Effects of Focusing on the Resolution Characteristics of Integral Photography

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The effects of focusing on the resolution characteristics of integral photography (IP) were analyzed. First, we attempted to obtain the resolution characteristics of capture and display systems as the product of their modulation transfer functions (MTFs). Next, the relationship between this overall MTF and focusing during the capture was studied. The results show that, we can obtain a nearly flat frequency response over a wide range of depth, including the lens array, when the focus is at infinity. Even if the object is very near the lens array, there will be no remarkable resolution degradation and the image can be reconstructed by sampling up to the Nyquist frequency. If the focus is at a position near the lens array, on the other hand, the response varies greatly depending on object position. The response falls remarkably as the object moves away from the point of focus. If several objects are distributed over a relatively wide range of depth, it is desirable to have the focus at infinity.

New Signal Readout Method for Ultrahigh-sensitivity CMOS Image Sensor

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A new signal readout circuit for a passive-pixel CMOS image sensor with high signal-to noise ratio (SNR) features was developed. It consists of a charge-transfer circuit and a noise reduction circuit. The charge-transfer circuit covers each sensor column and makes it possible to amplify the signal voltage by transferring signal charges accumulated in each photodiode to a parasitic capacitance that is small compared with the photodiode capacitance. We fabricated a prototype sensor to investigate its SNR performance. The prototype's column-to-column fixed-pattern noise (FPN) and random noise were respectively 56.7 dB and 58.4 dB below the saturation signal level, which had superior SNR characteristics compared to the sensor with the conventional readout circuit. By overlaying avalanche-mode photoconductive films, such as HARP (High-gain Avalanche Rushing amorphous photoconductor) film, on this kind of high SNR sensor, we expect that ultrahigh sensitivity CMOS image sensors can be mounted not only in broadcasting-type cameras but also in consumer products, such as video cameras, digital cameras, and other portable devices.

Molecular Alignment Enhancement Phenomenon of Polymer Formed from a Liquid Crystal Monomer in a Liquid Crystal Solvent

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We have been researching composite films of liquid crystal (LC) and polymer sandwiched between thin plastic substrates in order to realize flexible LC television displays. To achieve a high-contrast display device, we must align the molecules of the polymer micro-fibers dispersed in the composite film. This paper focused on a new alignment enhancement phenomenon affecting molecules in the polymer fiber. The molecular alignment order of a rigid-skeleton polymer made from a monomer (polymer's primary material) in a low-molecular-weight LC solvent was greatly enhanced by increasing the solution temperature, even though the molecular alignment order of the LC/monomer solution decreased. In molecular alignment measurements exploiting the wavelength shift phenomenon of infrared light scattered by the formed polymers, it was found that the polymer alignment order was three times greater than that of the original aligned monomer molecules. It was considered that the polymer alignment was improved by a polishing effect due to the one-directional thermal flow of LC molecules, which functions as a molecular hone. This super polymer alignment technique based on the molecular-scaled self-assembly mechanism of LC is not only applicable to flexible display technology; it should also be useful for forming molecularly aligned conductor/semiconductor polymers that will be essential to future organic electronics.