

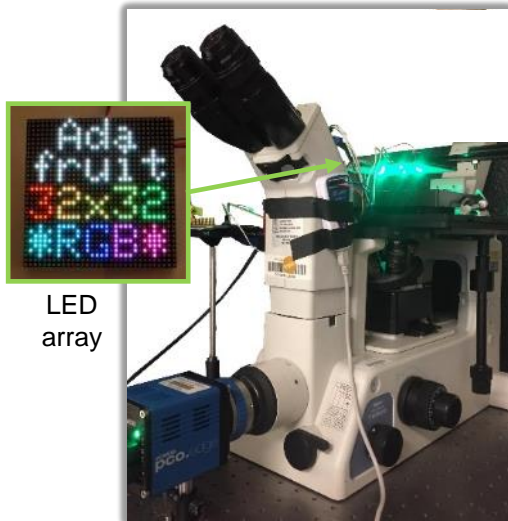
# Computational Microscopy

Joint design of optical hardware and computer software for new imaging capabilities

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## 1) Modify hardware



LED array

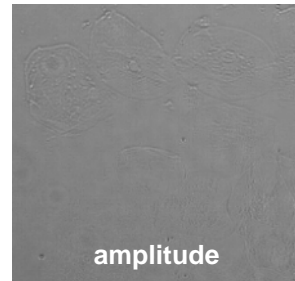
## 2) Crunch data

$$\arg \min_{\mathbf{x}, \mathbf{s}} \|\mathbf{b} - \mathbf{A}\mathbf{x}\|^2 + f(\mathbf{x})$$

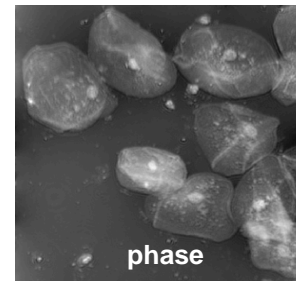
Nonlinear optimization algorithms for multi-dimensional inverse problems

## 3) Reconstruct images

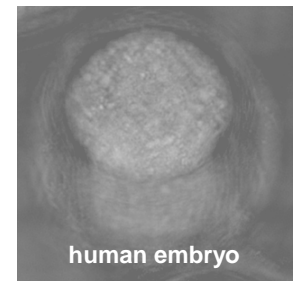
Phase retrieval - visualizes shape/density of transparent samples



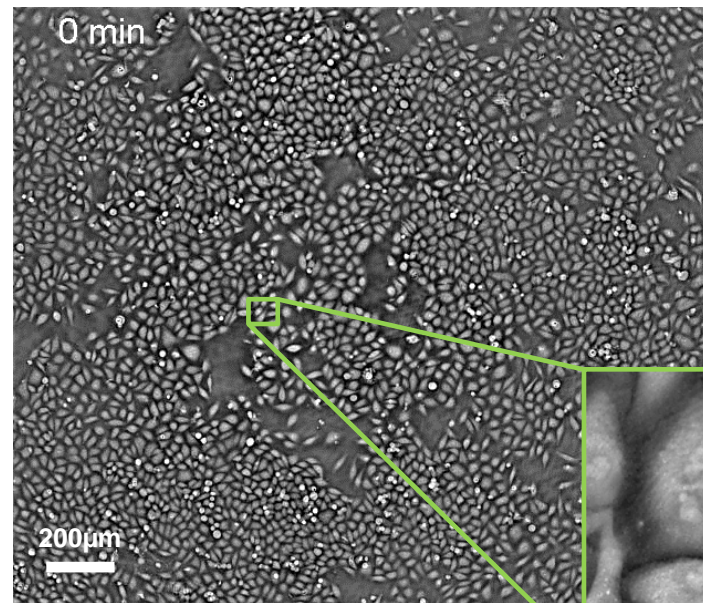
amplitude



phase



human embryo

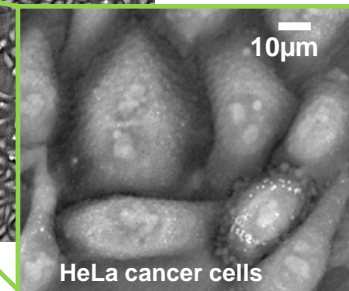
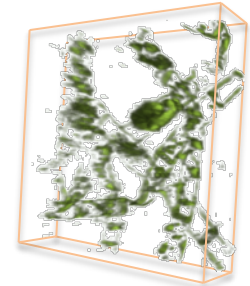


0 min

200µm

Gigapixel super-resolution

## 3D imaging



10µm

HeLa cancer cells