Introduction to Machine Vision Hardware, Architectures, and Considerations

46. Imaging Devices + Distortion

Imaging Devices - Conversion of Light Energy to Voltage

- Vidicon - Analog 2-D Area
  - Originally Scanned
- Photo Diode Array - 1-D Line, or 2-D Area, Discrete
- Charge Injection Device (CID) - 1-D or 2-D Discrete
- Charge Coupled Devices (CCD) - 1-D or 2-D Discrete
  - Array is Precharged
  - Photons Knock Out Electrons and Produce Pixel Voltage
  - Minimal Blurring
  - Fast Response to Illumination Changes
  - Small Size + Low Power (Essentially Noiseless)
  - Good Low-Level Light Performance

Possible Sources of Distortion

- Vignetting: Lens Effect in Center, Moving From Center to Outside Image Becomes Darker
- Parabolic Distortion: Electron Return (Vidicon) Better at Center, Analogous to Vignetting
- Blooming: Too Much Light at a Spot Causes Larger More Diffuse Area Around Spot
- Lag: Ghost Image, Not Fully Recharged Such As When Scan Rate Is Too High
- Geometric Distortion: Due to Lens/Pixel/Plate Geometry
- Blur: Improperly Focused Optics or Bitmap

Distorted Image: \( g(x,y) = \text{Dist}[f(x,y)] \Rightarrow f(x,y) = \text{Dist}^{-1}[g(x,y)] \)

Not Generally Done for Machine Vision Applications.
Linear sensor array offers alternative to CCDs

Device offers a resolution of 400 dots/in. in an 8-pin DIP

The TSL1401 linear sensor array comprises 128 charge-mode CMOS photodiodes, associated charge-amplifier circuitry, and a pixel data-hold function that features simultaneous-integration start and stop times for all pixels. The device has a resolution of 400 dots/in. and is offered as an alternative to CCDs in some line-scanning applications.

The devices has a pixel measurement of 63.5 (H) x 55 (W) μm, and a center-to-center spacing of 63.5 μm with a gap of 8.5 μm between pixels. Pixel-response nonuniformity is 7.5% max, and linearity is 0.4% typ, with a 0.5% image lag.

The TSL1401 uses a 5-V supply and operates with up to a 2-MHz clock rate and a serial-input pulse. Operational wavelength extends from 400 to 700 nm. The sensor array is packaged in a clear 8-pin DIP and can be used for mark detection, encoders, and optical character recognition. ($4.95 ea/1,000—available now.)

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The TSL1401 400-dot/in. linear sensor array is offered as providing a cost-effective solution for many scanning and sensor applications.