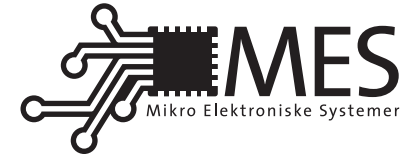




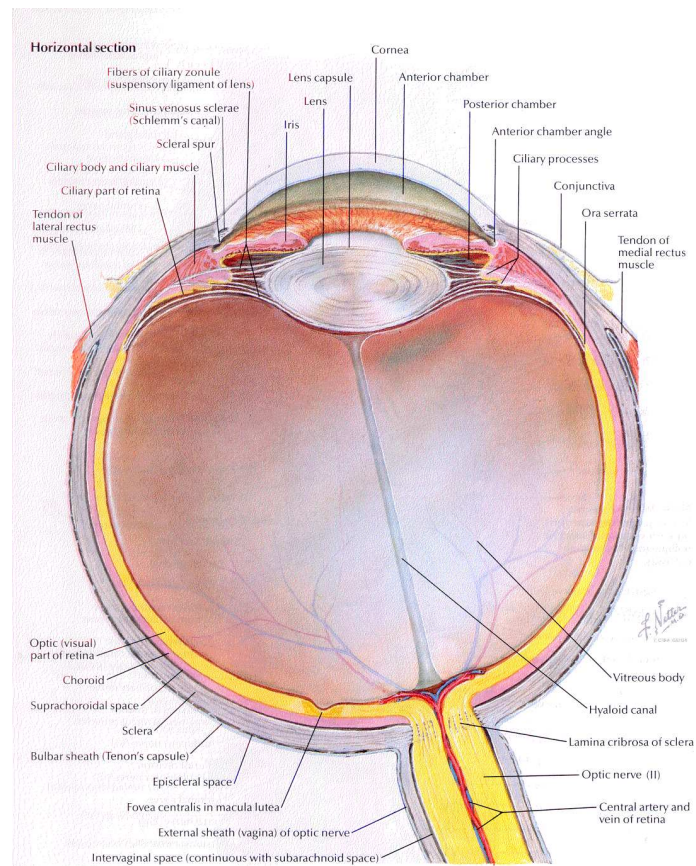
UNIVERSITY
OF OSLO



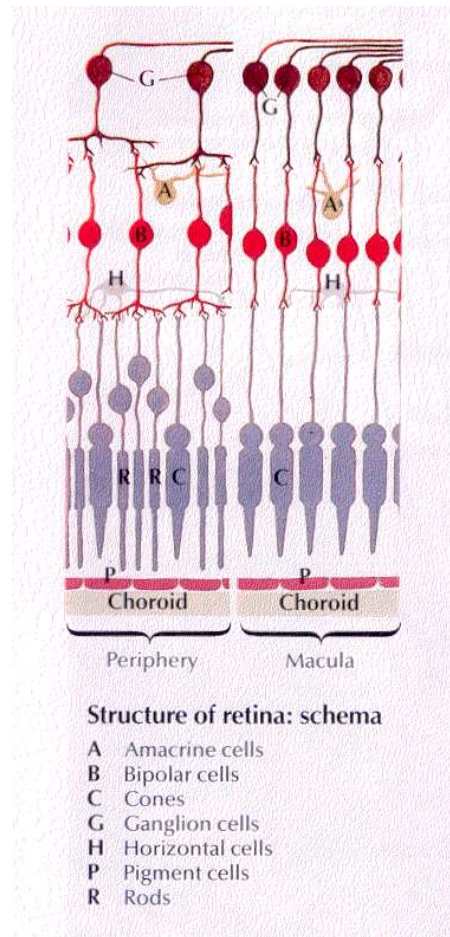
Neuromorphic Electronics

Retinomorphonic Circuits

Eyeball Cross Section



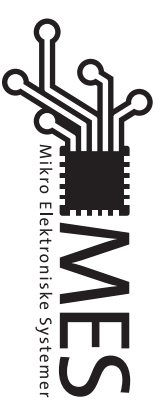
Retinal Cells





UNIVERSITY
OF OSLO

The Retina



Schematized Retinal Cells

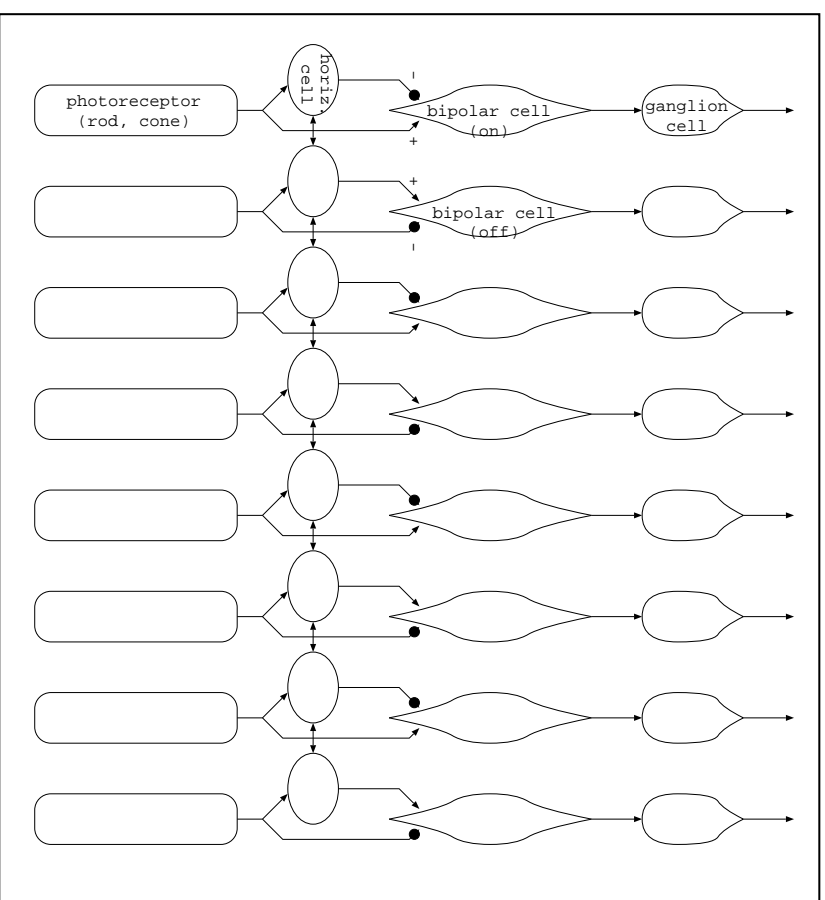




Photo Diode, Impact Ionization

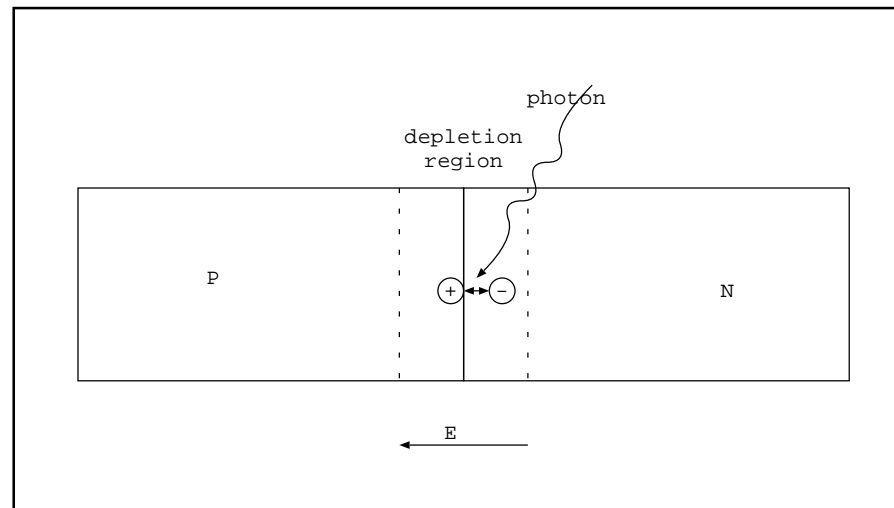




Photo Diode Layout

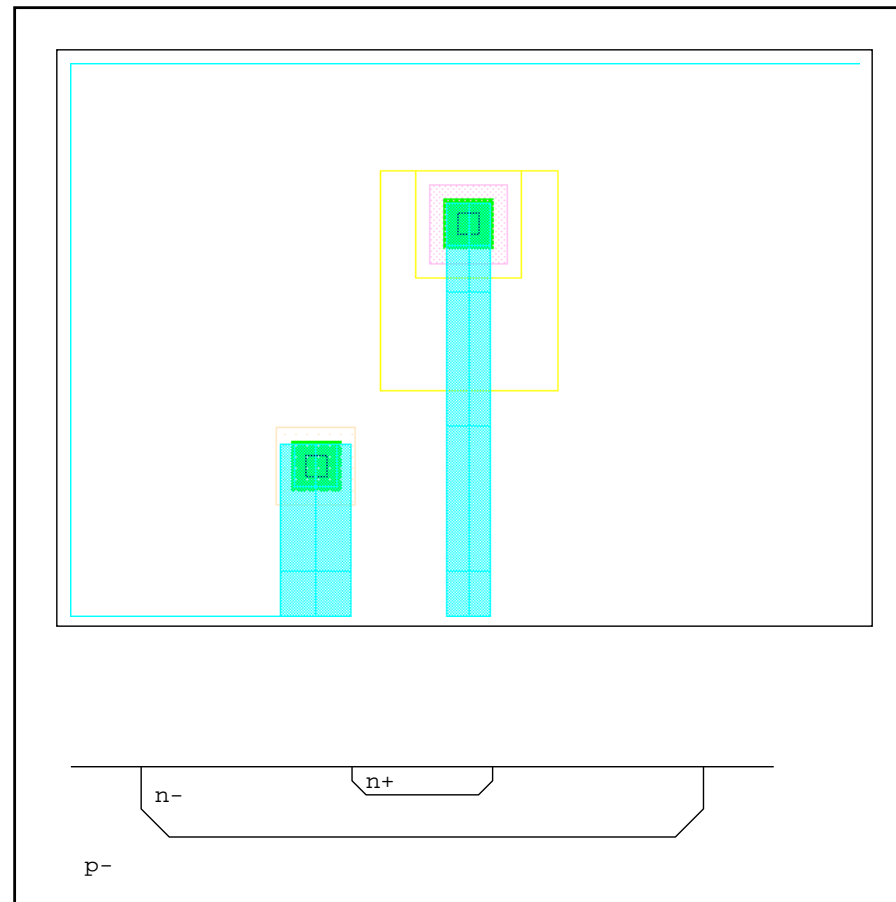




Photo Transistor Layout

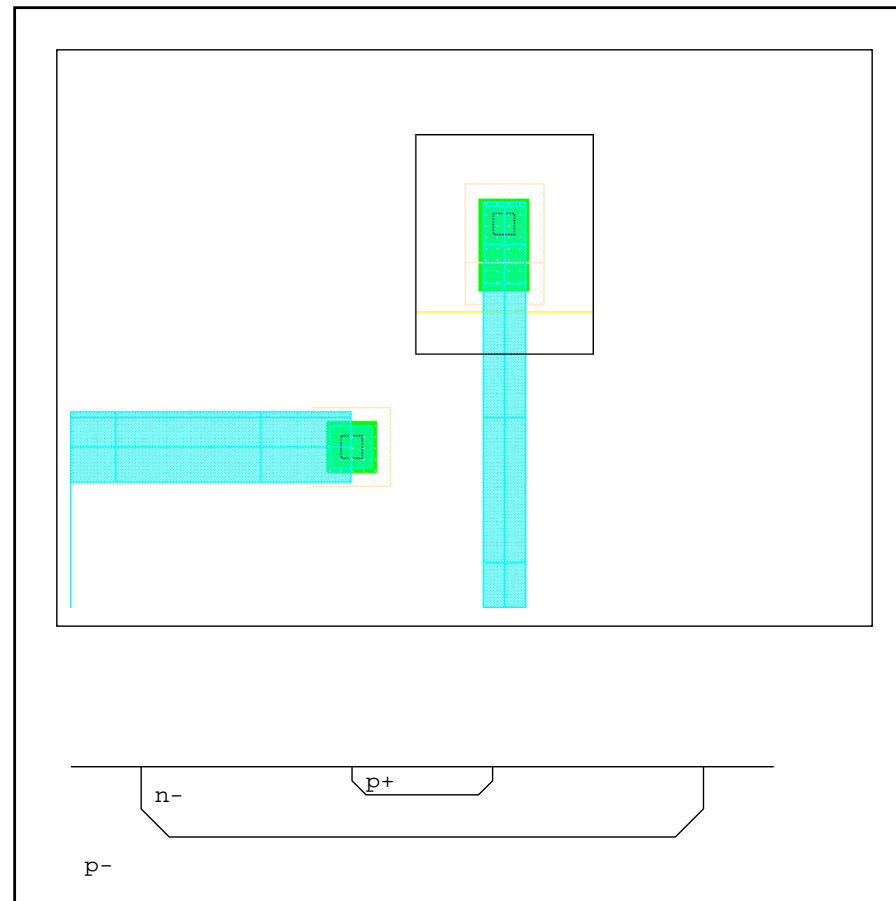
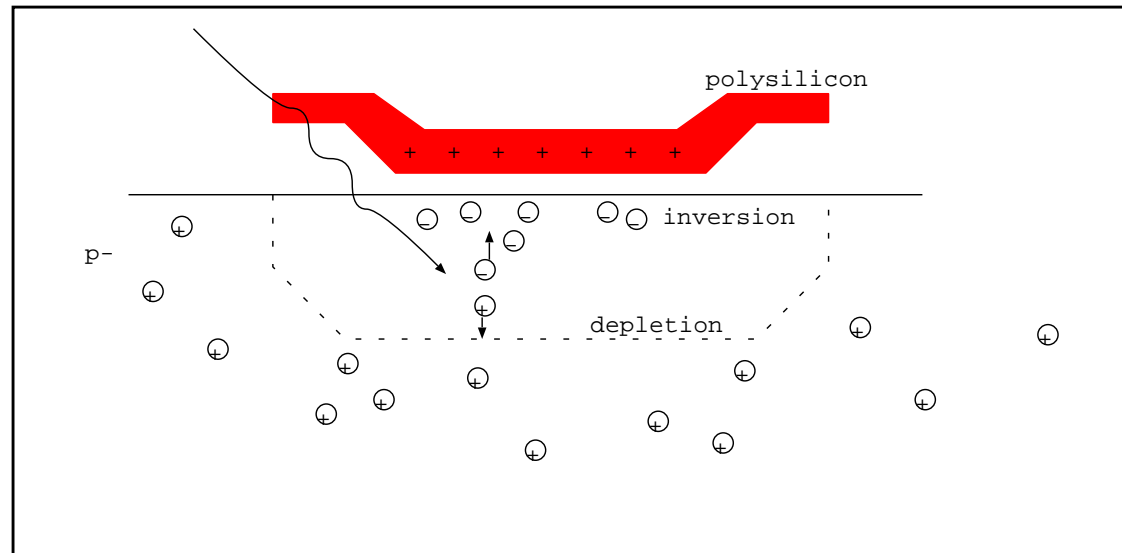


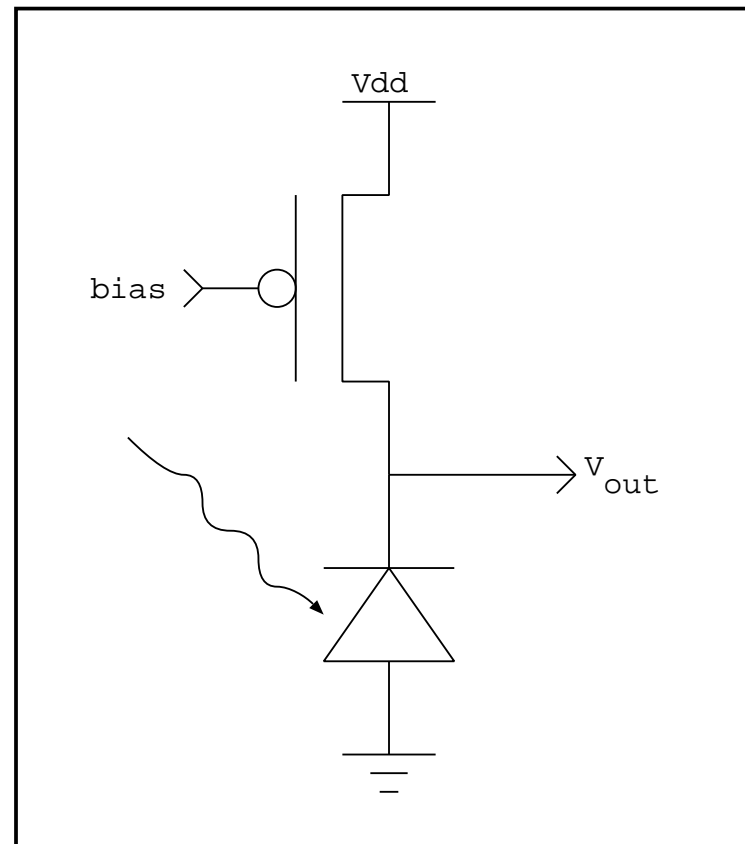


Photo Gate



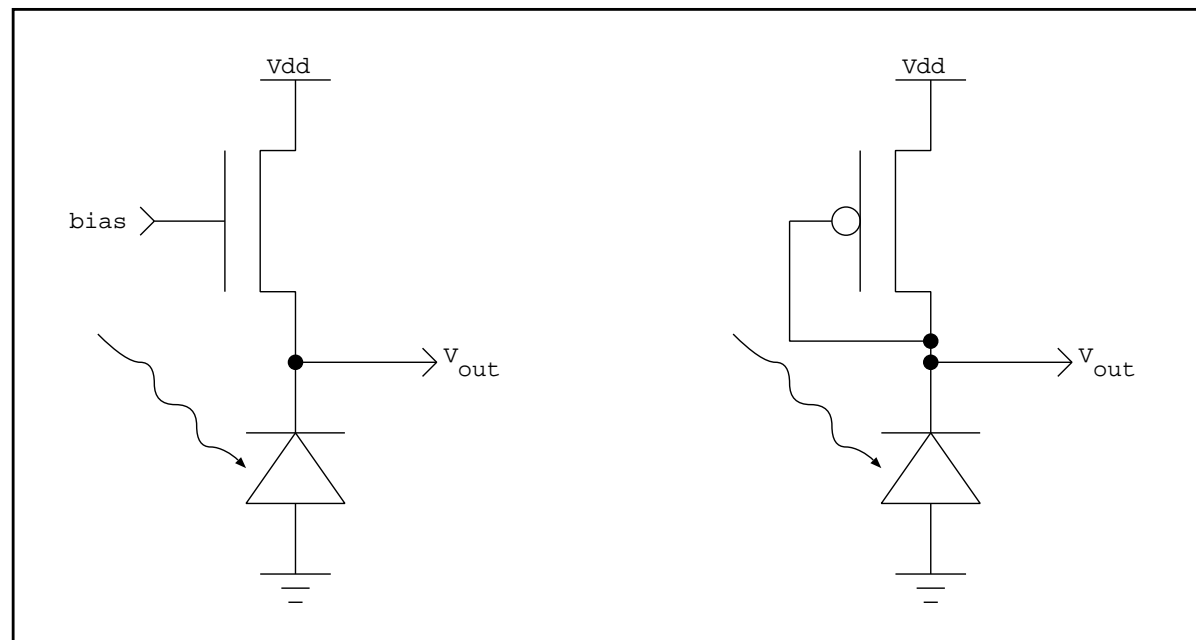


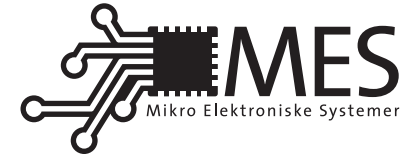
Amplification by Early Effect



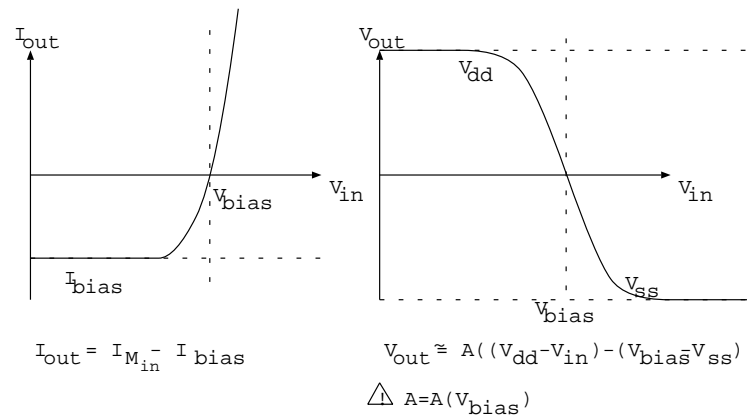
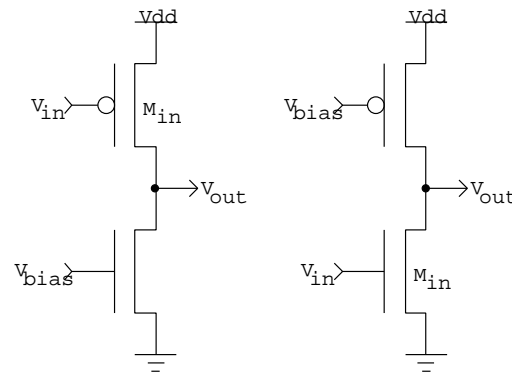


Logarithmic Amplification

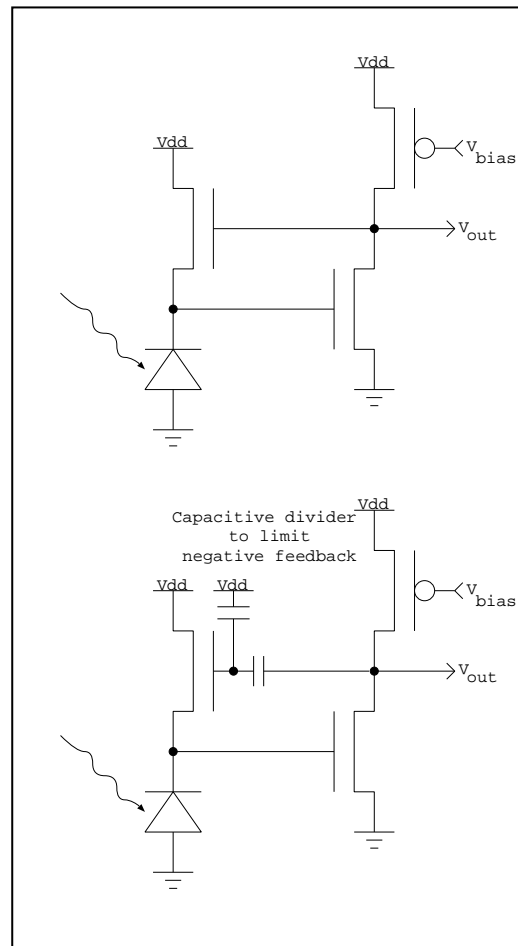




Common Source Amplifier

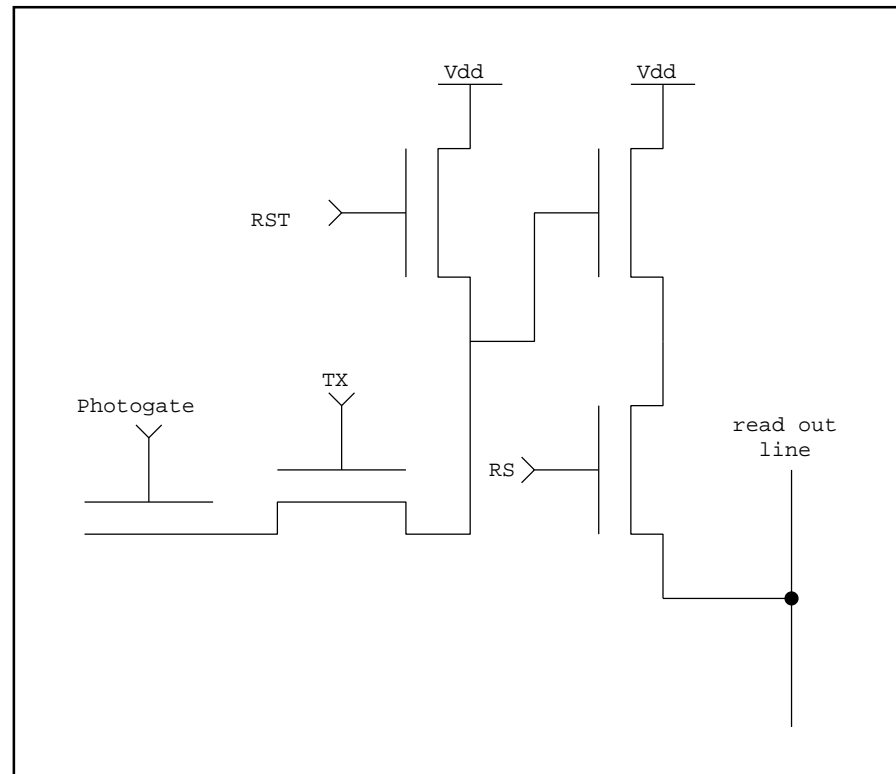


Common Source, Negative Feedback





Source Follower



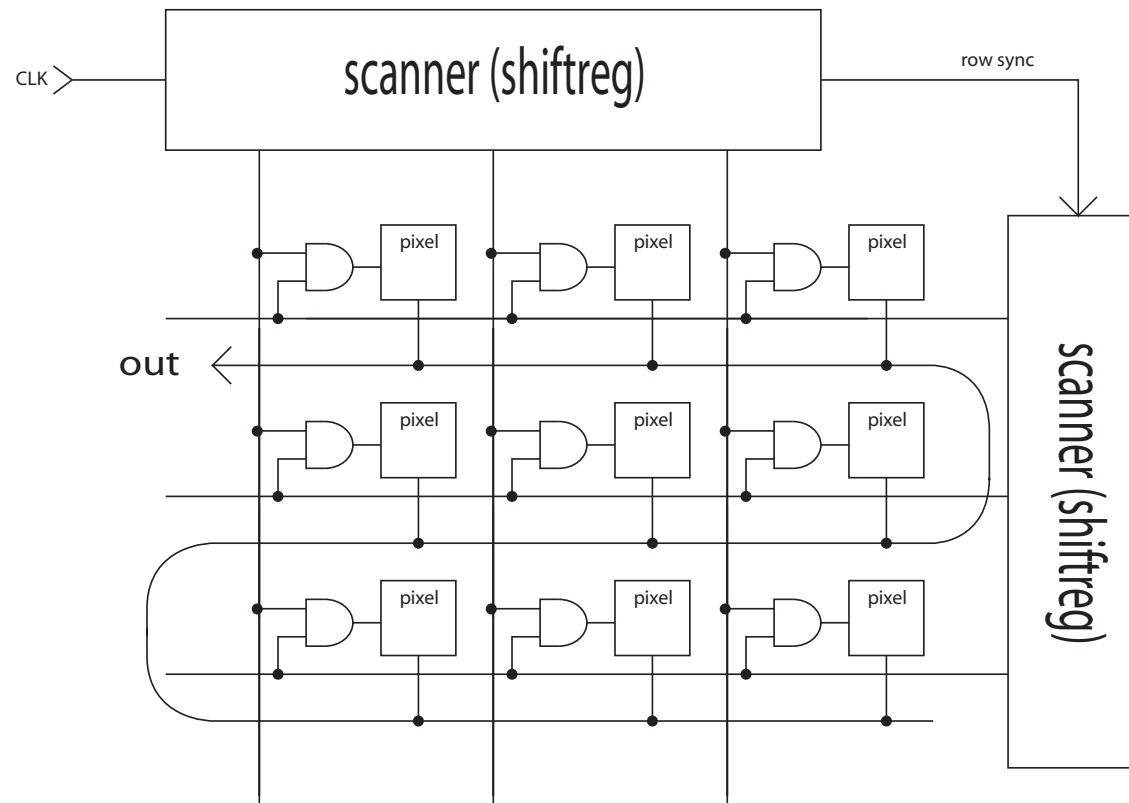


Overview

- Addressing/Scanning
- Charge Coupled Devices (CCD)
- Address Event Representation (AER)

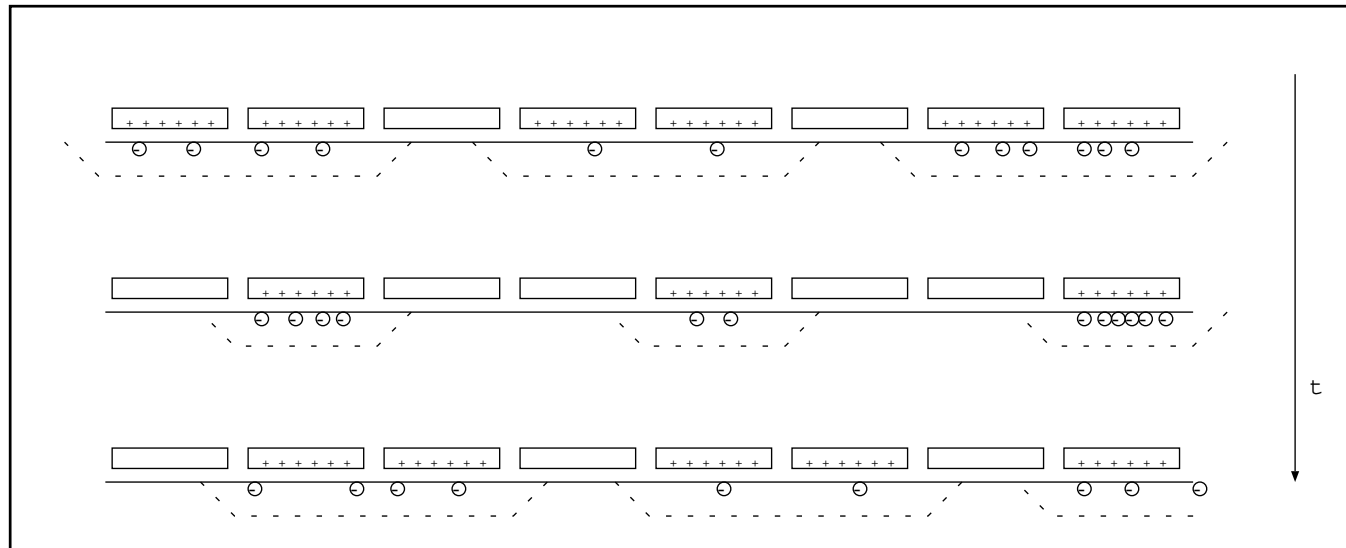


Scanning



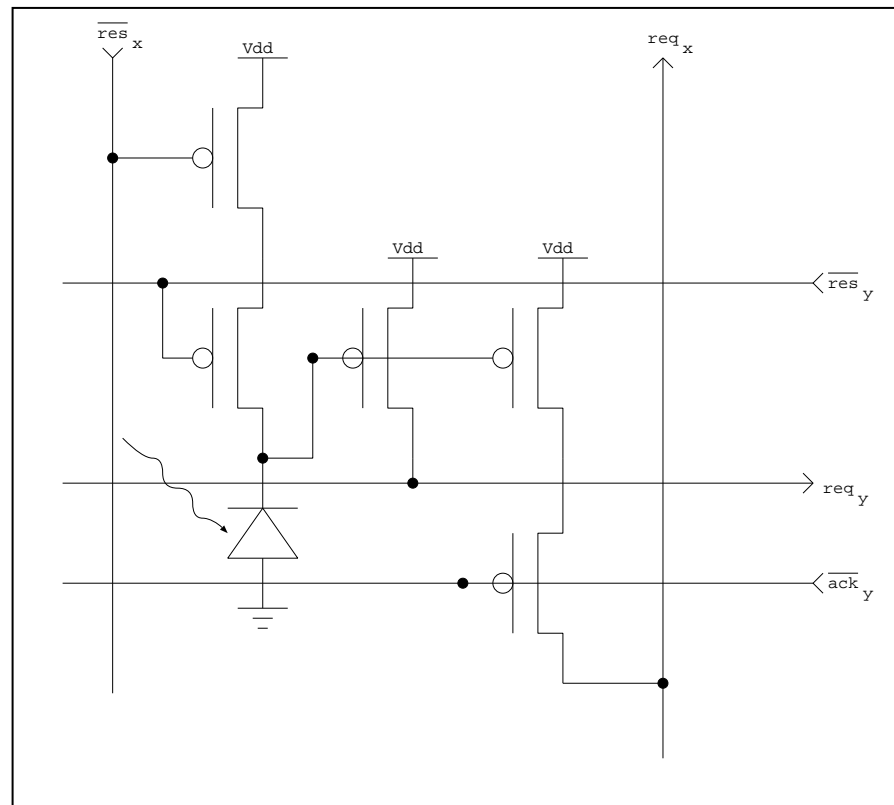


CCD



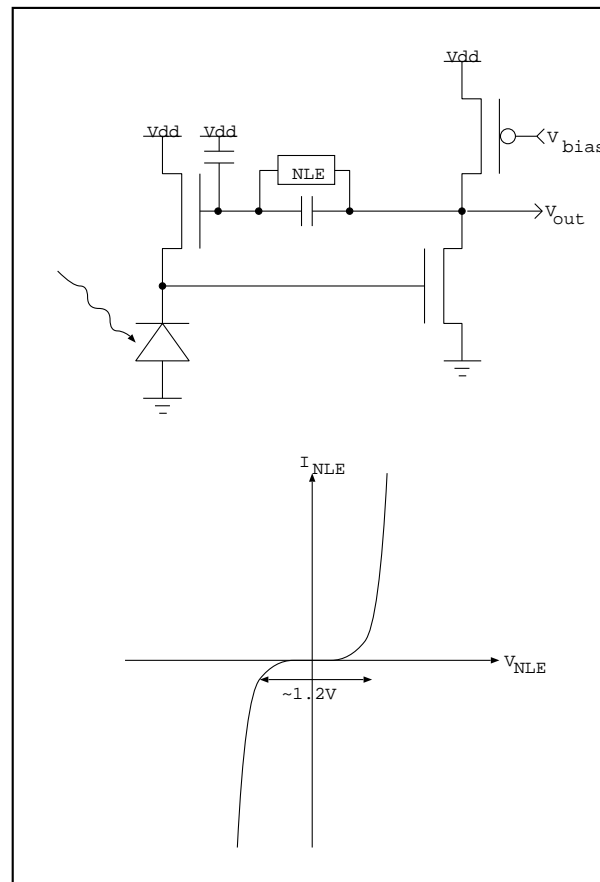


AER pixel

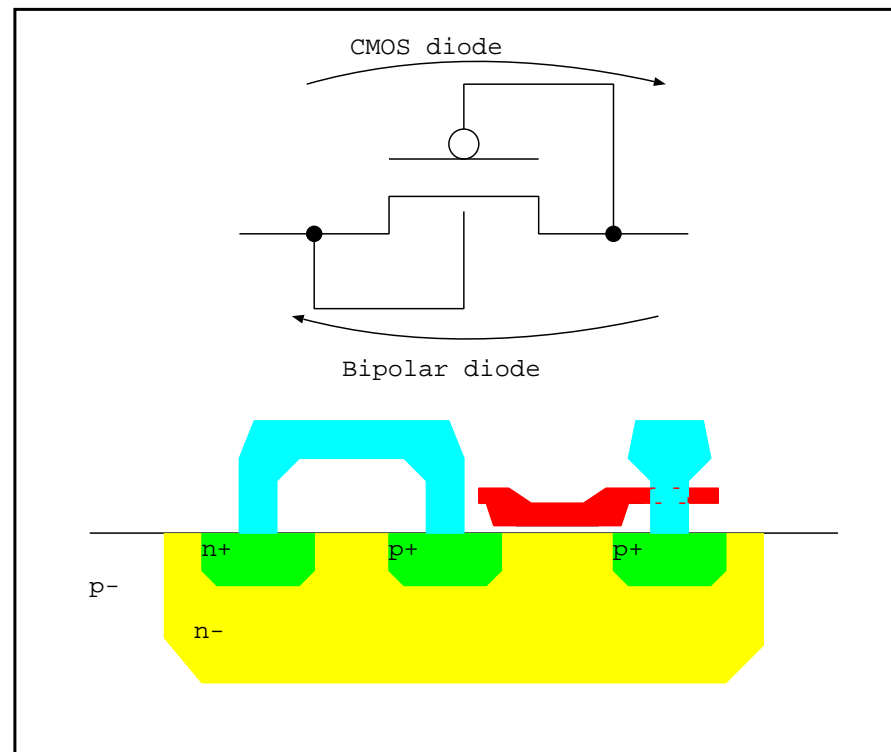




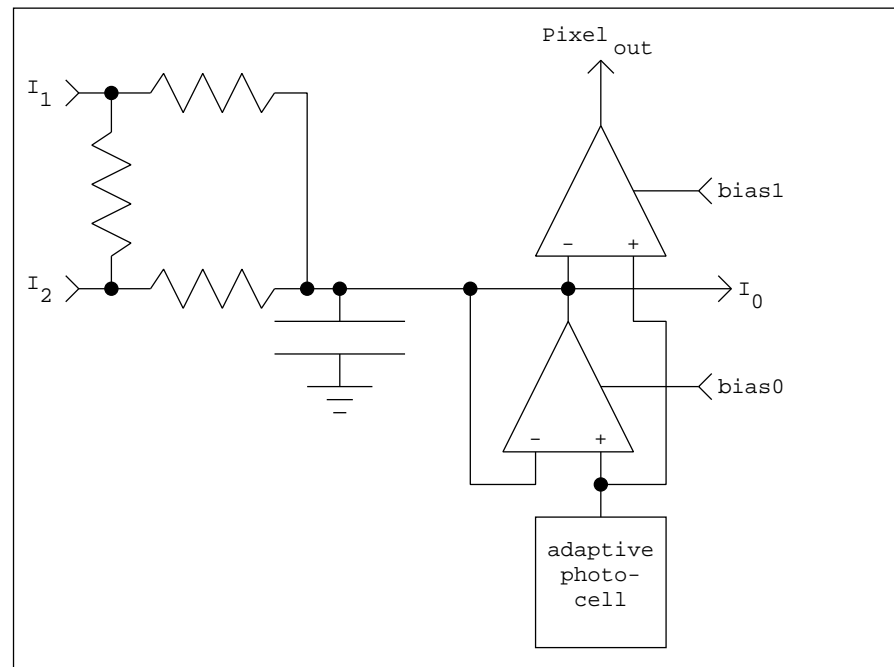
Adaptive Pixel



Non-Linear Element (Tobi-Element)

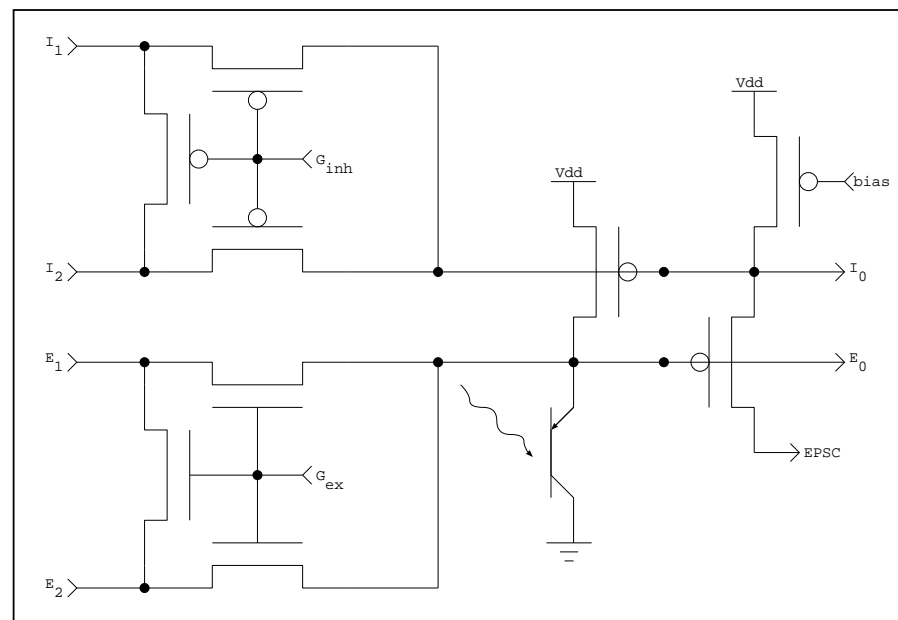


Retina Pixel (Mahowald)

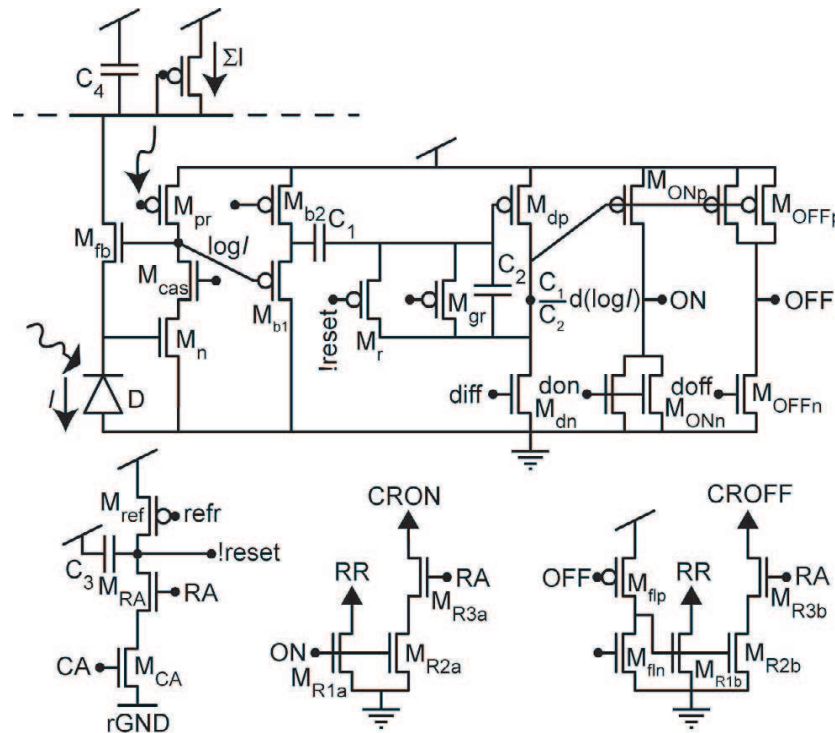




Retina Pixel (Boahen)

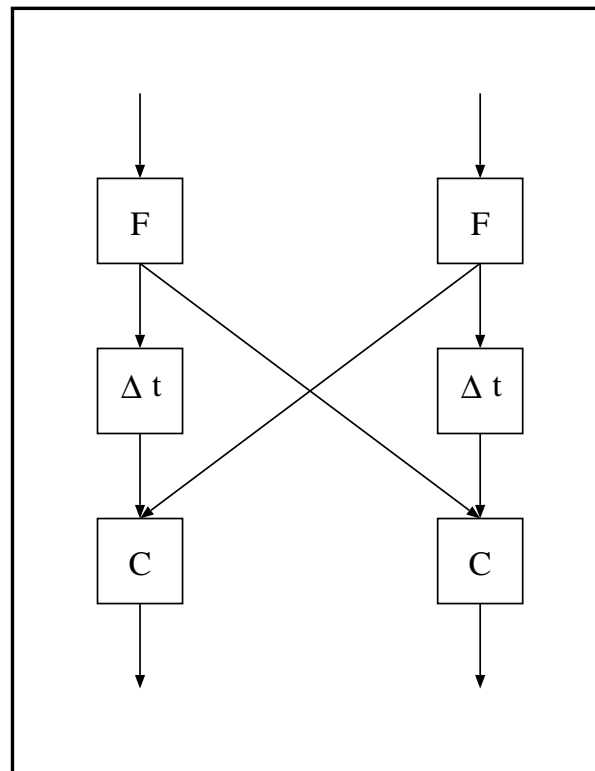


TmpDiff Pixel (Lichtensteiner)



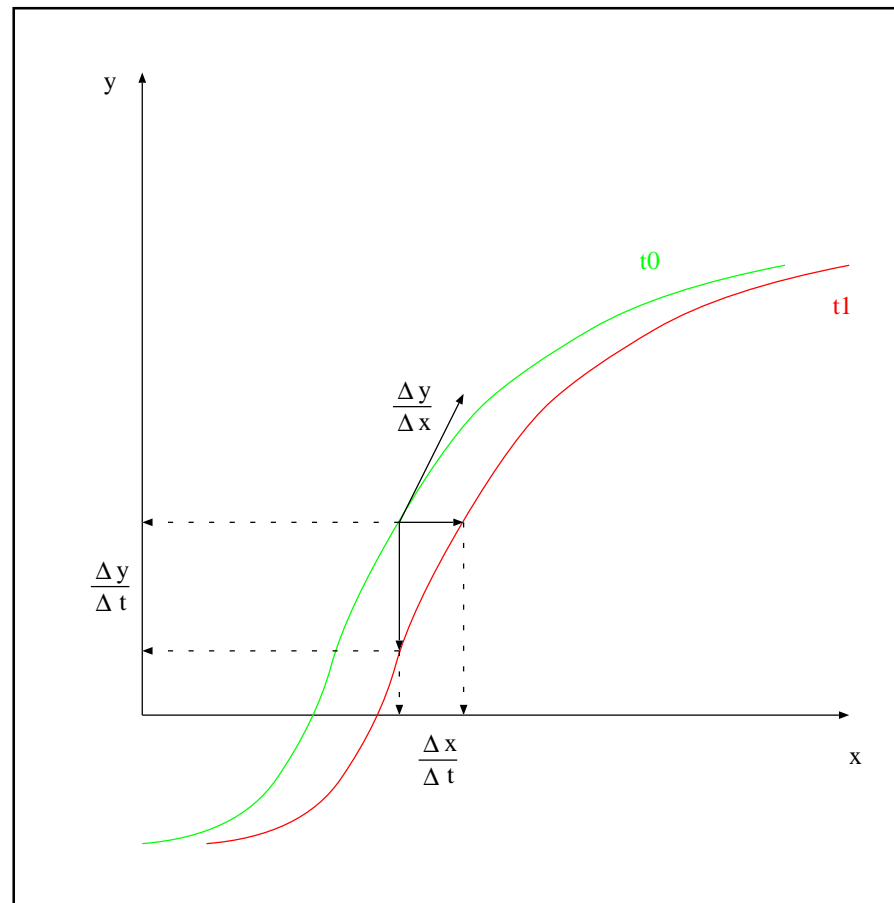


Token Based Motion Processing: Reichardt Detector



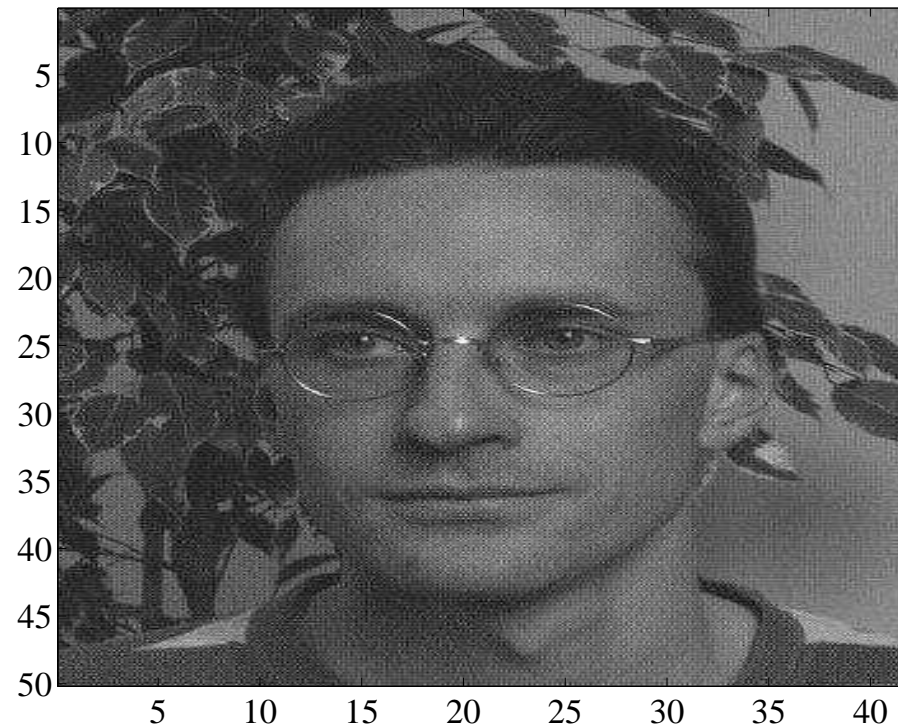


Intensity Based Motion Processing



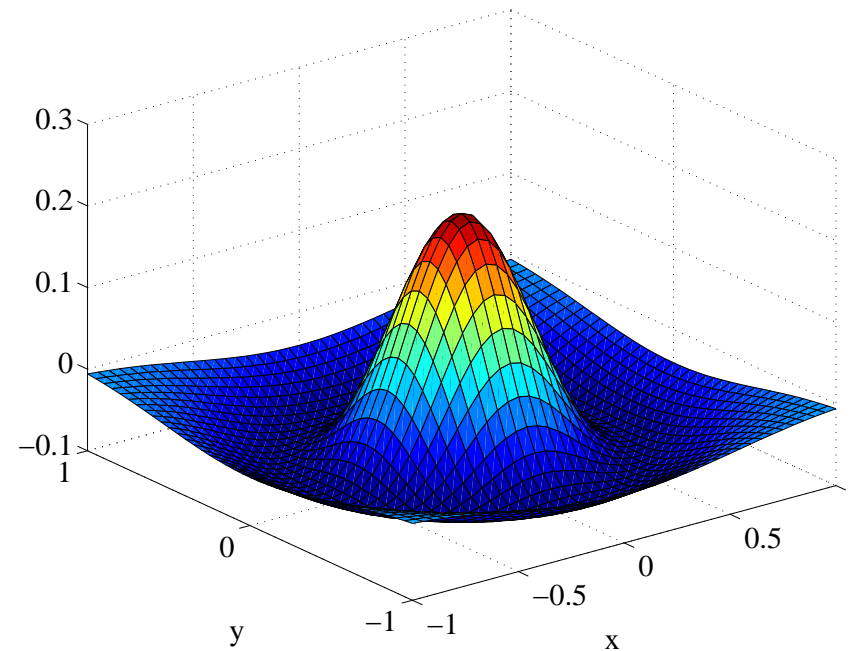


A Natural Scene



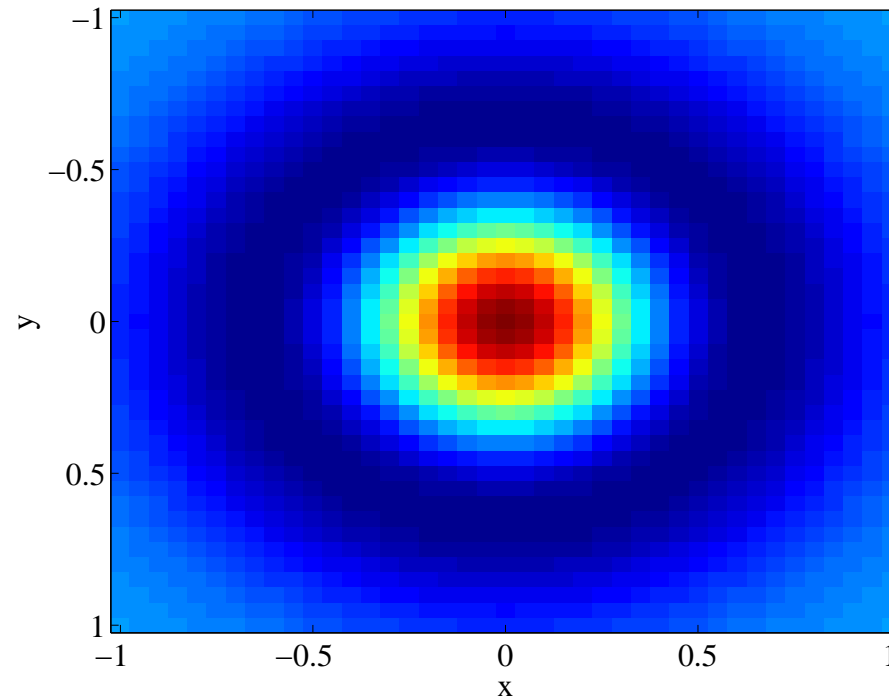


'Difference of Gaussians' Kernel(1/2)



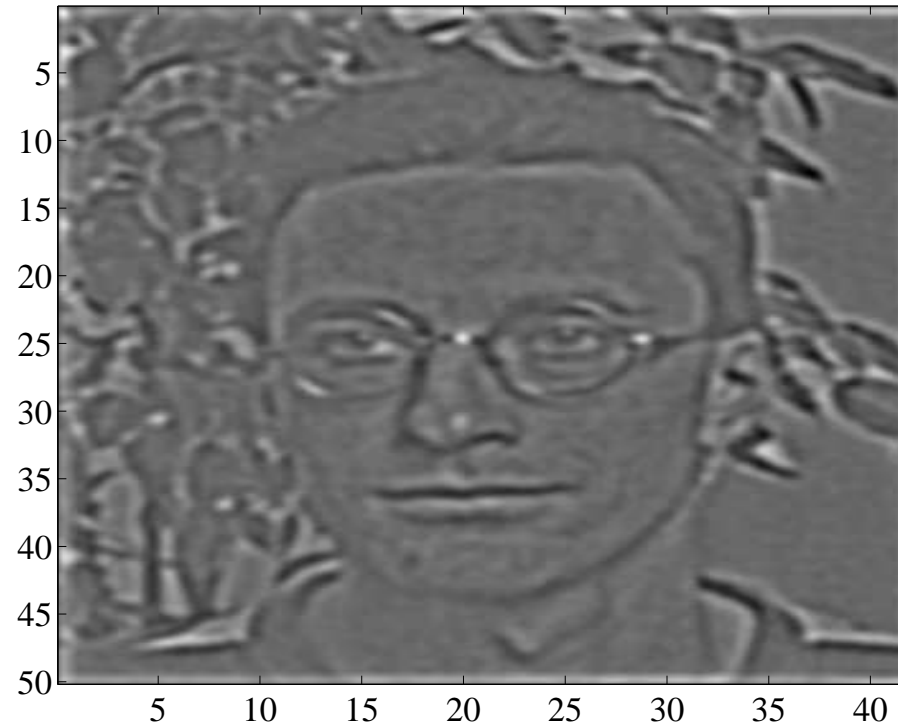


'Difference of Gaussians' Kernel(2/2)



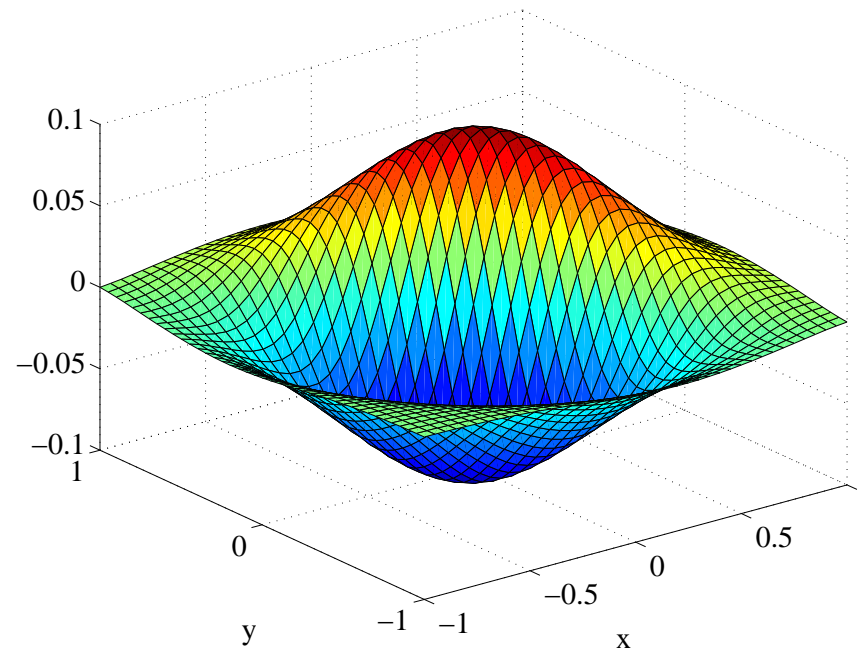


Contrast Enhanced



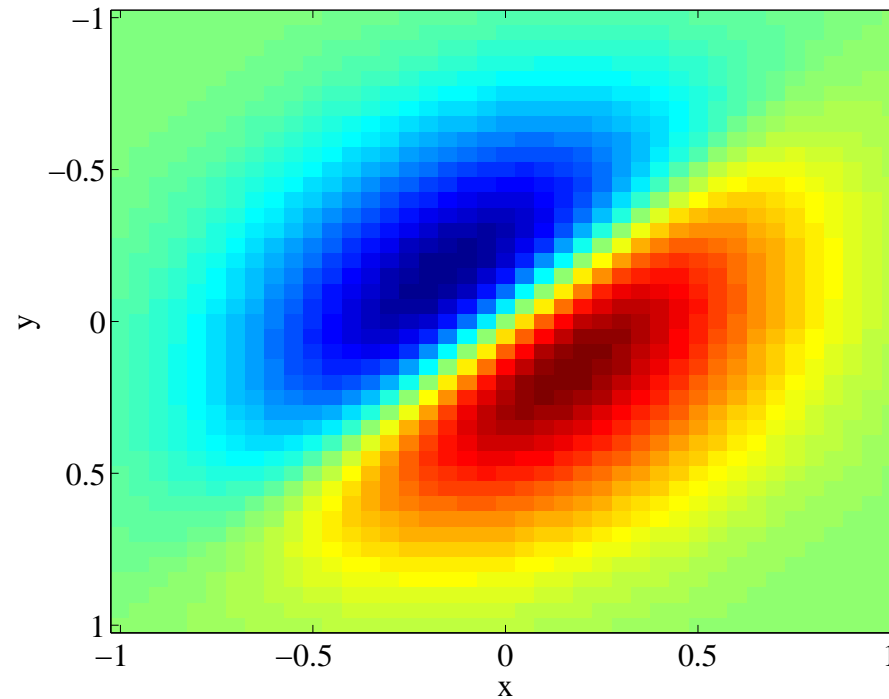


45 Degrees Edge Kernel (1/2)





45 Degrees Edge Kernel (2/2)





45 Degrees Edges Extracted

