaces for Solar Cell Performance Enhancement

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Antireflection (AR) coatings and light trappings surfaces can reduce many types of photo-induced current conversion losses in solar cells, including surface reflection, non-absorption and surface recombination. Antireflection coatings enhance short-circuit current density by reducing surface reflectance and increasing the amount of light that enters the solar cell. Some types of AR coatings also effectively passivate the surface, mitigating surface recombination which neutralizes electrons or holes that would otherwise contribute to current generation. Light trapping and randomizing surfaces improve short-circuit current density by increasing the average optical path length of light within the semiconductor, and thereby increasing the likelihood of absorption.

This paper reviews the physics of operation, modeling tools, fabrication techniques and example performance data for three categories of coatings: optical interference coatings, graded index coatings, and light trapping and randomizing surfaces. These coatings are primarily considered in terms of conventional single-crystalline, single-junction solar cells. Common performance evaluation criteria are defined and example performance data for each type of coating presented. Emphasis is placed, however, on qualitative performance characteristics in order to distinguish the applicability of the coating types and processes to various solar cell design types and functions.

LIDAR

Light Detection and Ranging

And Its Applications

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Light Detection and Ranging (LIDAR) is a technique that is used to capture information about a distant object and the medium it is in. A standard lidar system is comprised of three main parts: a receiver, a transmitter and a detector. The transmitter of this system is different from a typical radar system primarily because it is a laser generating apparatus. It is able to therefore take advantage of shorter wavelengths to produce a backscatter of light. Instead of firing radio waves into the medium, a lidar transmitter uses lasers. In this kind of system, the light fired by the transmitter can range from any wavelength: infrared even to ultraviolet light. By measuring the scattering in the medium from a beam of light, the lidar system is able to determine some key properties about the medium as well as the object causing the backscattered light. It can pinpoint the range of the object from the transmitter, and can produce detailed topographical maps of the medium/

environment. Through the atmosphere, most lidar systems are able to determine wind velocity, air temperature and even cloud properties. Due to the transmitter no longer having to operate in the radio band wavelengths, the actual technology used to comprise a lidar system is very different from that of radar technology and hence leads to a multitude of different applications. There are two very famous kinds of lidar systems: Rayleigh and DIAL. This paper will examine both of these lidar systems in detail and show the unique functions of each. LIDAR has applications from aerial surveying for missile defense systems to measuring water depth and tracking marine life. It can be used to measure the speeds of vehicles as well as detect chemical agents in the air. This paper will aim to describe a lidar system in detail, by explaining the features of its transmitter, detector, receiver and how they work together to form the system. It will then derive and illustrate the optical equations employed during the process; finally, this paper will aim to discuss LIDAR's most important applications in the real world. Enjoy!

3D display with parallax technology

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Among the various 3D display technologies, a display system requiring no special glasses is a useful technology for 3D images. The parallax barrier display system has superior characteristics, such as having a planar screen and a thin panel. However, the conventional parallax barrier display system has disadvantages of the resolution, brightness and supported number of viewers. These shortcomings make the 3D display less practical for the general uses. To overcome these weaknesses of the parallax barrier display method, various ideas were suggested and implemented. This paper introduces some achievements in the parallax display, such as distributed rendering system, step barrier display system, time-multiplexed

autostereoscopic display, Dynamic Parallax Barrier Autostereoscopic Visualization, 3D measurement of head position and expanded viewing zone for mobile devices.

The Future of Solar Cells

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An ever increasing need for electrical energy, depletion of fossil fuels, and global warming are forcing us to look to other methods of energy production. Solar cells are a great alternative energy source but they need to be efficient, cheap, and durable before they can take the place of fossil fuels. There are a variety photovoltaic technologies being developed each with pros and cons. Traditional crystalline silicon devices are durable and rather efficient (20-30%), but expensive. Organic cells are cheap, but inefficient(<5%) and not durable. Nanostructures are also not very efficient, but can assist other photovoltaic technologies. Thin films have the best possibilities for efficiency (>40%), cost, and production potential.

Self-Assembled Quantum Dots for Laser Applications

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Self-assembled quantum dots offer the unique feature of discrete atomic-like electronic energy levels that can be readily controlled through thin film growth conditions. When these dots are used as a laser active medium, it is possible to obtain better performance than in existing higher-dimension semiconductor lasers. Improvements include lower magnitude and temperature-dependence of the threshold current, lower homogeneous broadening and controllable inhomogeneous broadening. These lasers are now beginning to be commercially developed for applications from telecom to medical to ultrafast pulsed laser applications.

PHOTONIC CRYSTALS: PROPERTIES AND APPLICATIONS

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A new meta-material has emerged that promises to allow one to engineer and control the propagation of light. This meta-material has been coined the "photonic crystal" by pioneers in the field, E. Yablonovich and S. John. This paper aims to give an understanding of the fundamental physics and properties of the photonic crystal. The goal is to present the concepts with concepts from electromagnetism and optics rather than invoking analogies to solid state physics or quantum mechanics. Following the coverage of the fundamental properties of the photonic crystal, we cover the fabrication of these devices and finally, we wrap with the present and future applications of photonic crystals.

Medical Computed Tomography

By Eugene Kur (k-gene@berkeley.edu)

Computed Tomography (CT) utilizes the detection of how X-ray waves pass through an object in order to reconstruct an image of the density inside the object. It is most notably used in medicine to provide images of the inside of a person's body, where different organs and tissue have different densities, and thus can be distinguished in the image. An X-ray source emits light waves that propagate through a patient's body, with different degrees of attenuation, depending on the different densities encountered along the propagation path. The intensity of the X-rays that pass through the body is then detected, and from the data, an image of density can be reconstructed. This process is known as a CT scan, and is used to diagnose and monitor various illnesses such as cancers or processes such as blood flow.

Holographic Data Storage

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Holography combined with multiplexing allows for storage of mass amounts of information in a medium. Section I gives a brief introduction to the principles of holography which is just the basics of interference. Section II introduces some unique features of holographic storage namely high information density, large read throughputs and the ability to perform associative searches. Section III discusses the various components that make up a holographic data storage: the object beam, reference beam, storage medium and output detector. Section IV introduces some examples of working prototype holographic data systems.

The Transmission Electron Microscope and Aberration

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TEM, transmission electron microscopy, is a microscopy technique that uses a beam of high-energy electrons that get pumped through a thin specimen, diffracting as it passes through. An image is formed from the interference produced by each Bragg-scattered beam of the electrons transmitted through the specimen. The image is magnified and focused onto an imaging device, such as a fluorescent screen, photographic film, or a sensor (CCD camera). By Scherzer's Theorem, just like with conventional light-based microscopes, TEM suffers spherical aberration, chromatic aberration, and other higher order aberrations, ultimately limiting the resolution to about 100 times the wavelength of the electron. In addition, it suffers from relativistic effects because of the electron's velocity. However, the Transmission Electron Aberration-Corrected microscope, or TEAM, incorporates a variety of ways to correct for aberration, including multipole lenses (hexapole, quadrupole-octapole), monochromatic (but still high-power) beams, and post-specimen correctors with Wien filters designed to self-cancel the aberrations. Currently, the TEAM 0.5 has a resolution limit of about 0.5 Angstroms, and by October 2009, an even newer, more sophisticated TEAM is expected to be built.

Metamaterials in the Modern Application of Camouflage

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Since the discovery of metamaterials in the late 1940's, not a lot of publicity has been given to this subject. Some applications under research for metamaterials have included the superlens, filters, beam steerers, modulators, microwave couplers, and radomes. The unique property of metamaterials lies in the structure of the material itself, and not the chemical composition. These unique properties allow the material to have negative indices of refraction, increasing the range of possibilities for light manipulation. However, the scientific community has not done much in the research of its cloaking possibility until recently in the 21st century. Recent research in applications of optical camouflage have rendered objects nearly invisible. Military interest has sparked in the usage of metamaterials for achieving invisibility in hopes of raising the effectiveness of covert operations and reducing casualties. Such ideas have only been the fodder of science fiction, but recent university studies have shown promising results.

High Dynamic Range (HDR) Display Systems

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The human eye as an optical system has a remarkable capability of detecting a wide range of light intensities, allowing us to see the ultimate contrast ratio. Most display technologies do not have the dynamic range of intensities to fully use this capability of the human eye. Research to find a HDR display system has resulted in a DLP projector based display and a LED based display, both of which are coupled to an LCD monitor. Both of these vastly improve the contrast ratio and overall luminance of the display. Brightside Technologies has become the first company to implement the second design and put the display up for sale to the public. Another display system that has a high dynamic range is the OLED display. If the OLED is able to overcome a couple of shortcomings, it should win out on the HDR display competition.