R·I·T

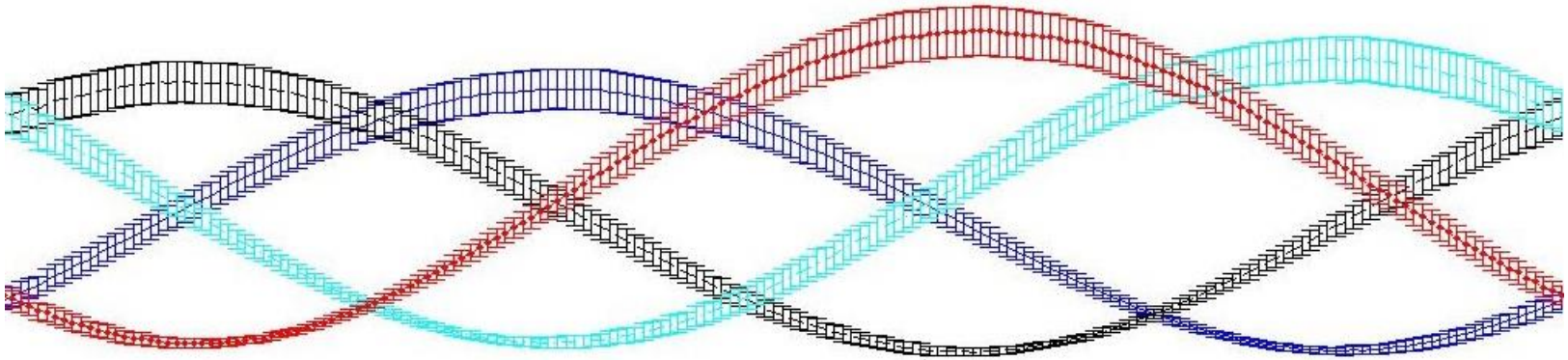
MOXTEK

Lorentz center

Polarimetric Techniques & Technology

Workshop: 24 – 28 March 2014, Leiden, the Netherlands

Micropolarizer arrays and polarization-sensitive imaging sensors



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Why measure polarization?

Polarization is a fundamental property of EM radiation.

Polarization provides information about *geometry, texture and shading*.

Polarization is largely uncorrelated with spectral and intensity features.

How to measure polarization?

Modulate the intensity.

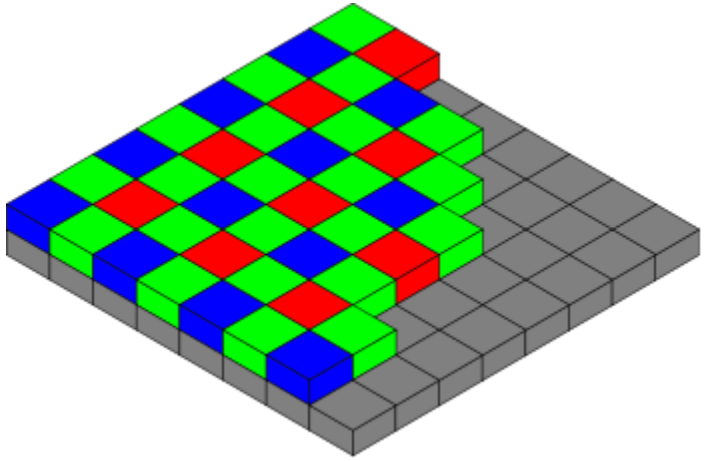
+ Division of time
    - mechanically or electrically rotate polarizer axis

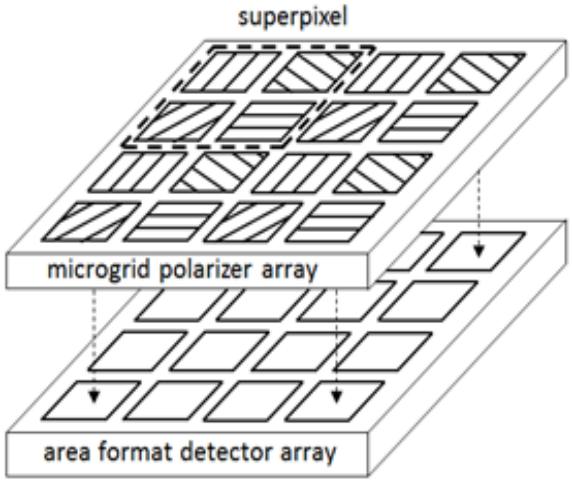
+ Division of intensity
    - use beam-splitting optics to create several channels

See review by J. S. Tyo et al. 2006

Division of Focal Plane

Modulate the intensity at the pixel level



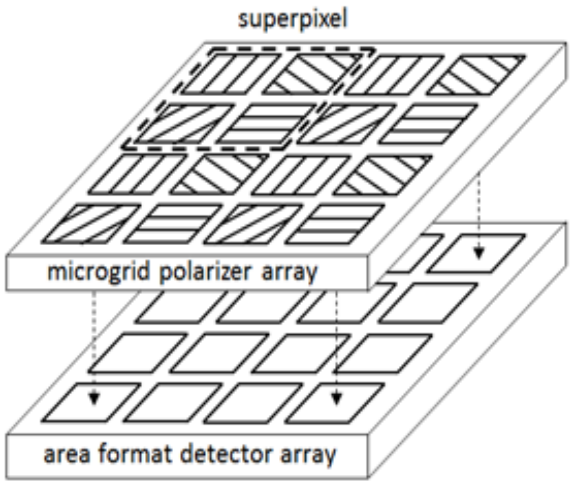


Division of Focal Plane

Advantages

ideal for deployment in space, air and on people

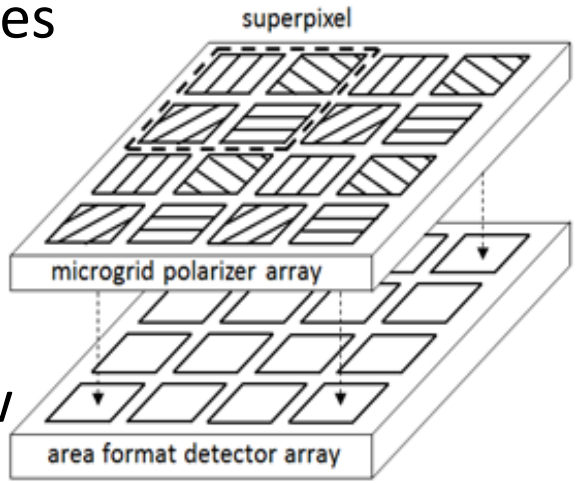
- Snapshot
- Compact
- Light weight
- No moving parts
  - Stable calibration
  - Low risk of failure
- Low power requirement
- Easy data management
- Single detector



Division of Focal Plane

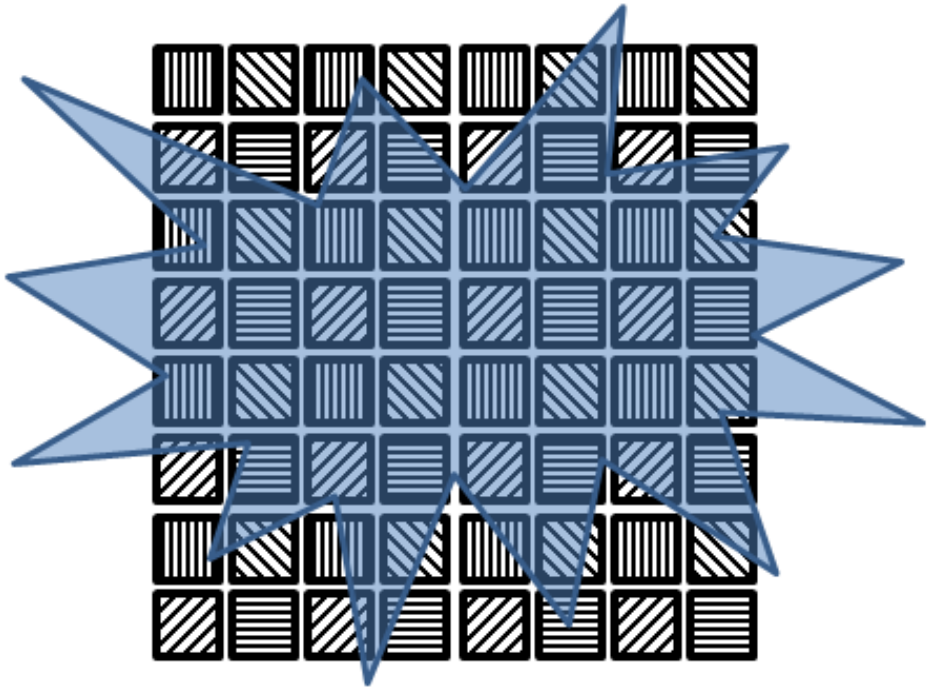
Challenges

- Instantaneous field of view differences
  - Proper sampling is needed

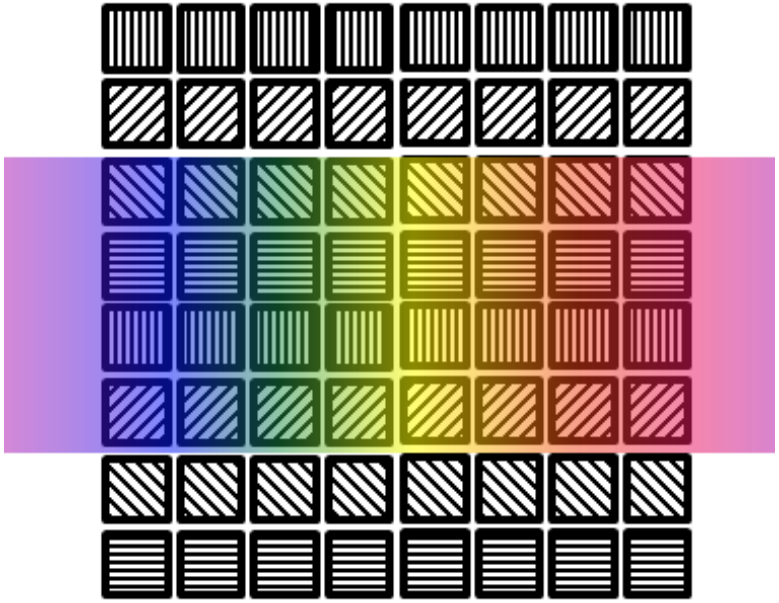


Oversampling -> loss of field of view
not loss of resolution

Several Pixel Layouts

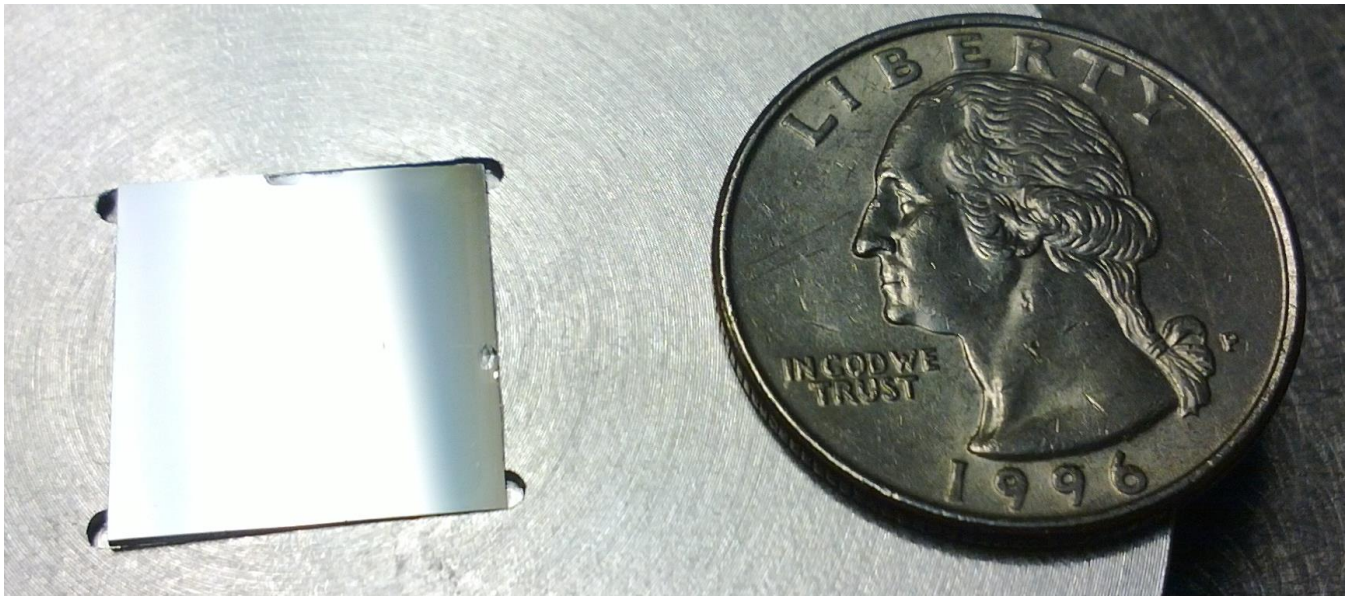


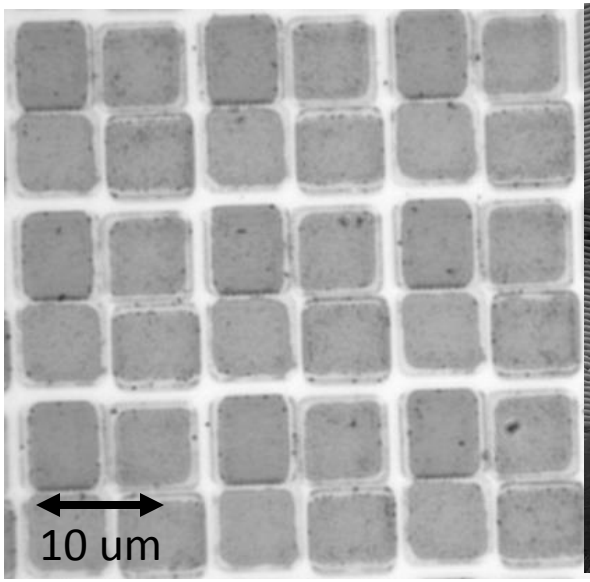
For imaging polarimetry

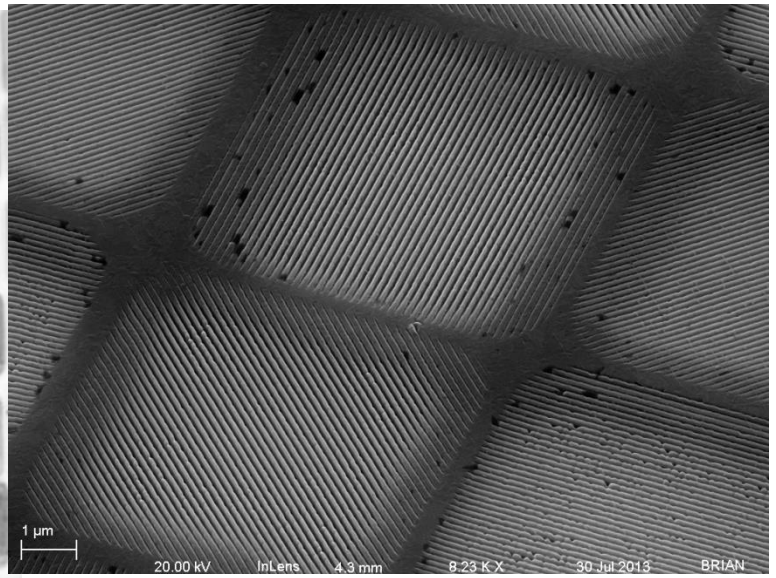


For spectropolarimetry

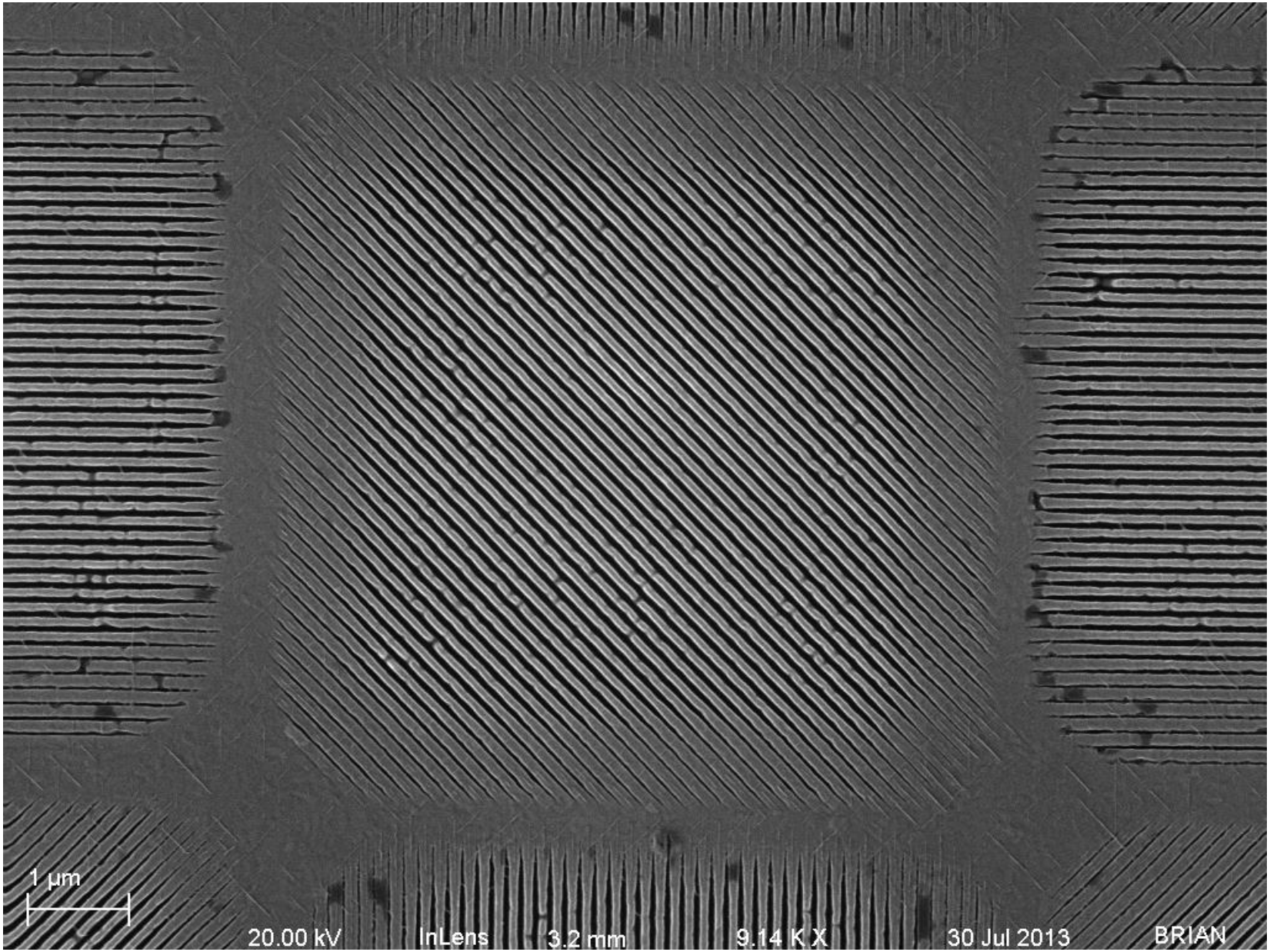
Micropolarizer Arrays



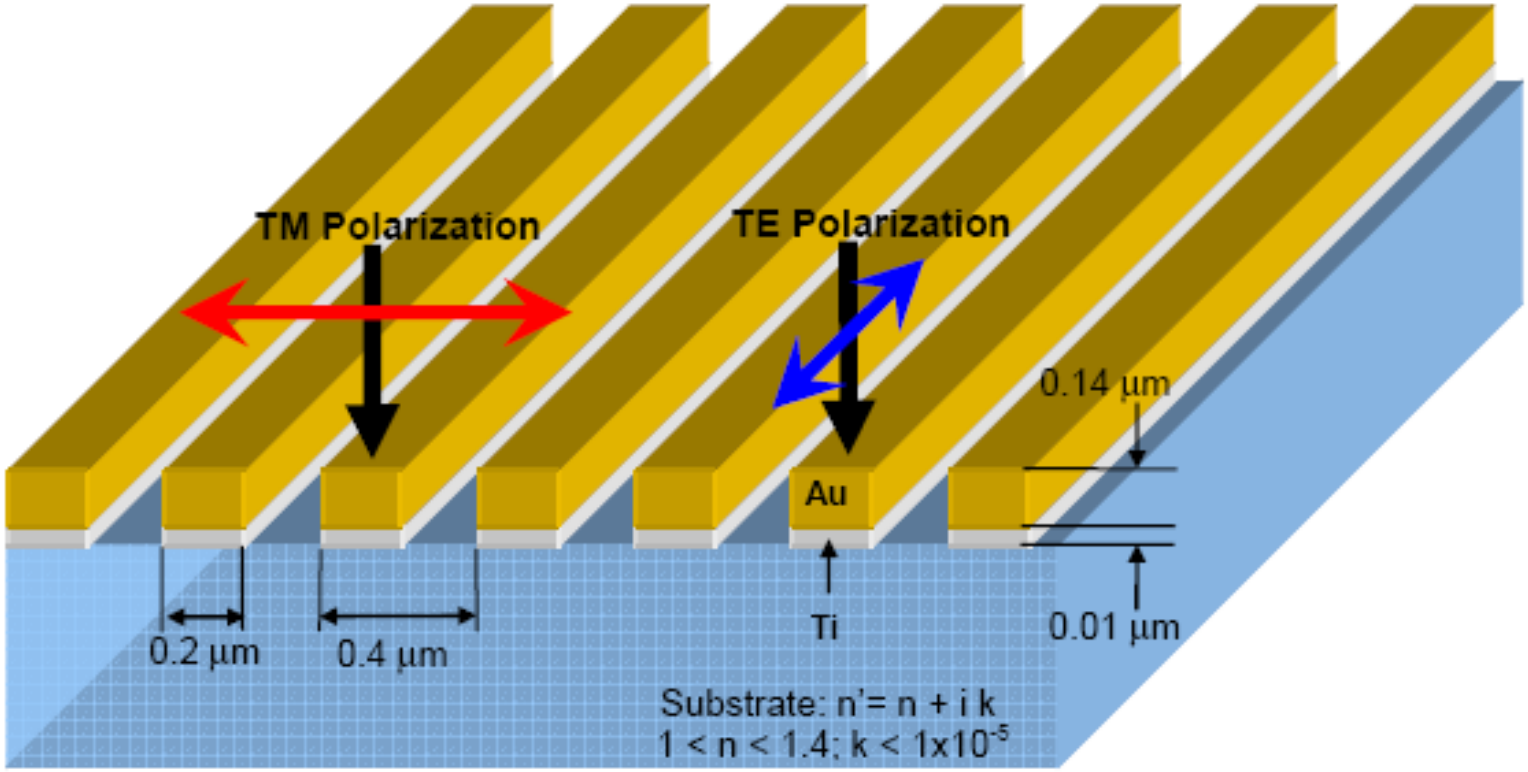




One Polarizer Pixel



One Polarizer Pixel



Source: Kemme et al., (2006).

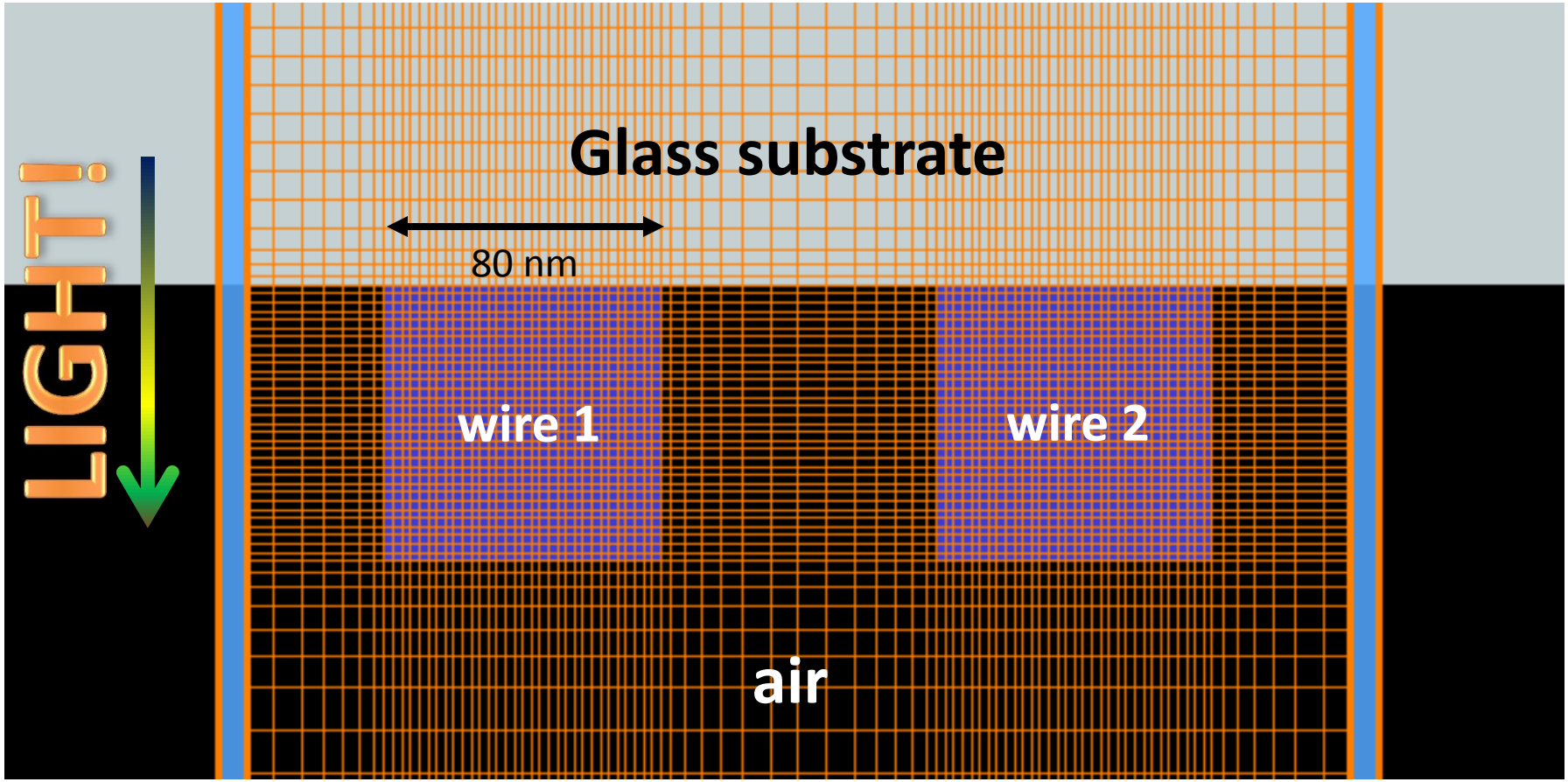
Micropolarizer Performance

Contrast ratio: *ability to reject unwanted polarization states*

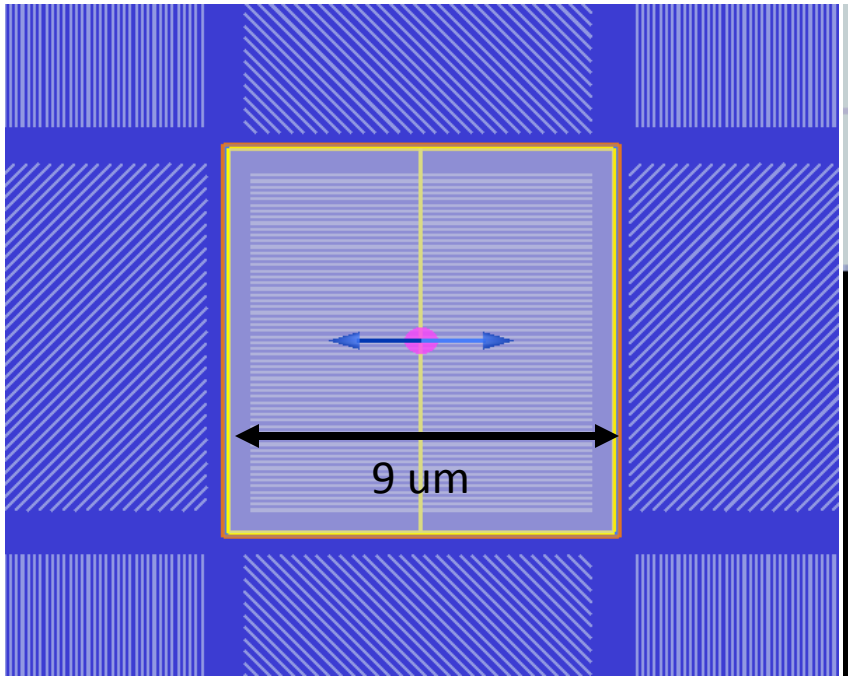
Throughput: *ability to transmit desired polarization states*

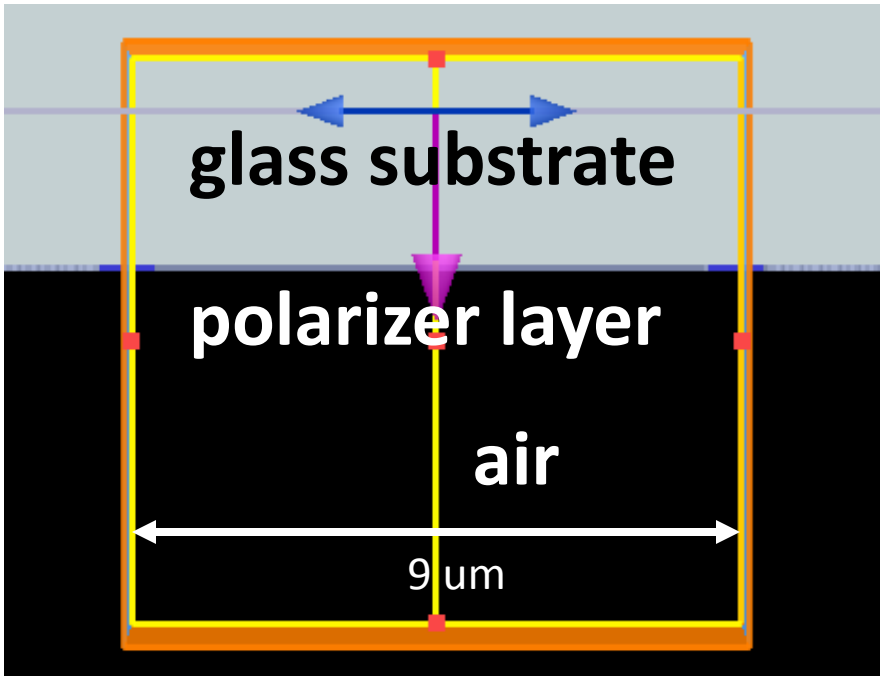
Spectral operational range

Finite-difference time-domain modeling



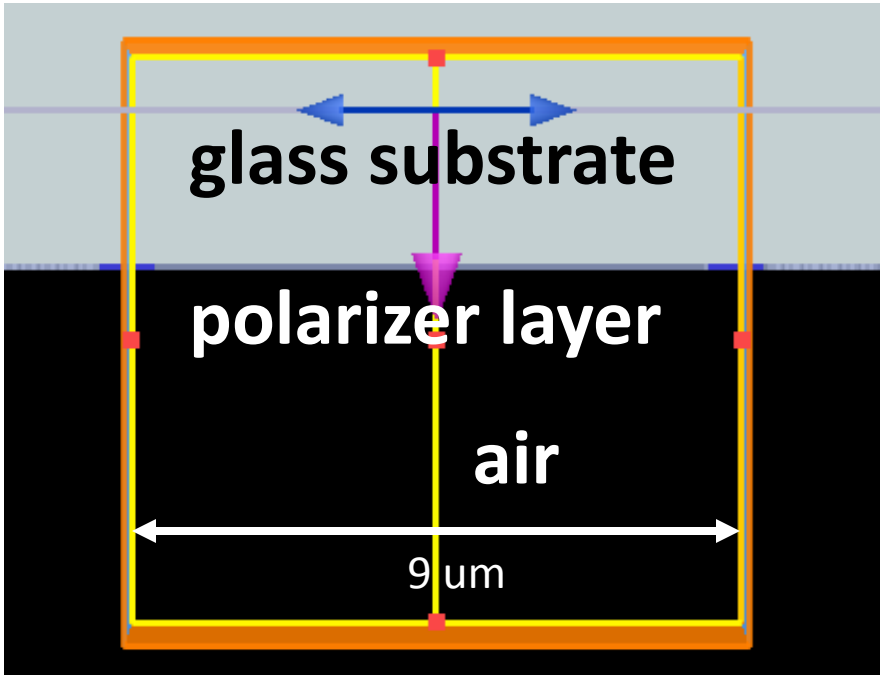
single-pixel modeling



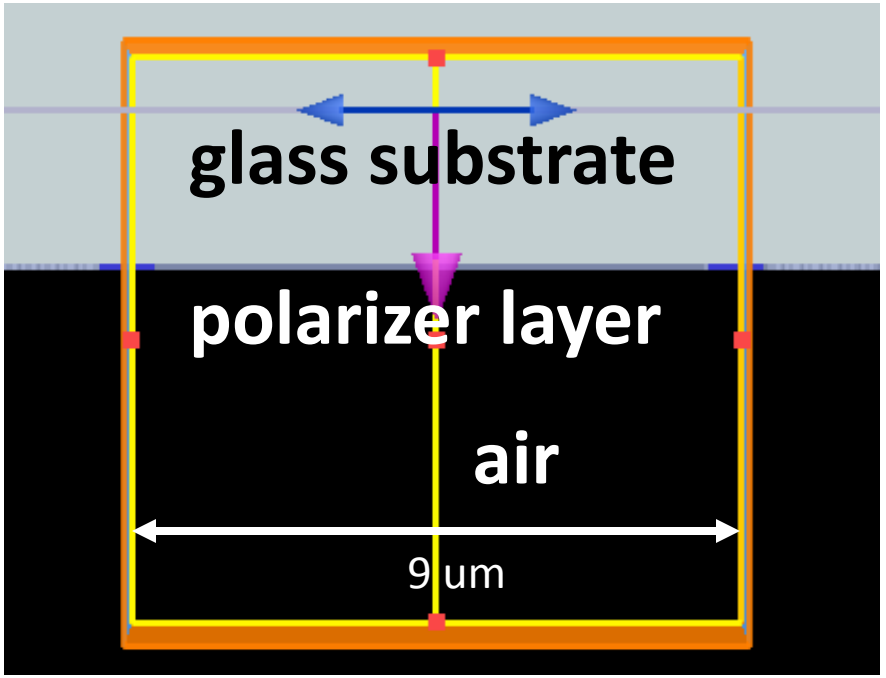


single-pixel modeling

polarization parallel to wires

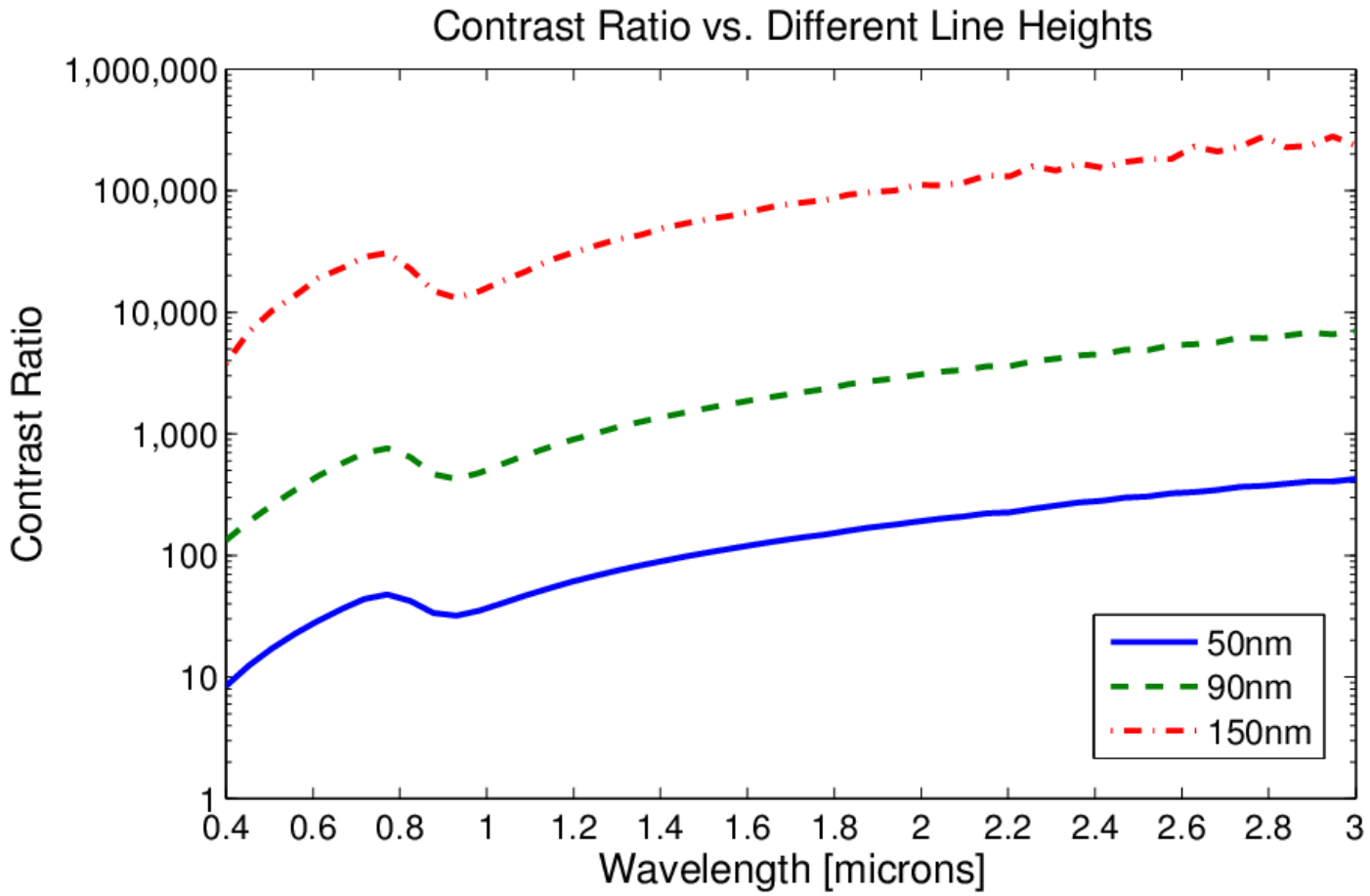


single-pixel modeling



polarization perpendicular to wires

single-pixel modeling



I borrowed a better camera…

4D Technology

Optical Metrology for a Dynamic World

Sample data!

Stokes Parameters

Polarization!

Movie!

Conclusions

- What could you do with this?
- What are the requirements of your application?
  - Contrast ratio?
  - Throughput?

Please let me know!