CMOS Imager for a Polarization – Difference Imaging Camera

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Overview

- Polarization – difference imaging
- PDI Camera
- CMOS imager
- Circuit Examples

Motivation

- Trouble with seeing objects suspended in scattering media
- Polarization – difference imaging- a possible solution
- Biological basis – visual systems of certain animal species can sense polarization in nature

Polarization – Difference Imaging

- Incident light is separated into two beams polarized in orthogonal directions
- Rejection of unpolarized background light;

  Retention of polarized image-forming light
- Transformation of resultant image data into useful imagery

PDI Camera

- Desired properties: reliable, portable, fast, cost-effective
- Major components:
  - Polarization analyzer
  - CMOS imager
  - Image display system

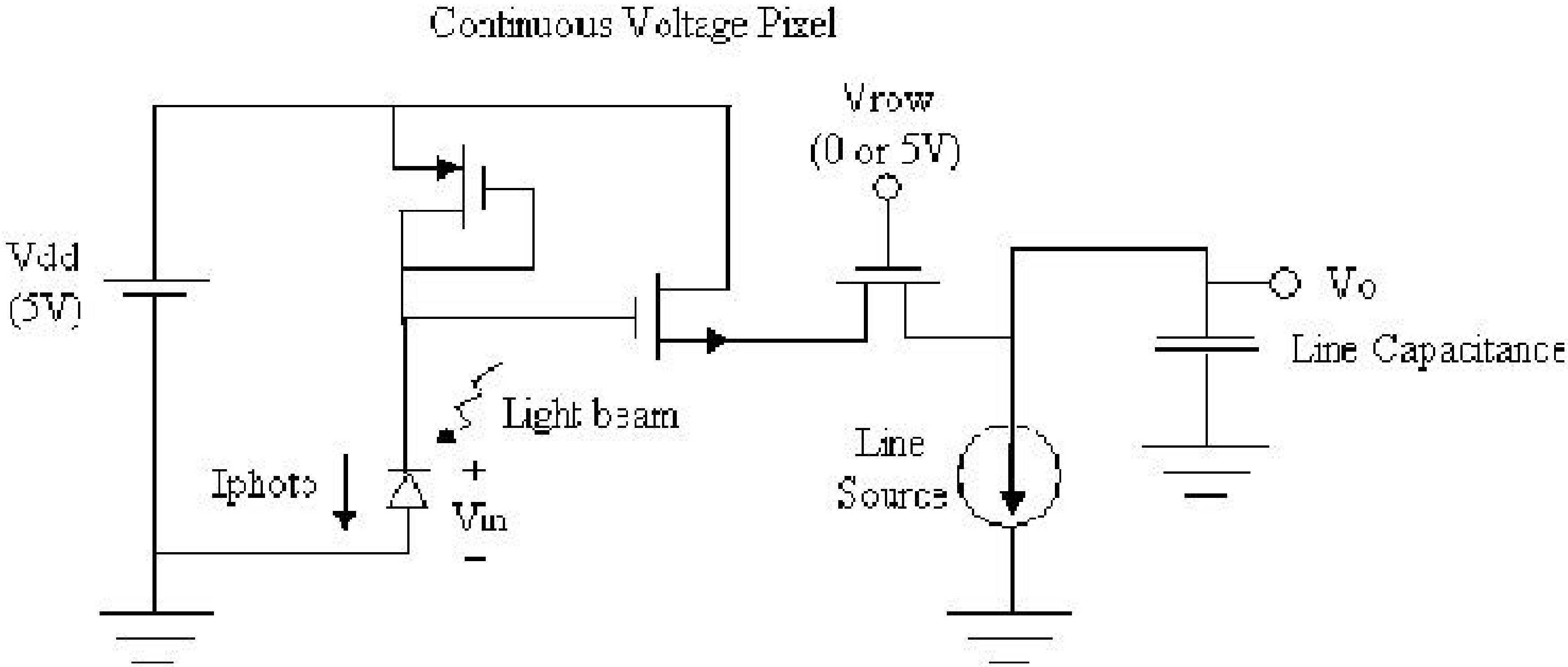
CMOS Imager

- CMOS device structure
  – Widely available
  – On-chip signal processing capabilities
  – Flexibility
- Active pixel-array
  – Random accessibility
  – Fast/Low power

Imager Circuitry

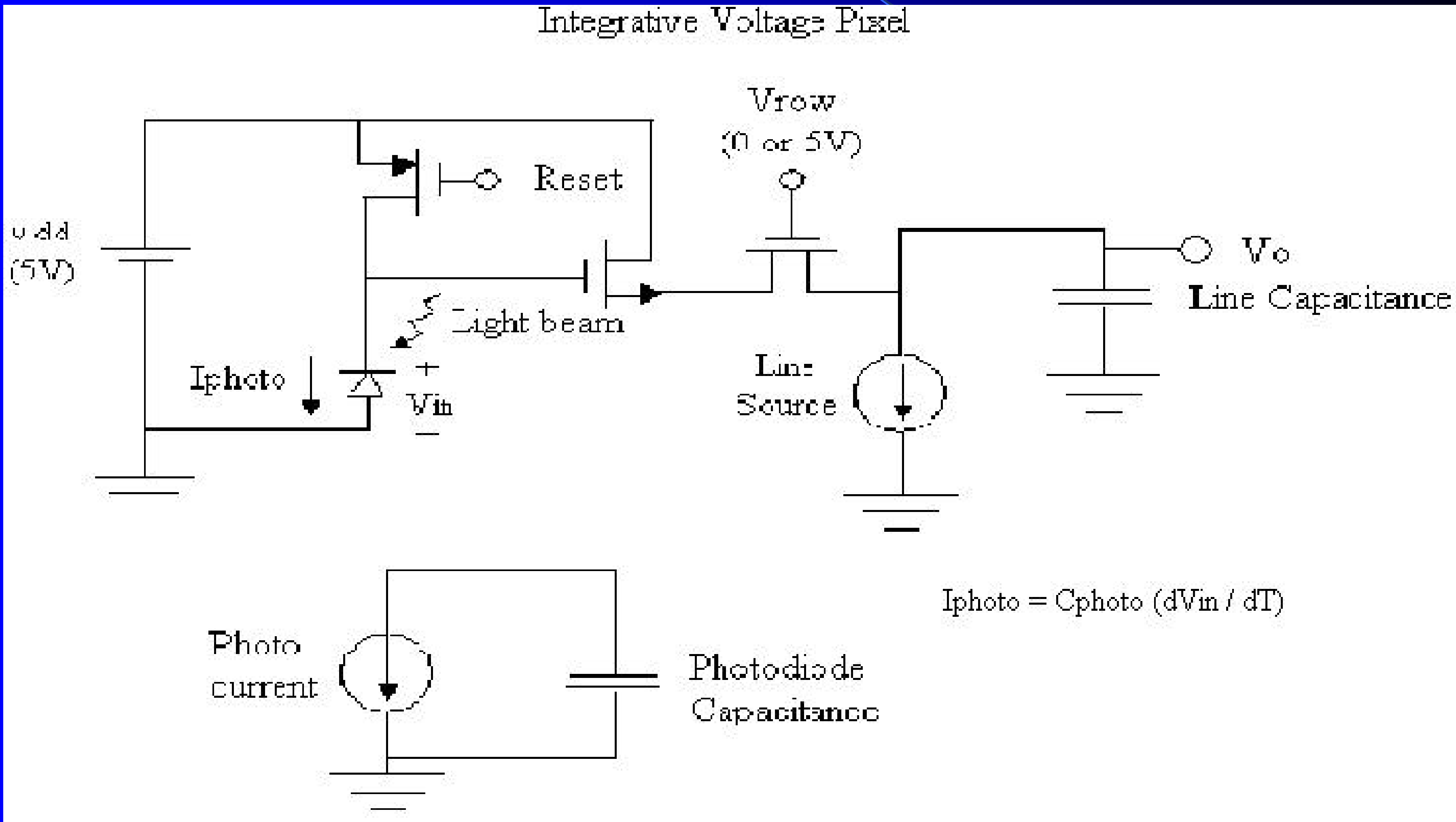
- Circuit models
  - Active pixel designs
  - Adders, subtractors, multipliers, differential amplifiers
- Testing
  - Linear input/output characteristic
  - Range of operation
  - Input resistance
  - Change of design and process parameters; temperature

Circuit Sample - Pixel

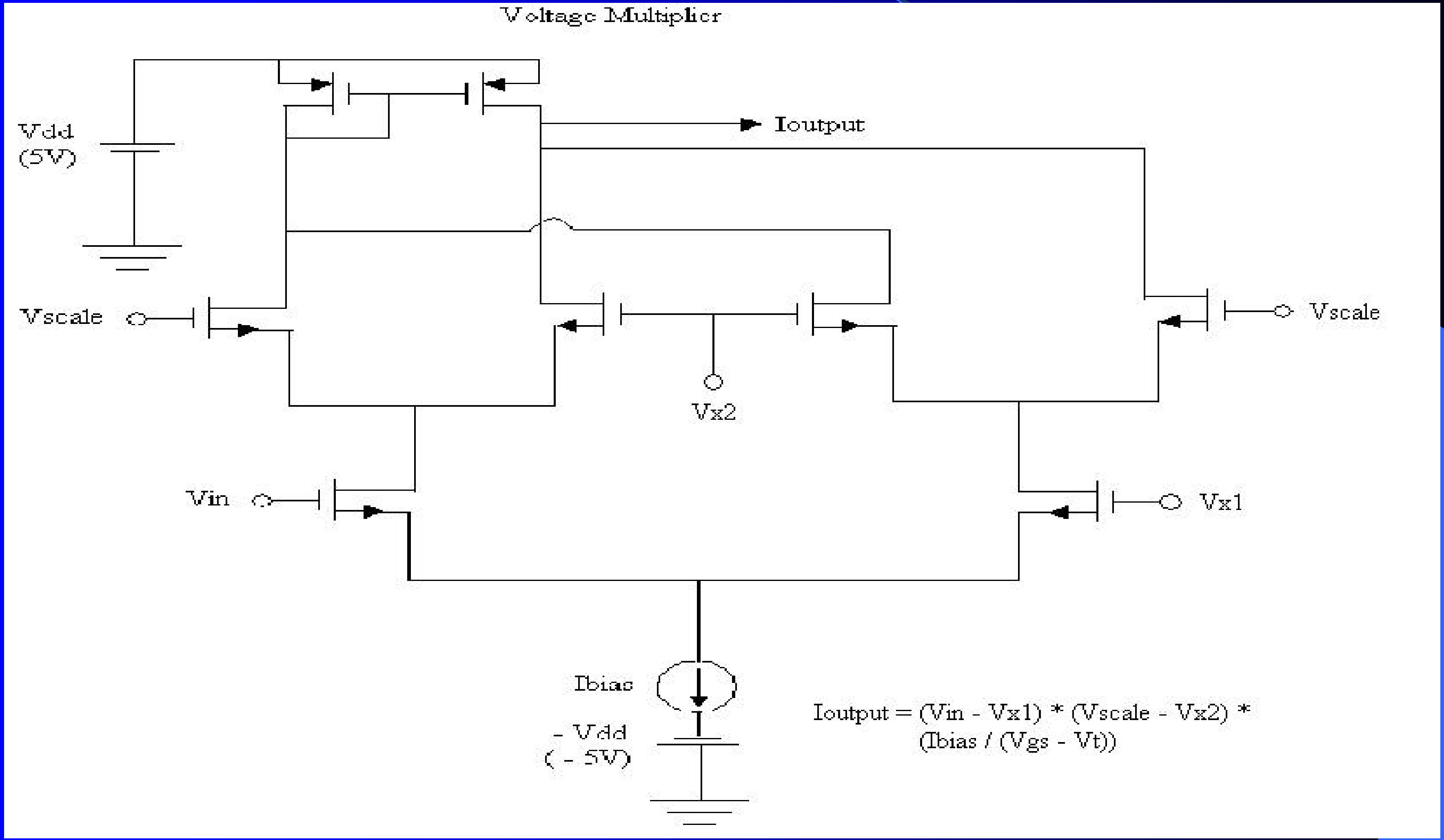


Iphoto = (1/2)Kp'(W / L)(Vgs - Vt)^2(1 + (Vds / Va))

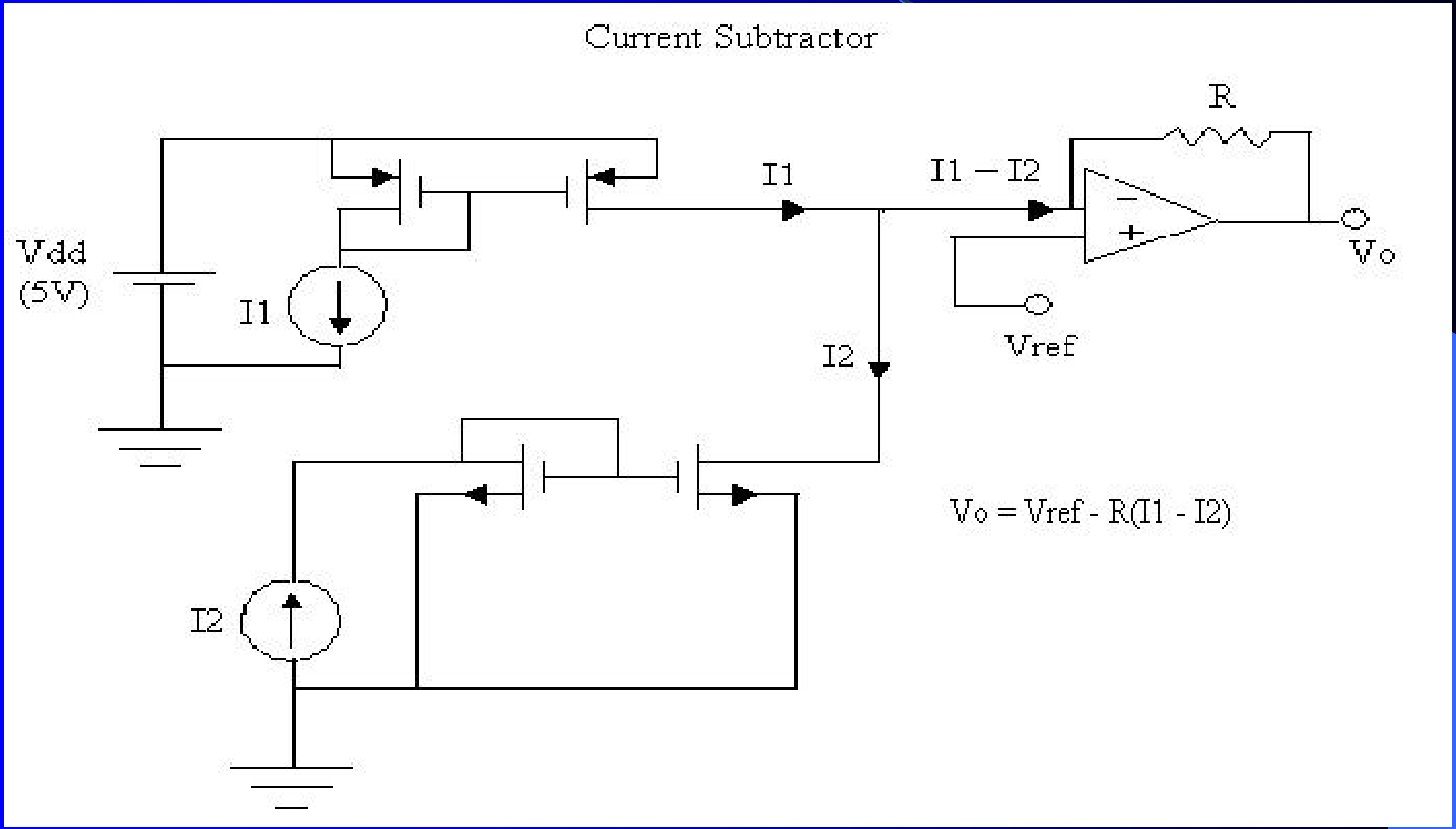
Circuit Sample - Pixel



Circuit Sample - Multiplier



Circuit Sample - Subtractor



Summary

- Polarization – difference imaging- enhancing visibility of objects in scattering media
- CMOS imager- electronic adding, subtracting, scaling of polarized signal
- Properties- random access pixel array, on-chip processing, active pixel design