“Light field photography using a handheld plenoptic camera”

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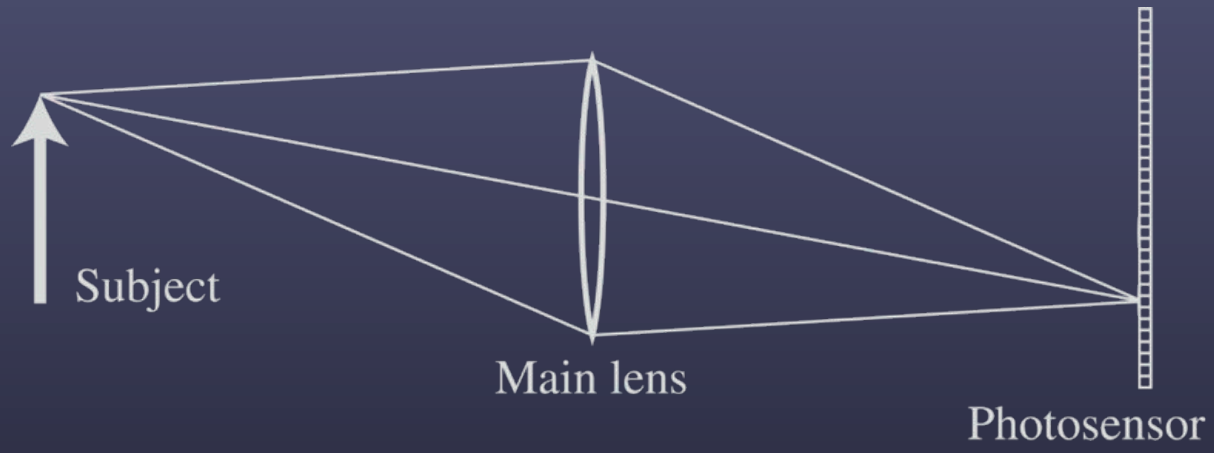
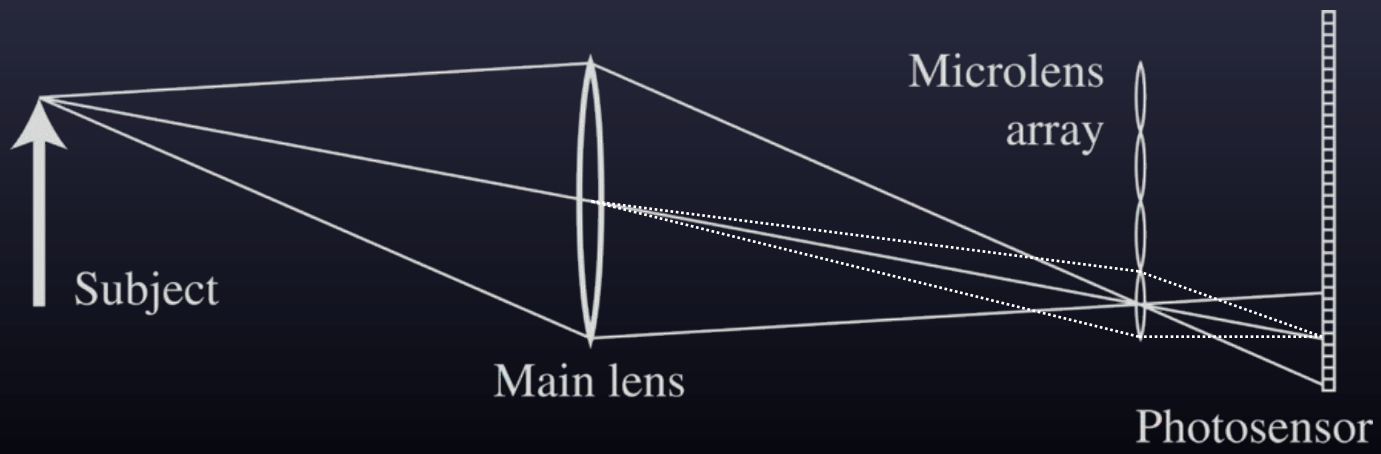
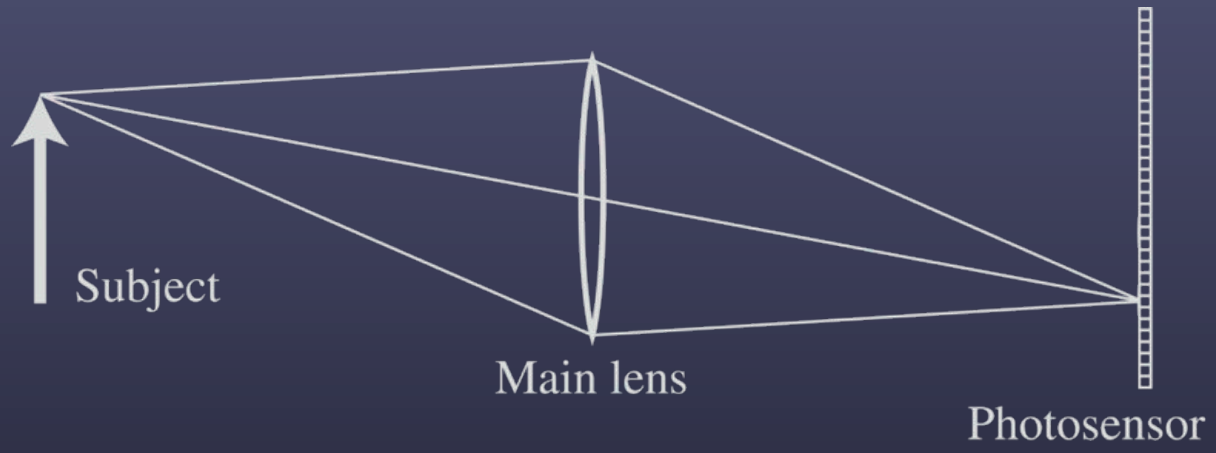
and TR 2005-02)

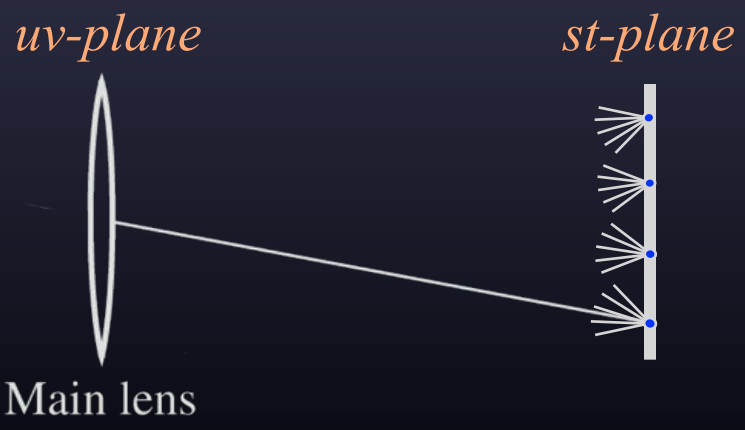
Conventional versus plenoptic camera





Conventional versus plenoptic camera

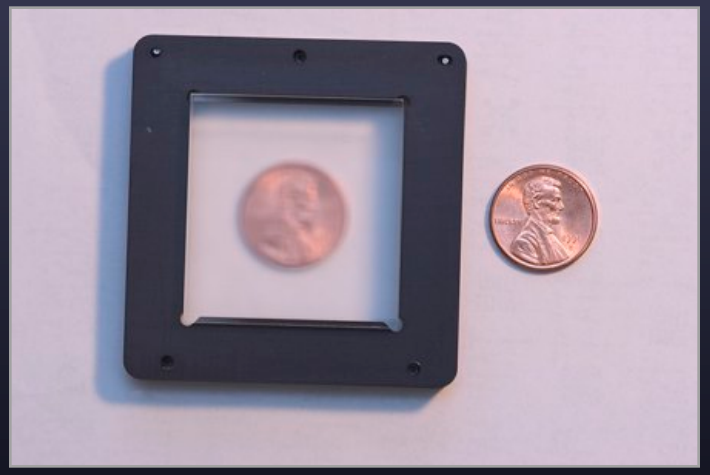




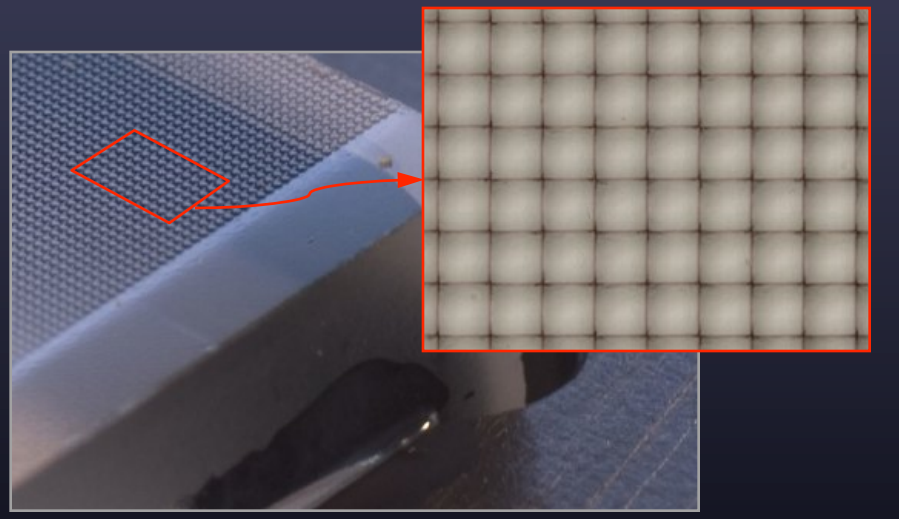
Prototype camera

Contax medium format camera

Kodak 16-megapixel sensor

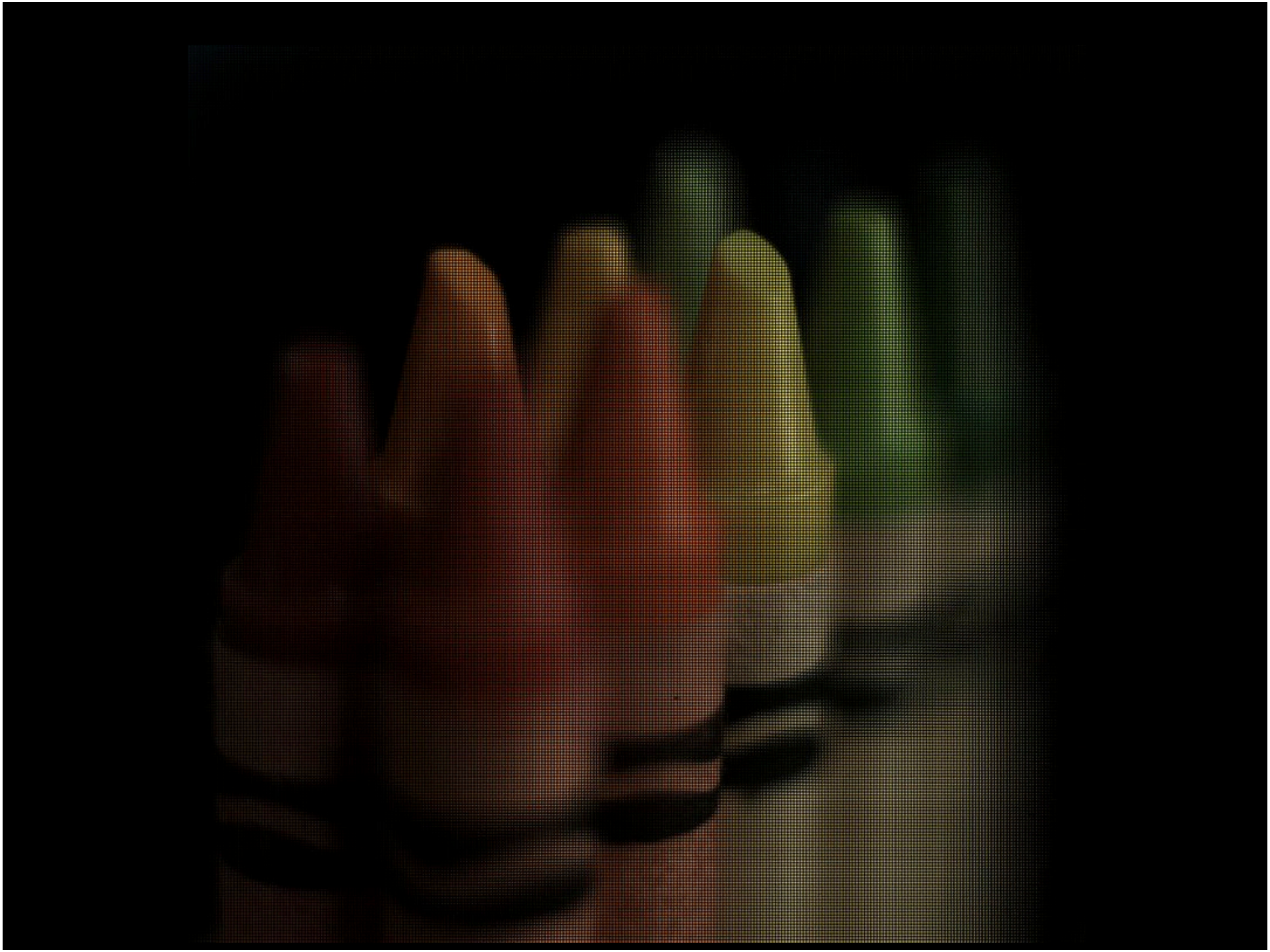


Adaptive Optics microlens array

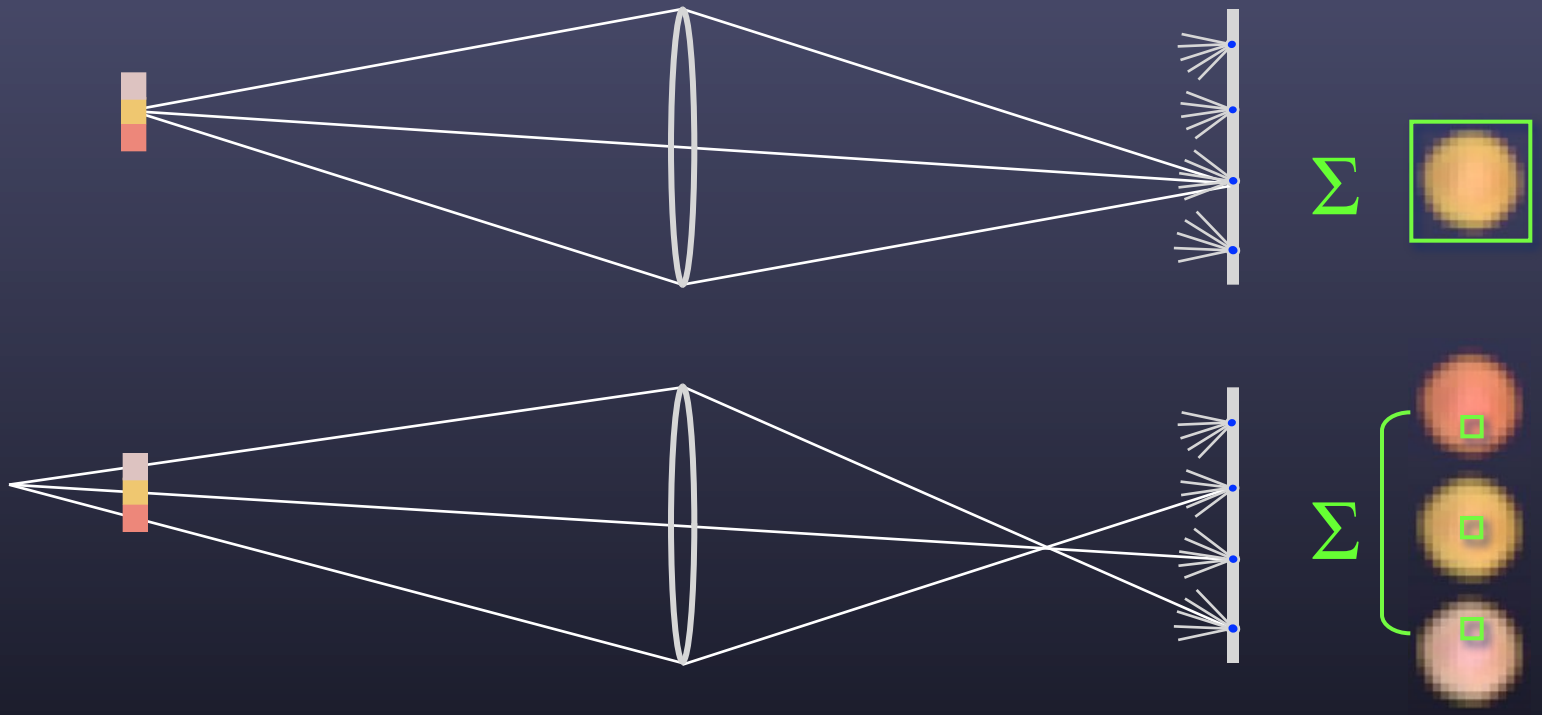


125µ square-sided microlenses

4000 × 4000 pixels ÷ 292 × 292 lenses = 14 × 14 pixels per lens



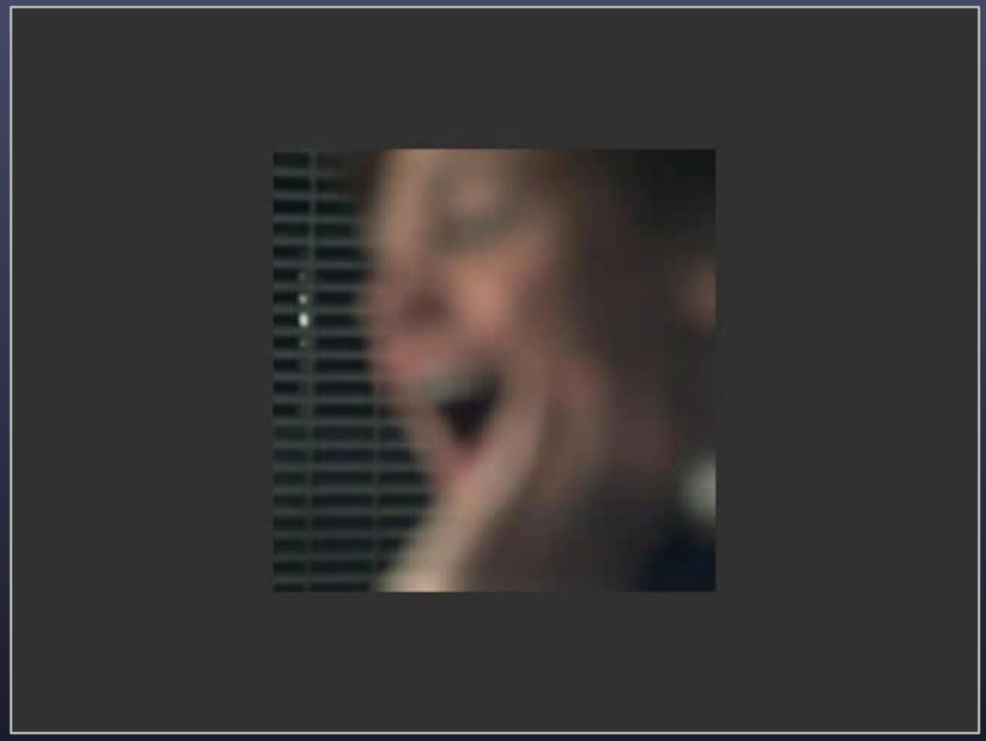
Digital refocusing



- refocusing = summing windows extracted from several microlenses

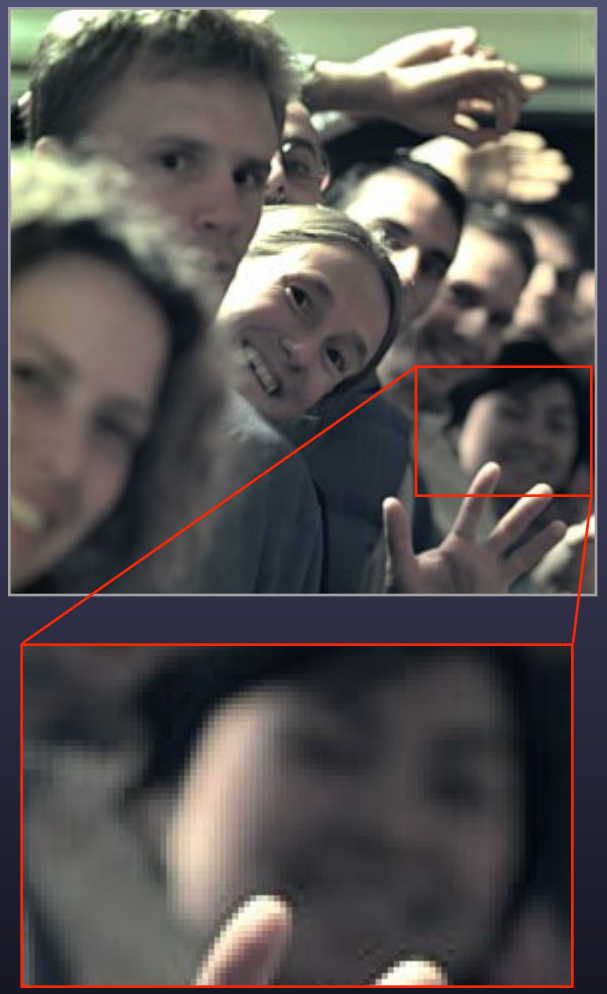
Example of digital refocusing

Refocusing portraits

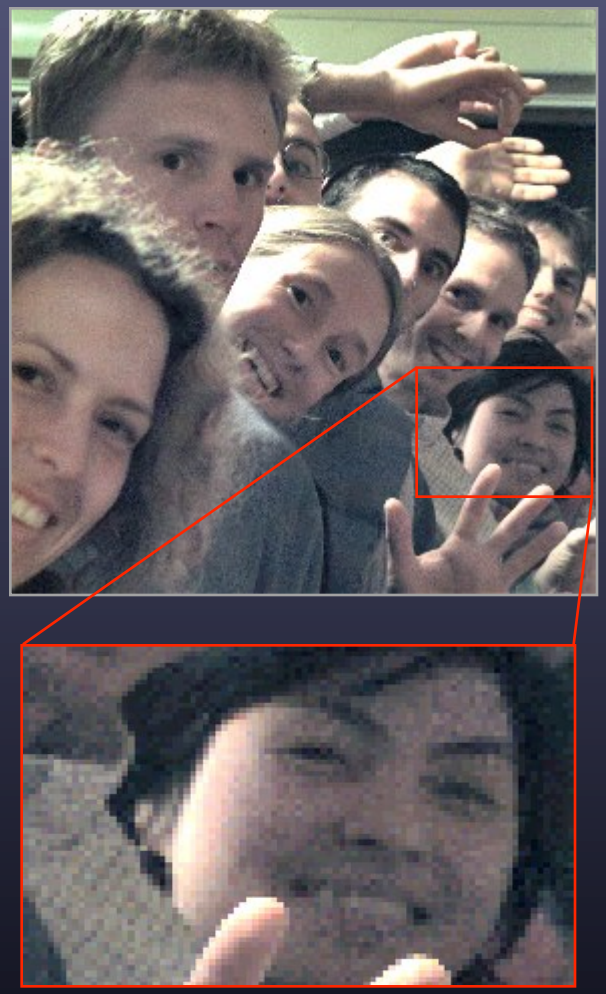


Refocusable sports photography

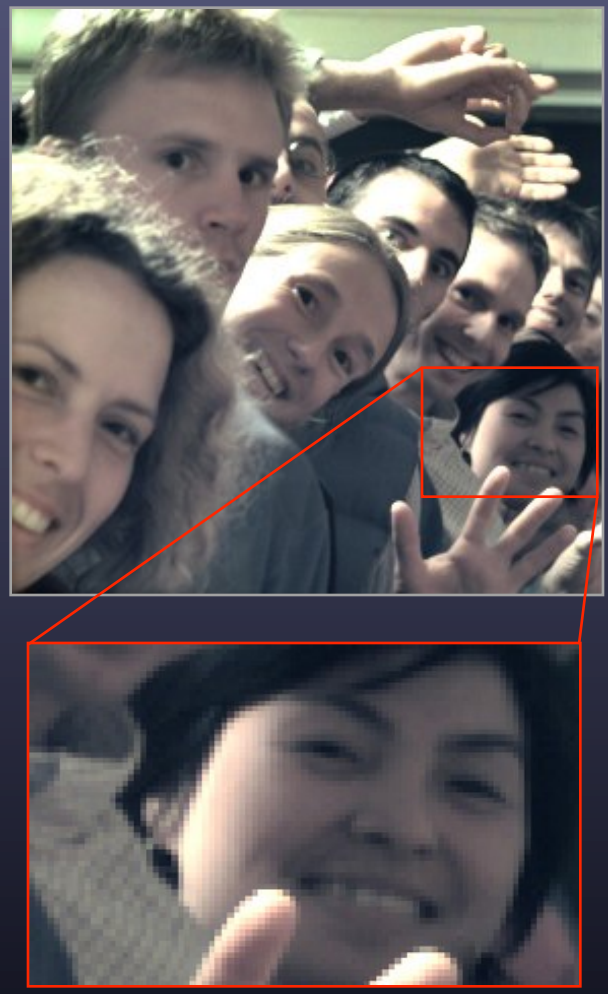
Extending the depth of field



conventional photograph, main lens at f / 4



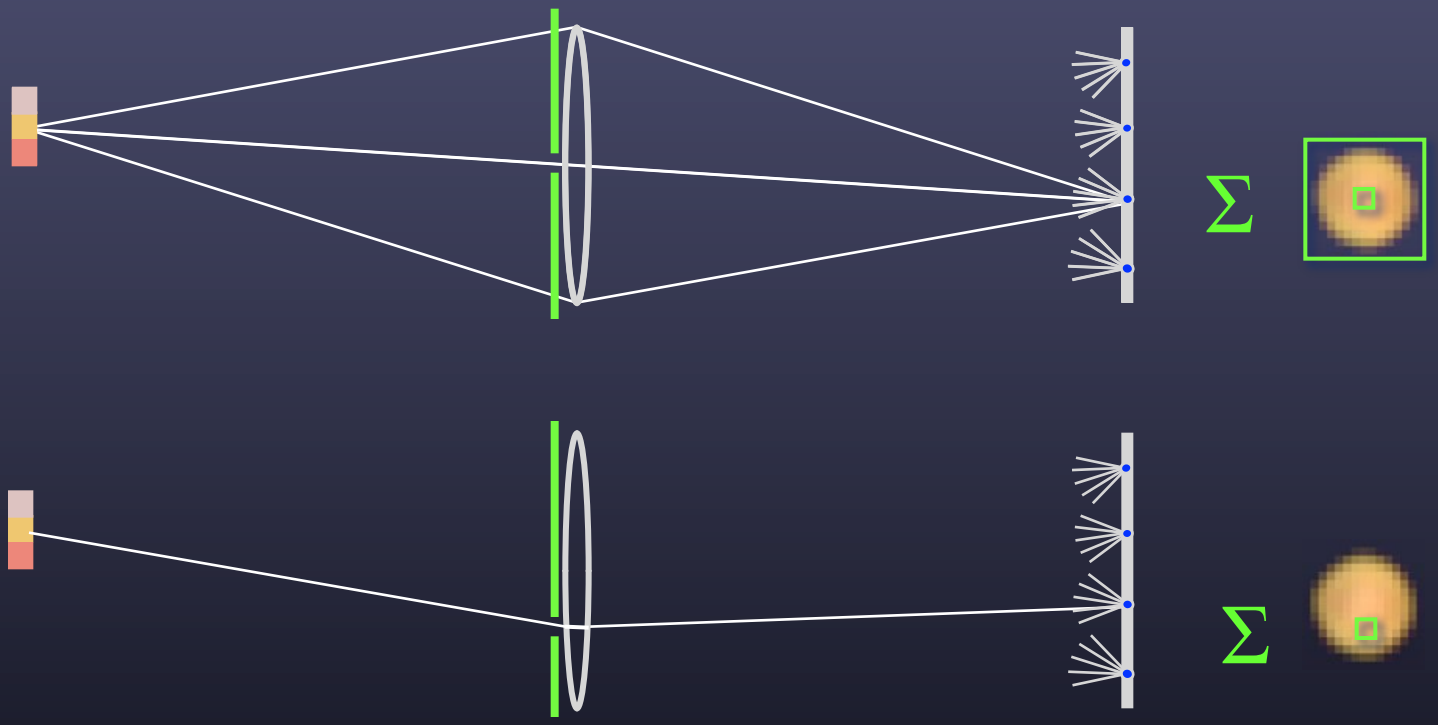
conventional photograph, main lens at f / 22



light field, main lens at f / 4, after all-focus algorithm [Agarwala 2004]

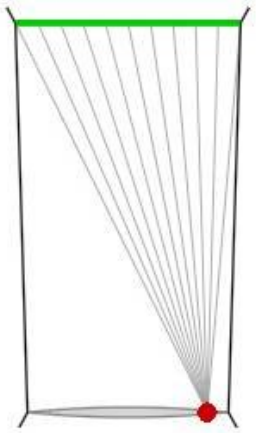
Macrophotography

Digitally moving the observer

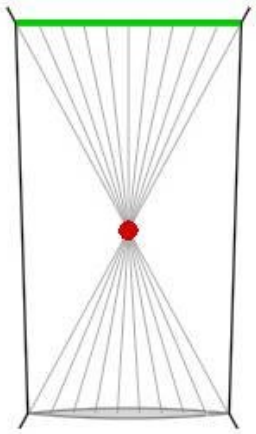


- moving the observer = moving the window we extract from the microlenses

Example of moving the observer



Moving backward and forward



Implications / commercialization
(see refocusimaging.com)

- cuts the unwanted link between exposure (due to the aperture) and depth of field
- trades off (excess) spatial resolution for ability to refocus and adjust the perspective
- sensor pixels should be made even smaller, subject to the diffraction limit

  36mm × 24mm ÷ 2.5μ pixels = 266 Mpix

  20K × 13K pixels

  2000 × 1333 pixels × 10 × 10 rays per pixel

  or

  2000 × 1500 pixels × 3 × 3 rays per pixel = 27 Mpix