Stochastic Localization Microscopy (STORM)

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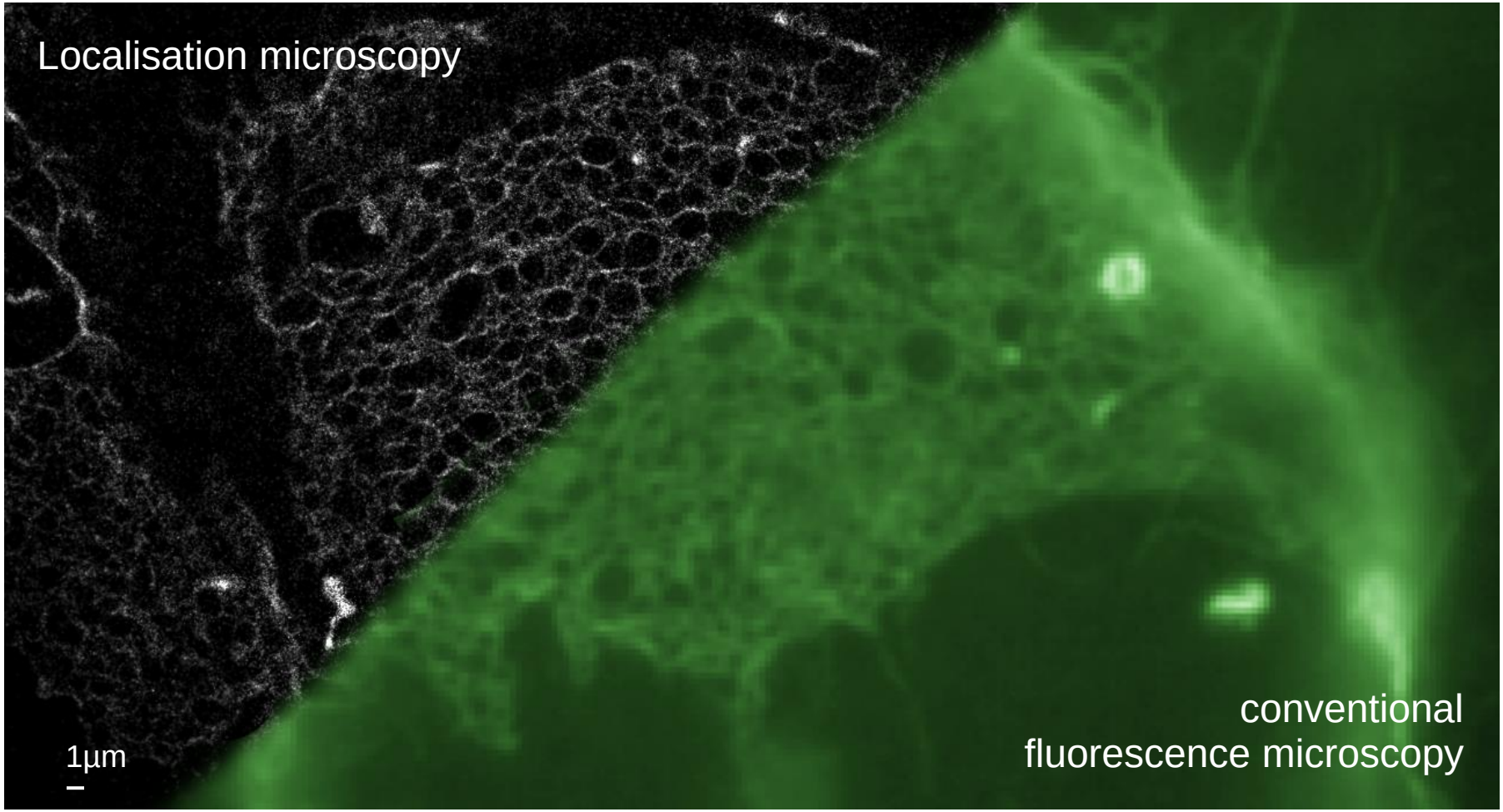
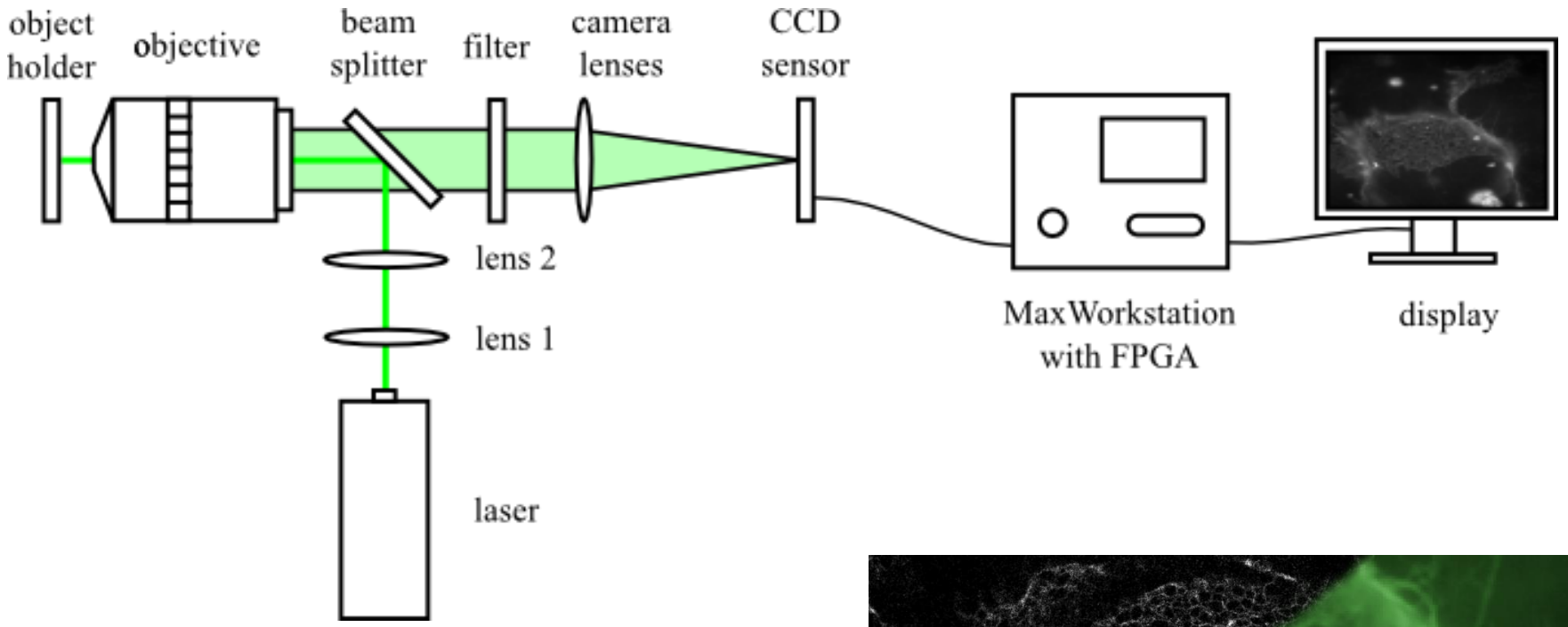
Motivation

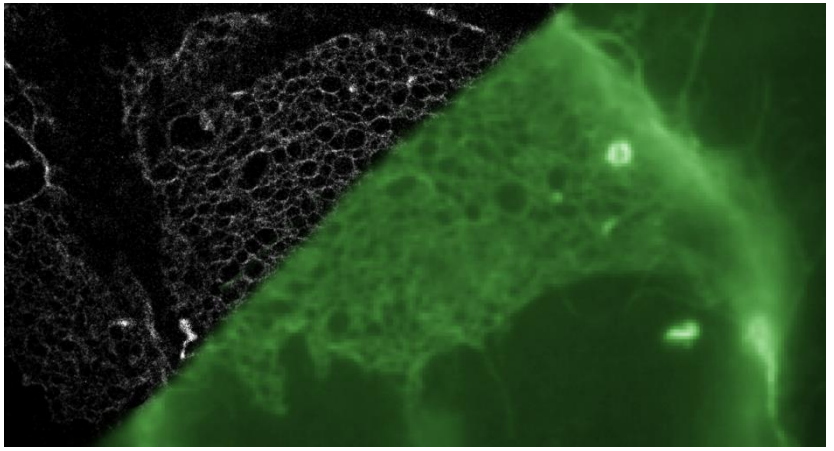


Increases the resolution of visible light microscopy by about a factor of 10.

Localisation microscopy



Fluorophores blink and
can be optically separated



The algorithm

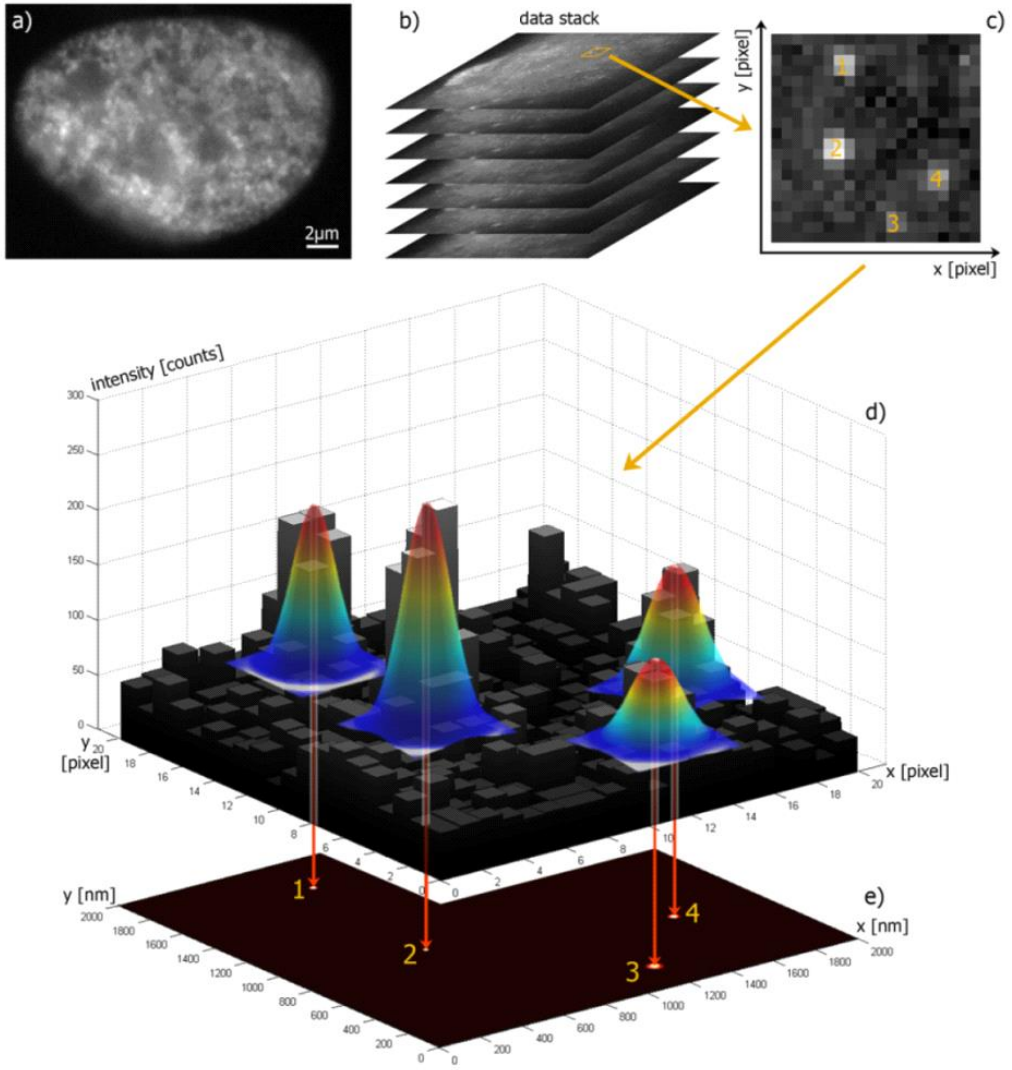


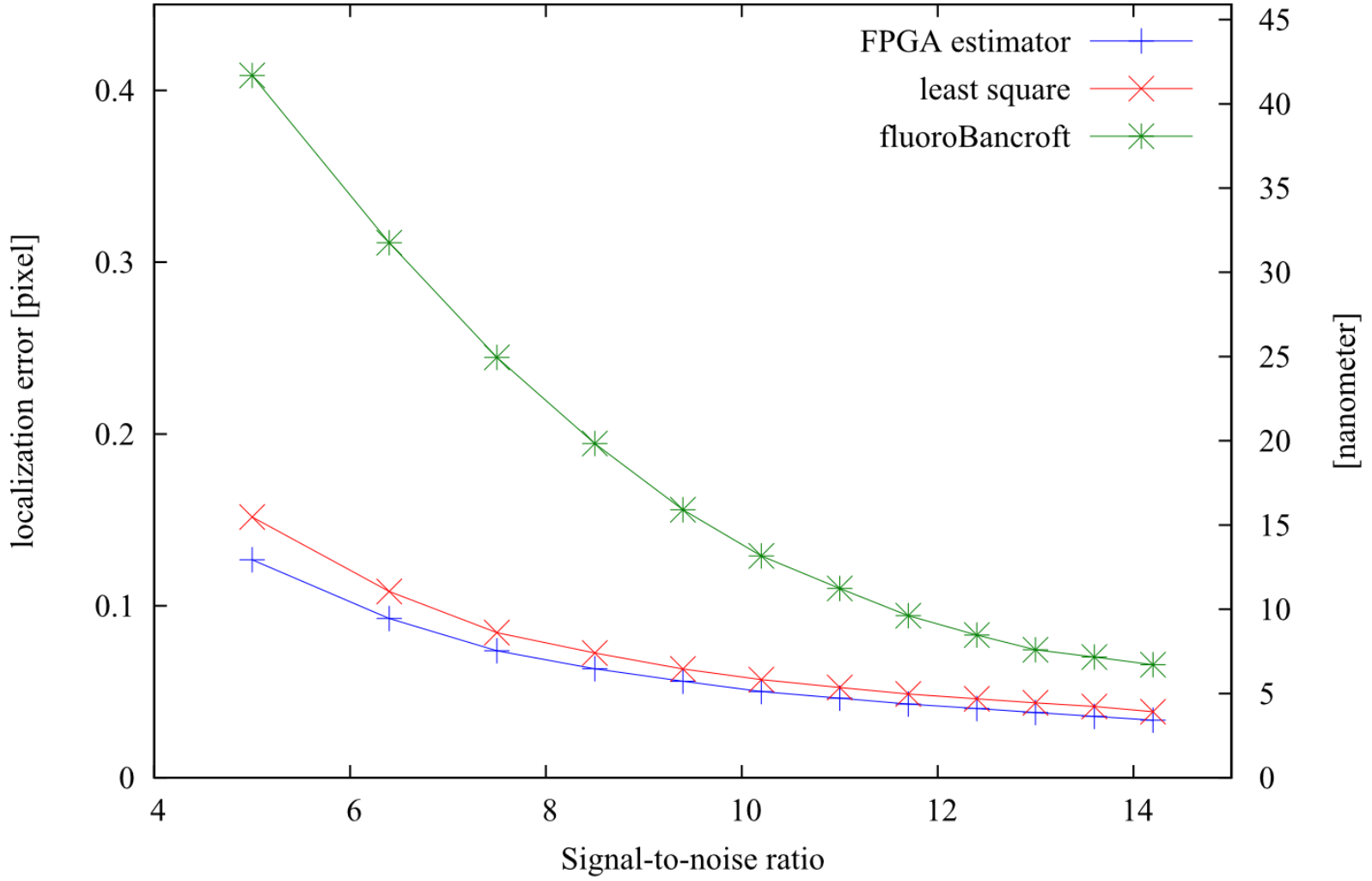
Image: Michael Hausmann

a) Record movie
b) Remove background
c) Find signals of blinking fluorophores
d) Locate
e) Plot positions

Steps b) to d) were implemented on the DFE.

Localization accuracy, low background

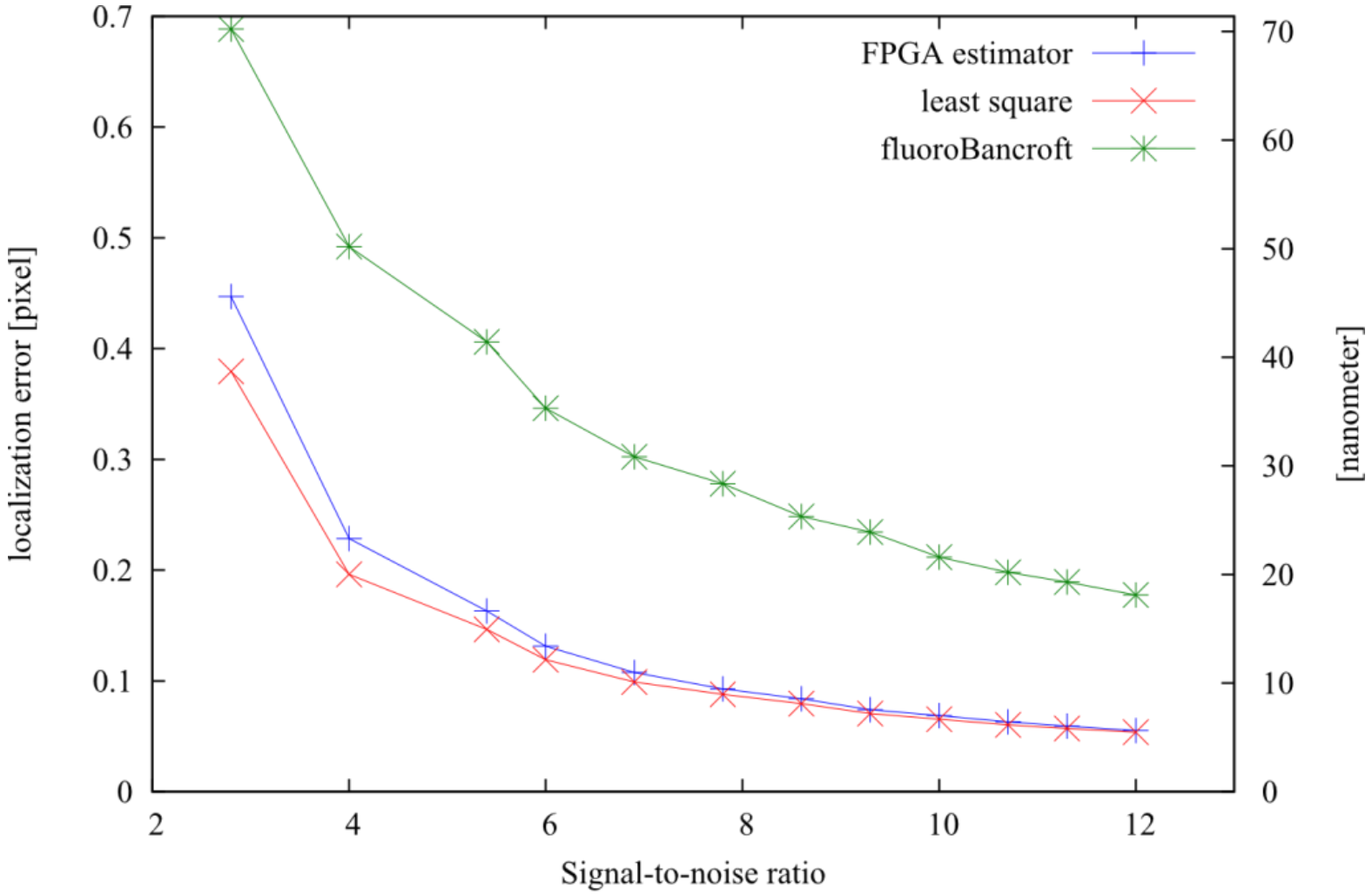
B=10



Better accuracy than least-square fit for low backgrounds

Localization accuracy, high background

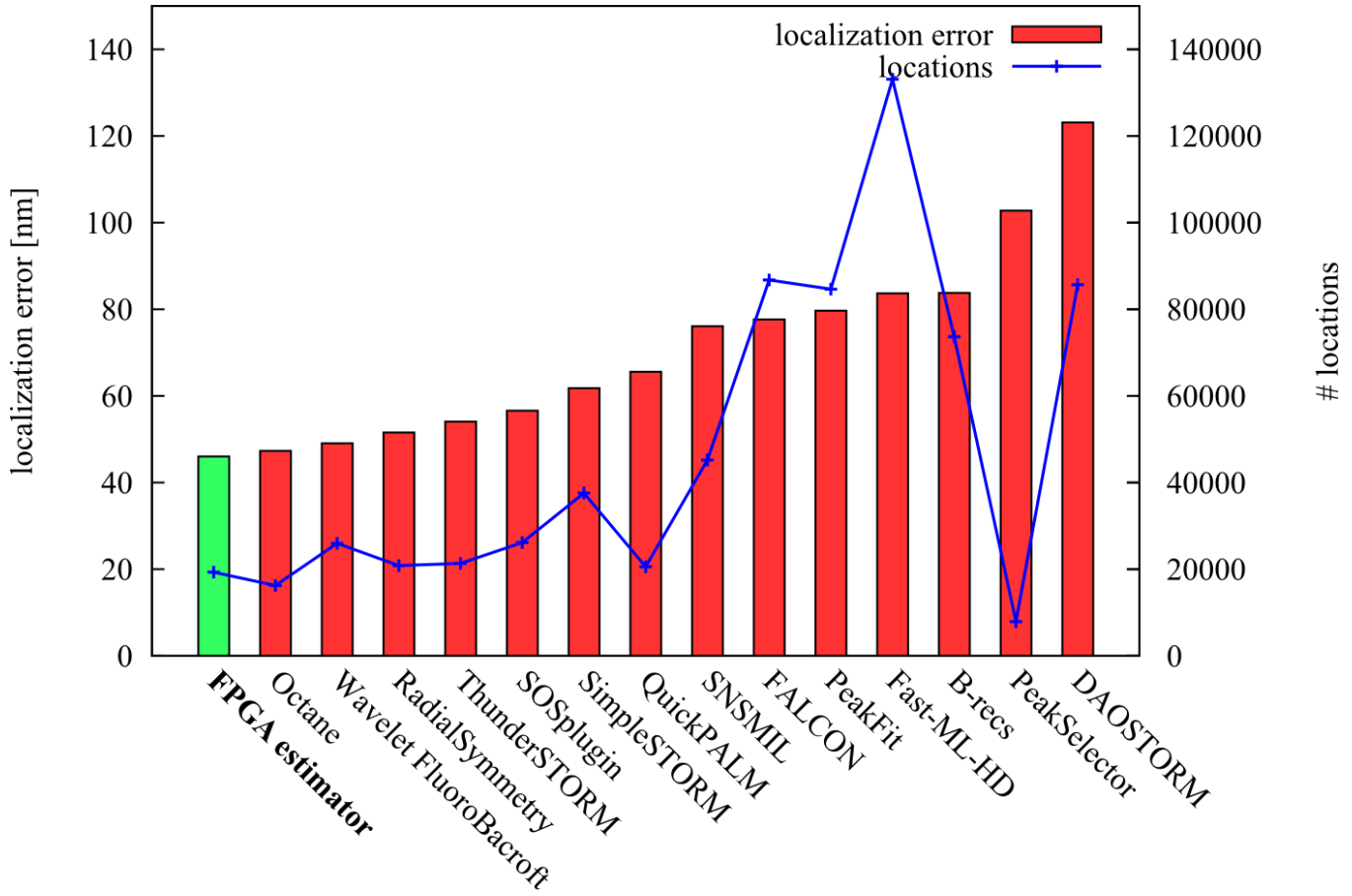
B=100

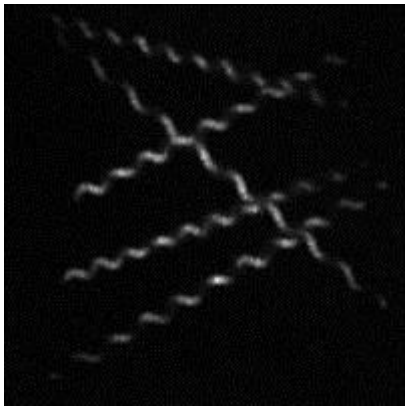


Accuracy within 5% for high backgrounds

Accuracy

ISBI Localization Microscopy Challenge 2013, sample HD3





Acceleration

Typical image with 329,444 signals

Intel i5 450:
Iterative signal fitting

[Intel]

4h

x100

Intel i5: New algorithm with
center-of-mass calculation

[Intel]

1min 20s

x180

Max3
Dataflow design

0.8s

See also:

Grüll, Kirchgessner, Kaufmann, Hausmann, Kebschull:
Accelerating Image Analysis For Localization Microscopy With FPGAs,
International Conference on Field Programmable Logic and Applications 2011

Kaufmann, Piontek, Grüll, Kirchgessner, Rossa, Wolburg, Blasig, Cremer:
Visualization and Quantitative Analysis of Reconstituted Tight Junctions Using Localization Microscopy,
PLoS ONE, vol. 7, Public Library of Science, 2012