CCD thickness investigation

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with

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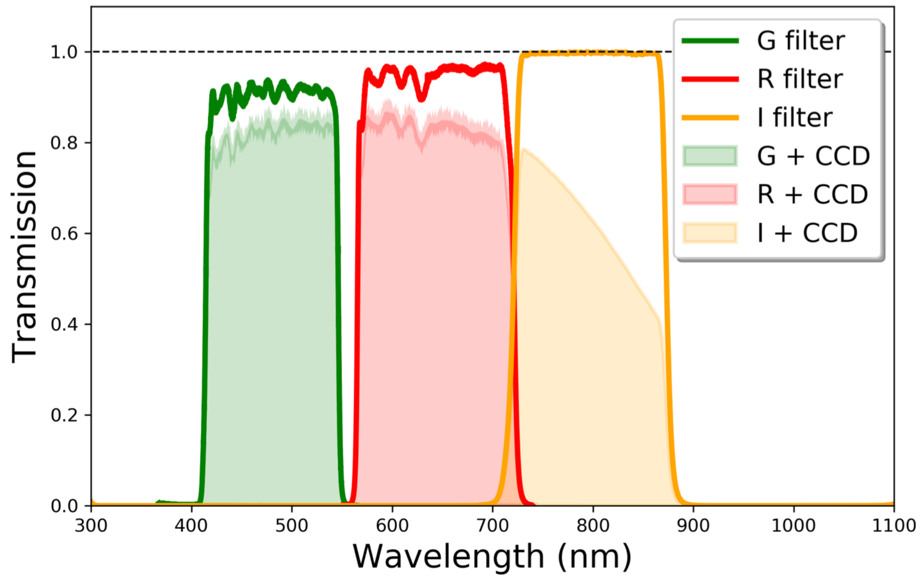
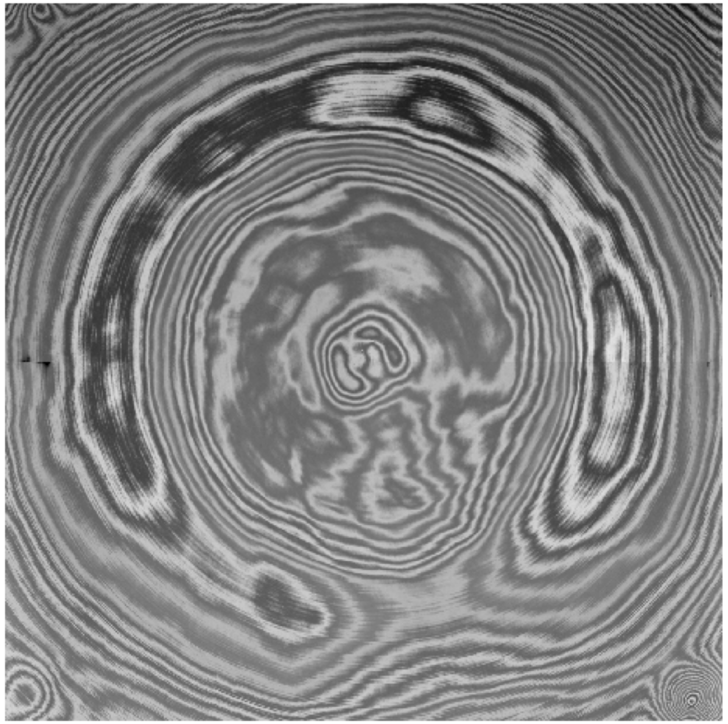
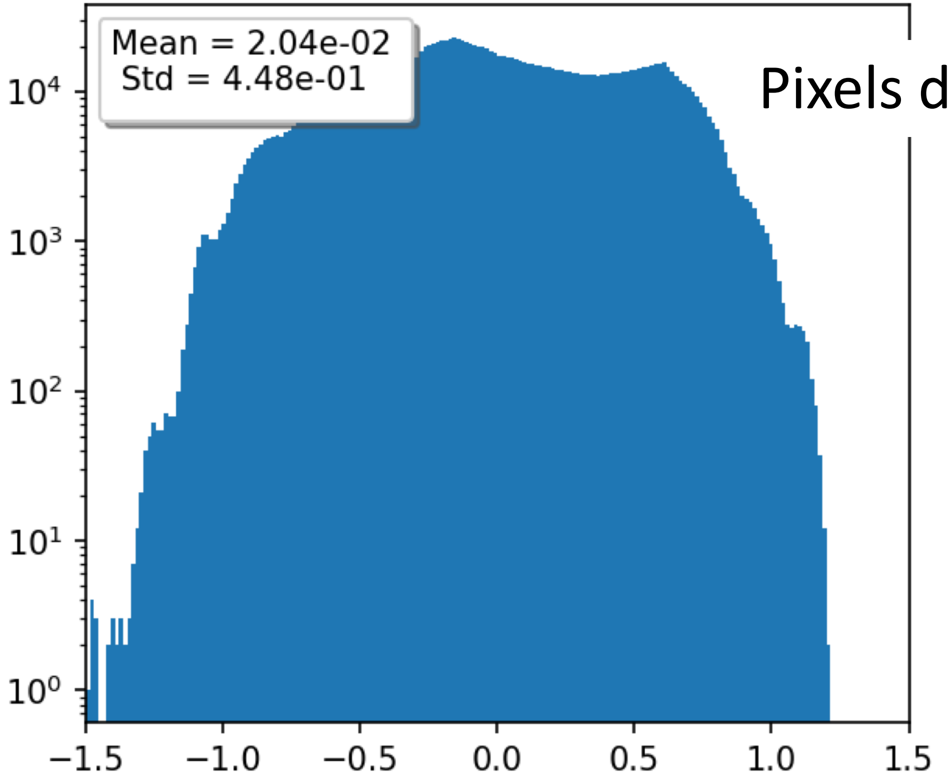
Initial idea: use CCD fringing pattern from PCA analysis of I-band images (M. Medford) to deduce CCD thickness profile



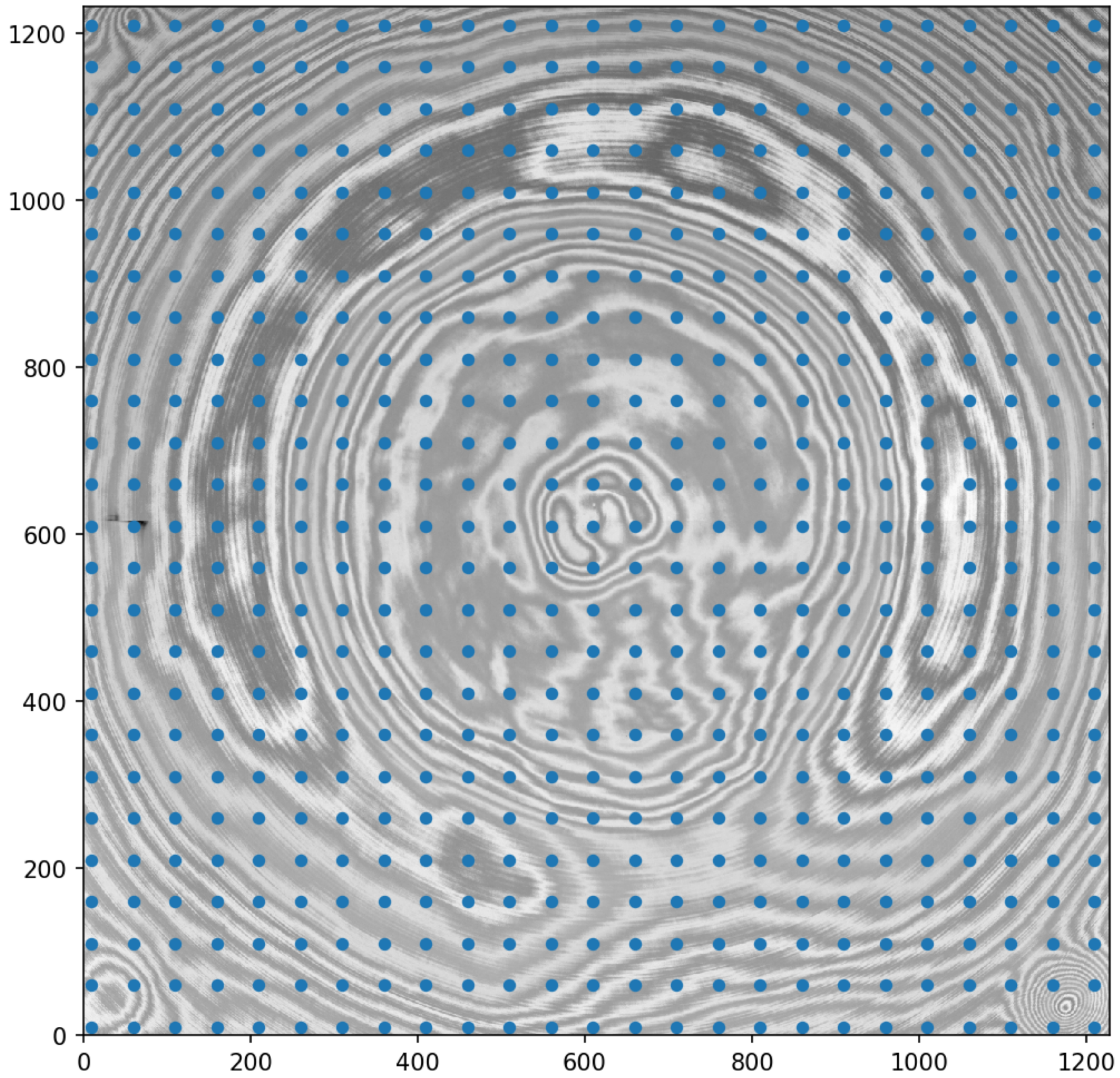
CCD 01 fringing map

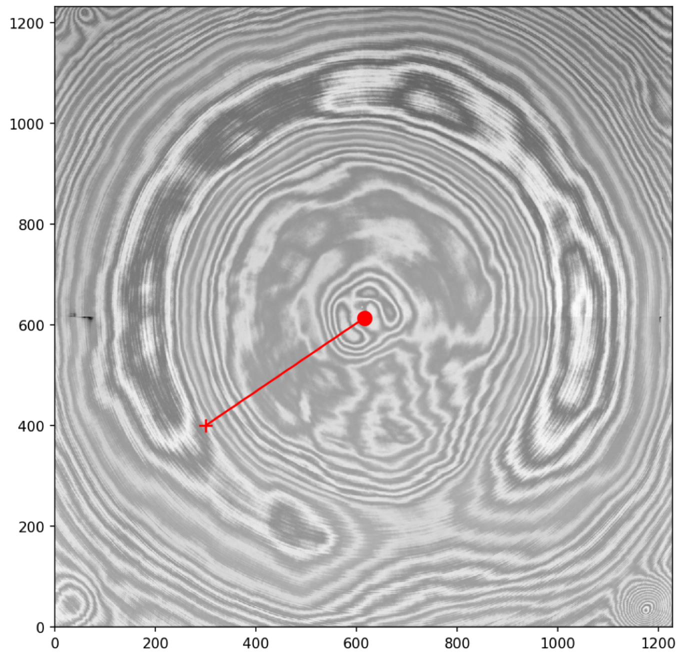


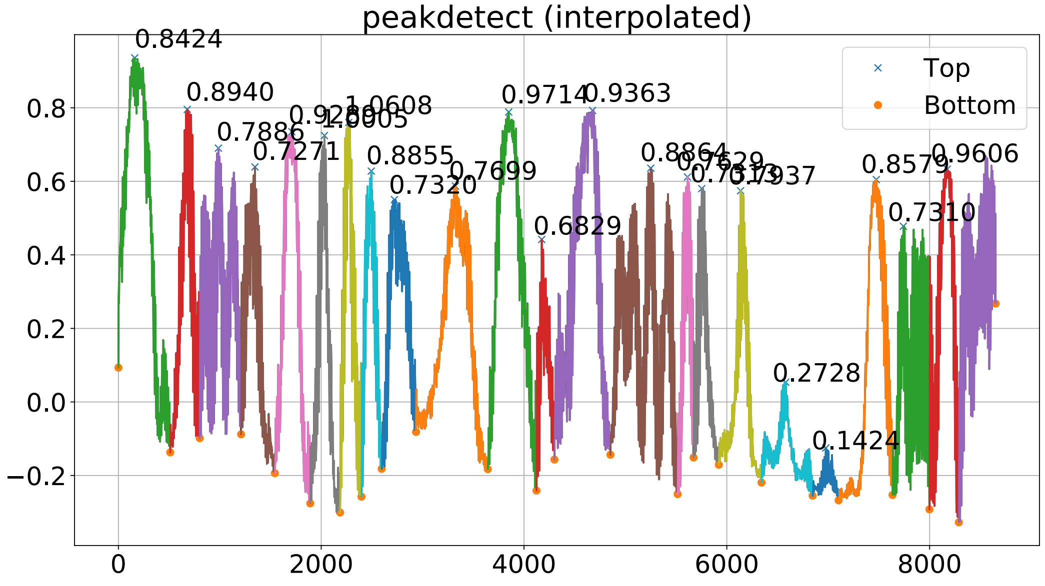


Pixels distribution

Point grid used by Michael Coughlin to count fringing from the CCD centre (CCD 01)

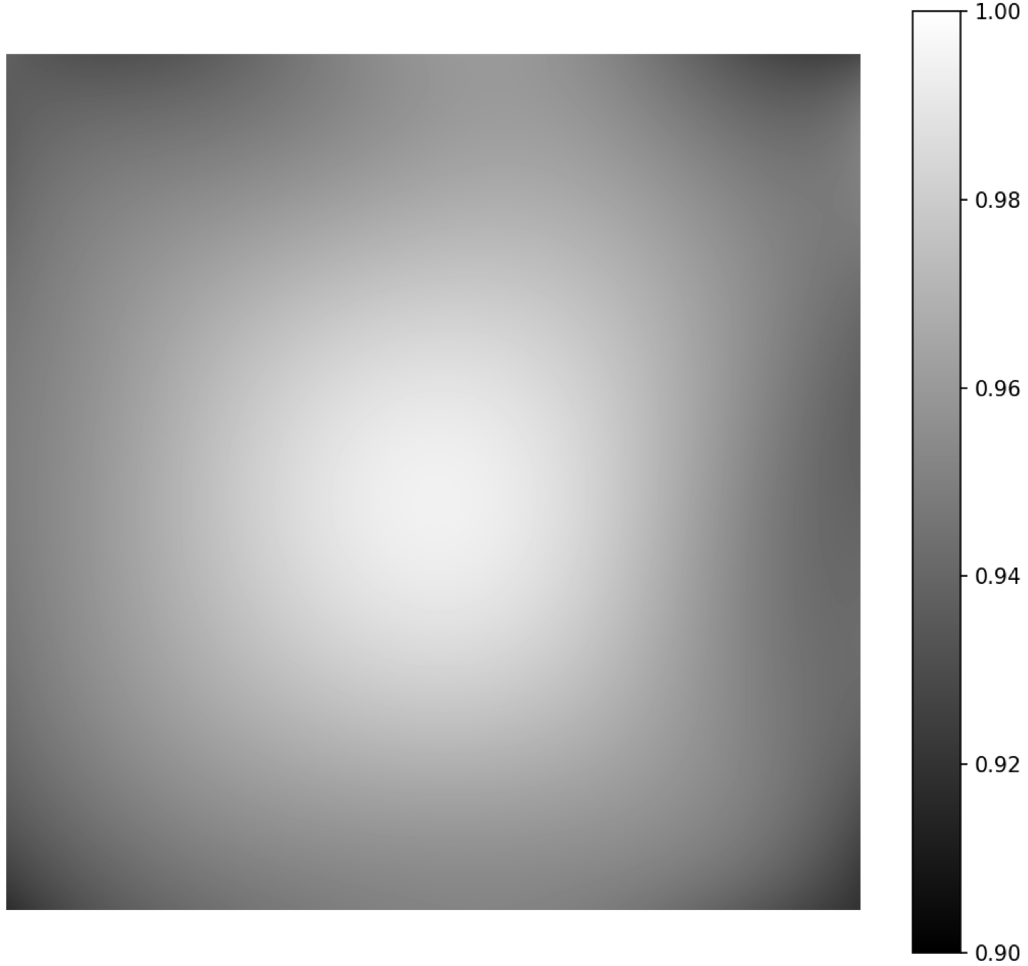


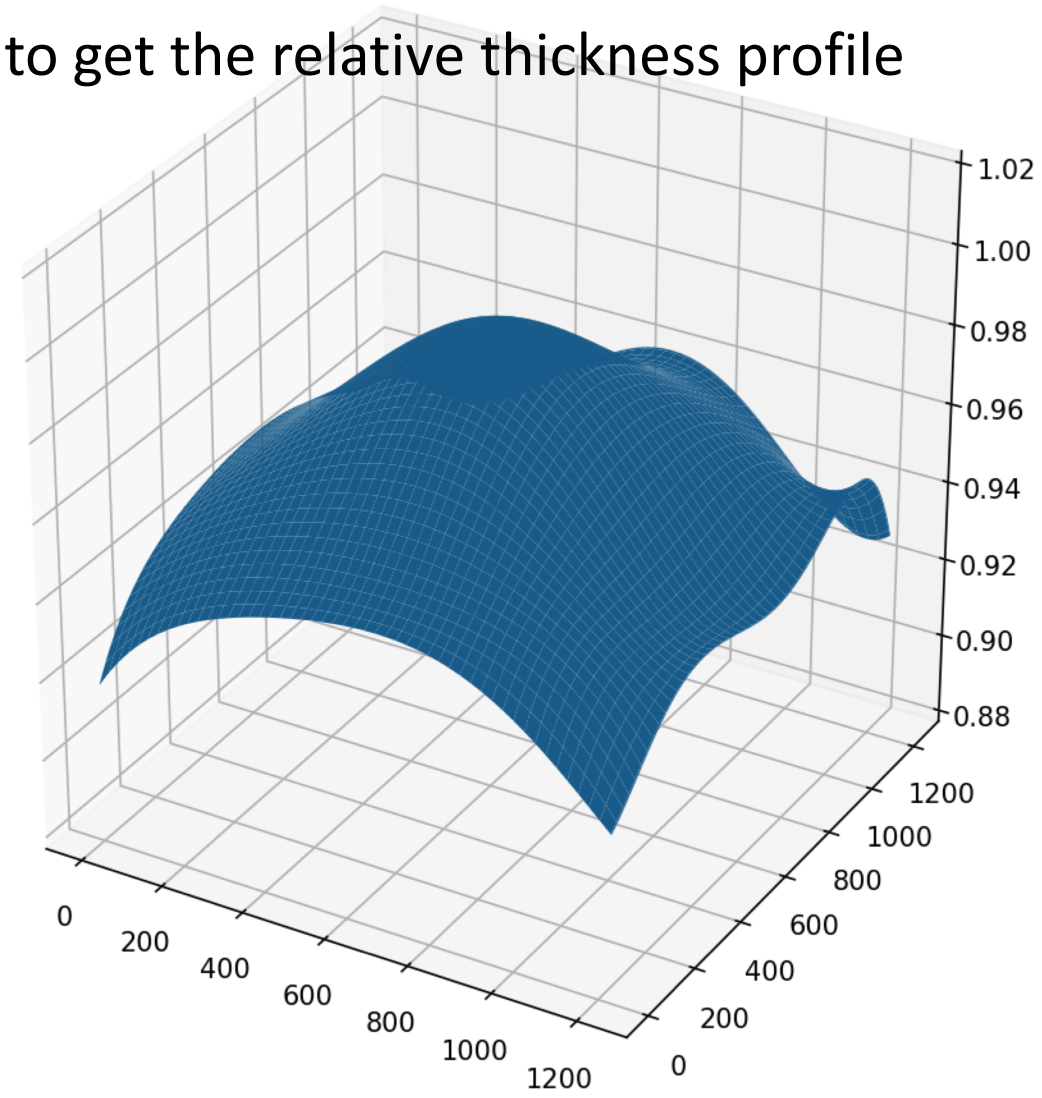




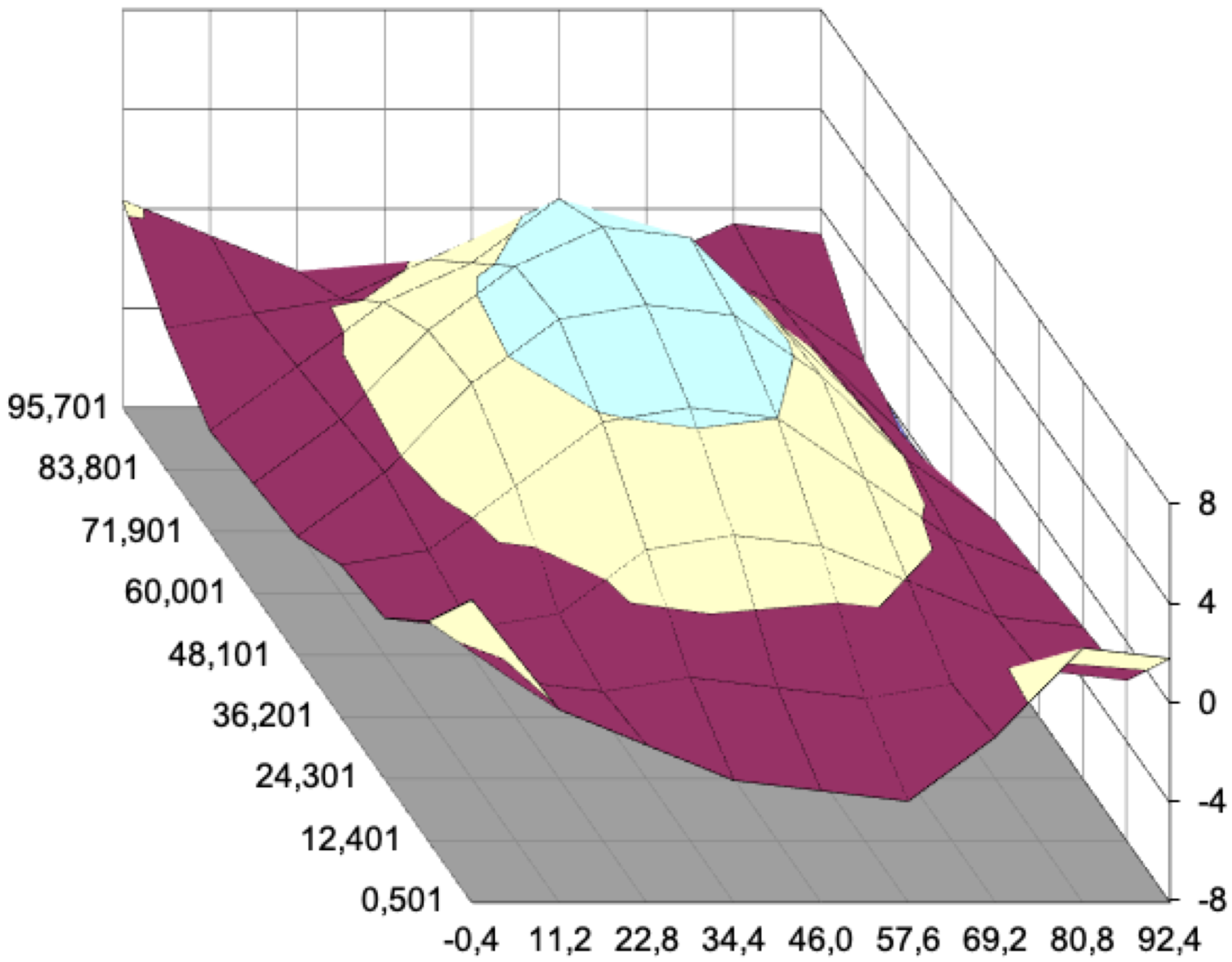
From fringing map to thickness profile

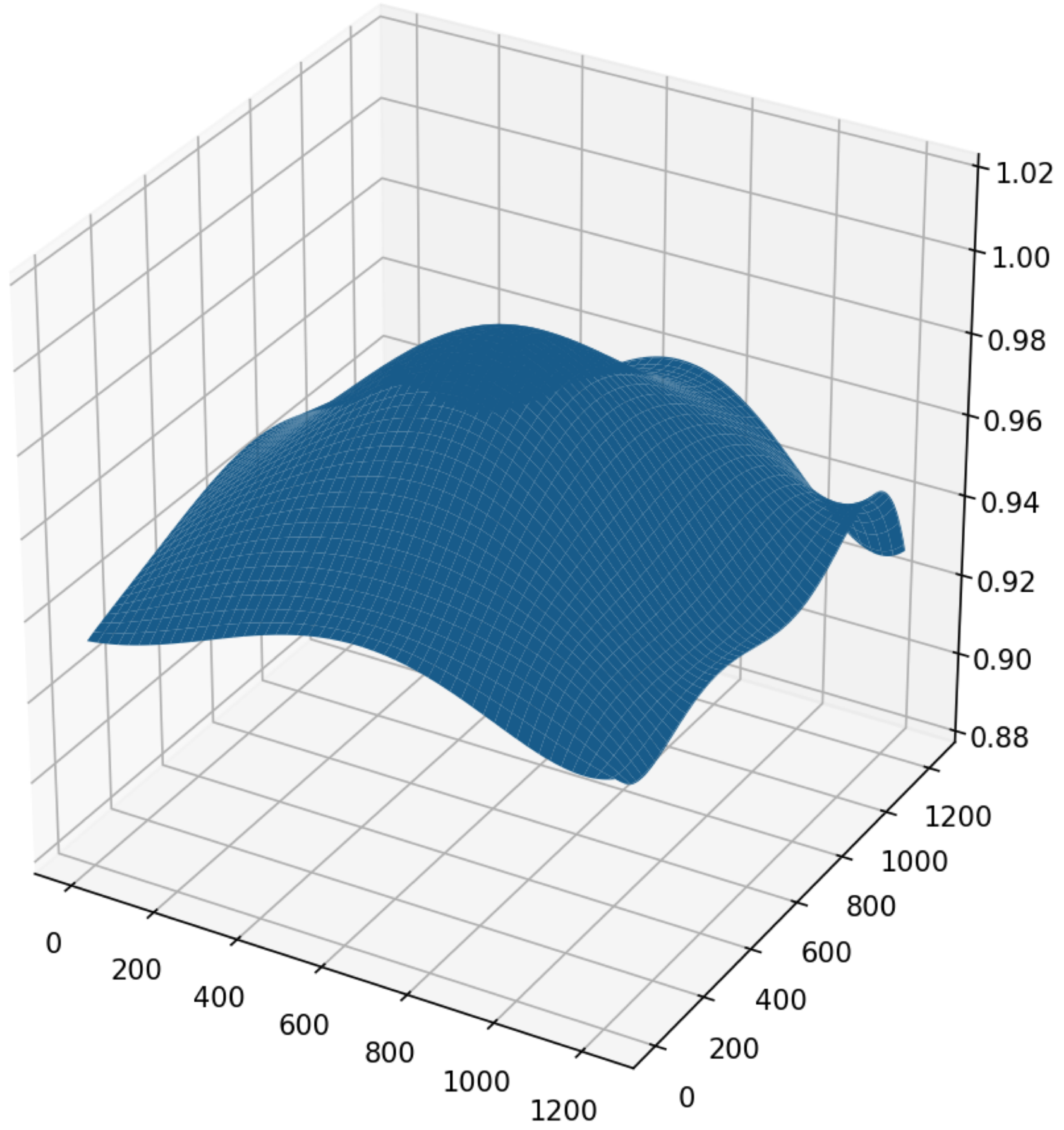
- Thickness variation : $\delta d = \pm n_{\text{Fringes}} \frac{\lambda}{2n_{Si}}$ with $\lambda = 800$ nm and $n_{Si} = 3.6$
- Interpolated 2D-map using 2D-spline technique to get the relative thickness profile



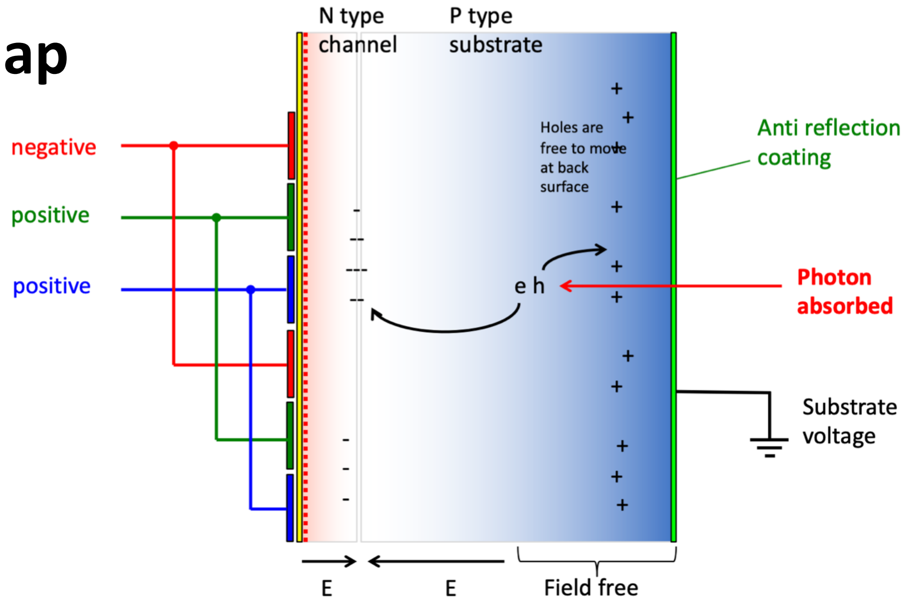


Comparison with e2v thickness variation measurements with local correction on corners (bottom left and right and top left)



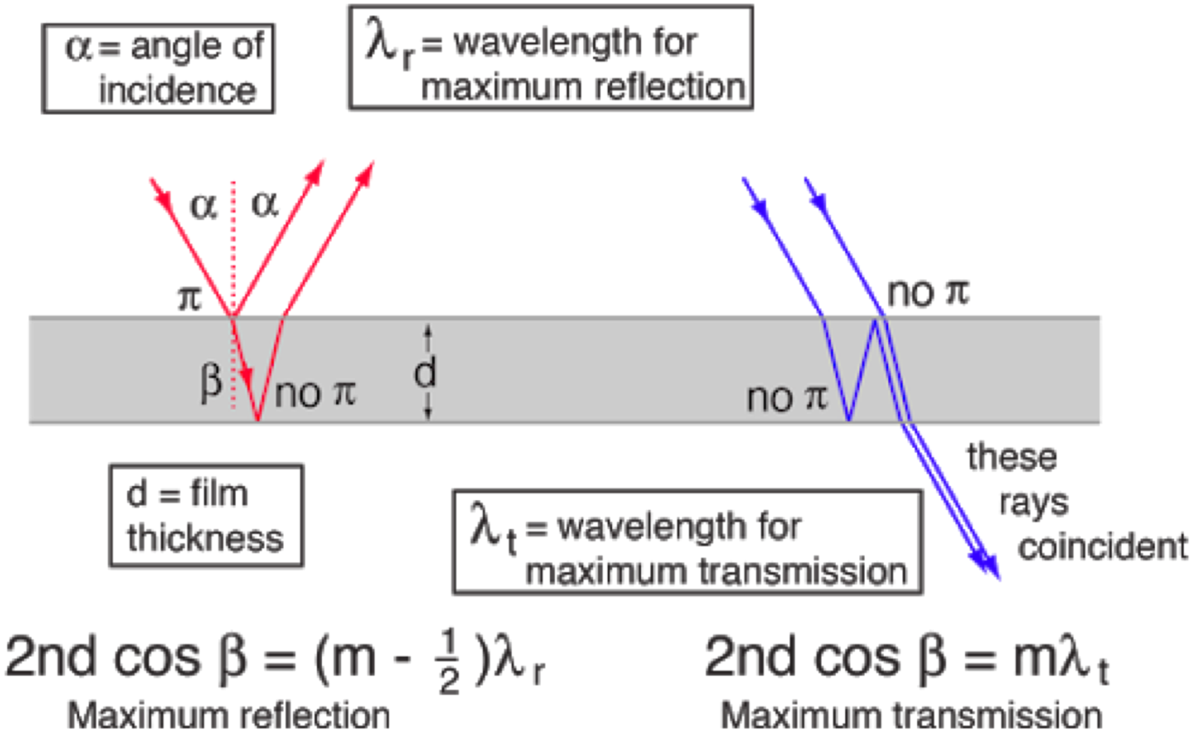


Forward modelling: from thickness profile to fringing map



Transmitted intensity: $$I = I_0 \frac{(1-r)^2}{1 + r^2 - 2r\cos\Delta\phi}$$

with
I_0 = incident light intensity
r = interface reflexion coefficient
$\Delta\phi = 2\,\frac{2\pi}{\lambda} n_{\mathrm{Si}} d \cos\beta$
d = thickness
n_{Si} = Silcon refractive index
β = angle of refraction



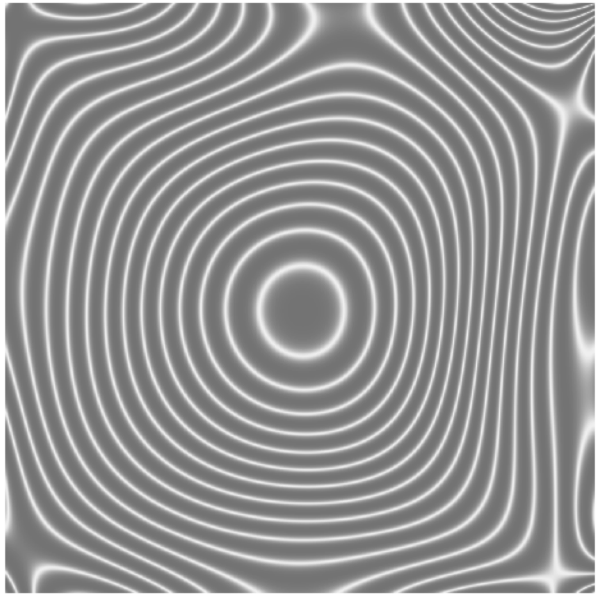
<u>Default input values</u>

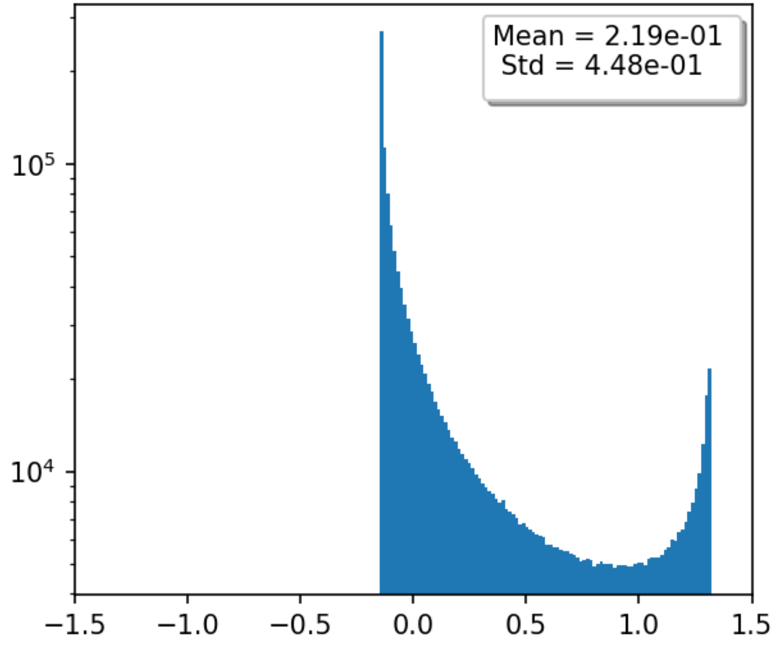
- $r = 0.5$
- $d = 30\ \mu\mathrm{m}$
- $n_{\mathrm{Si}} = 3.6$
- $\beta = 0$

Forward modelling with profile from fringing pattern

Mean fringing maps with

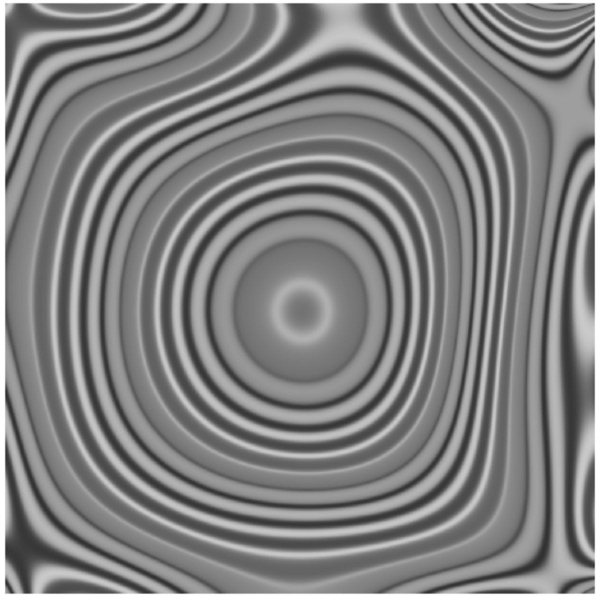
- $\lambda = 800$ nm
- $d = 30$ µm
- $r = 0.5$

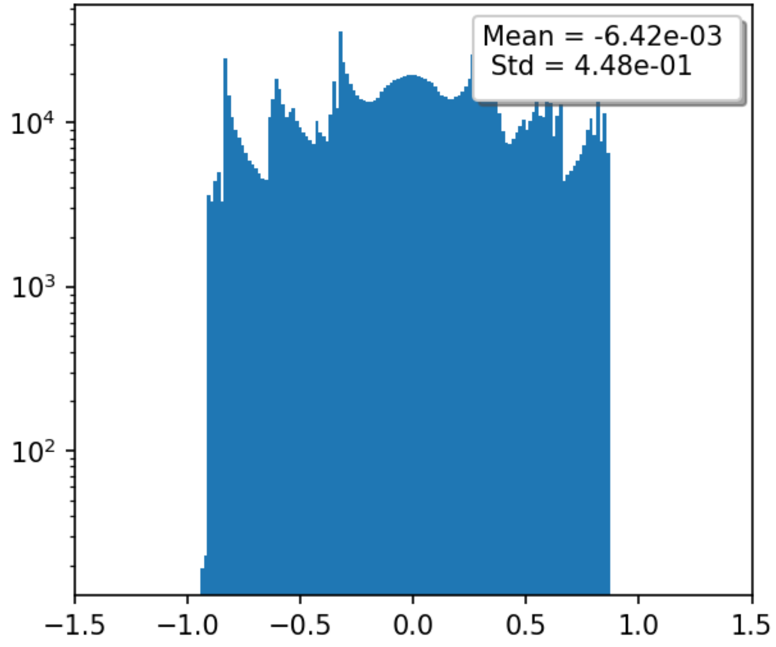




Mean fringing maps with

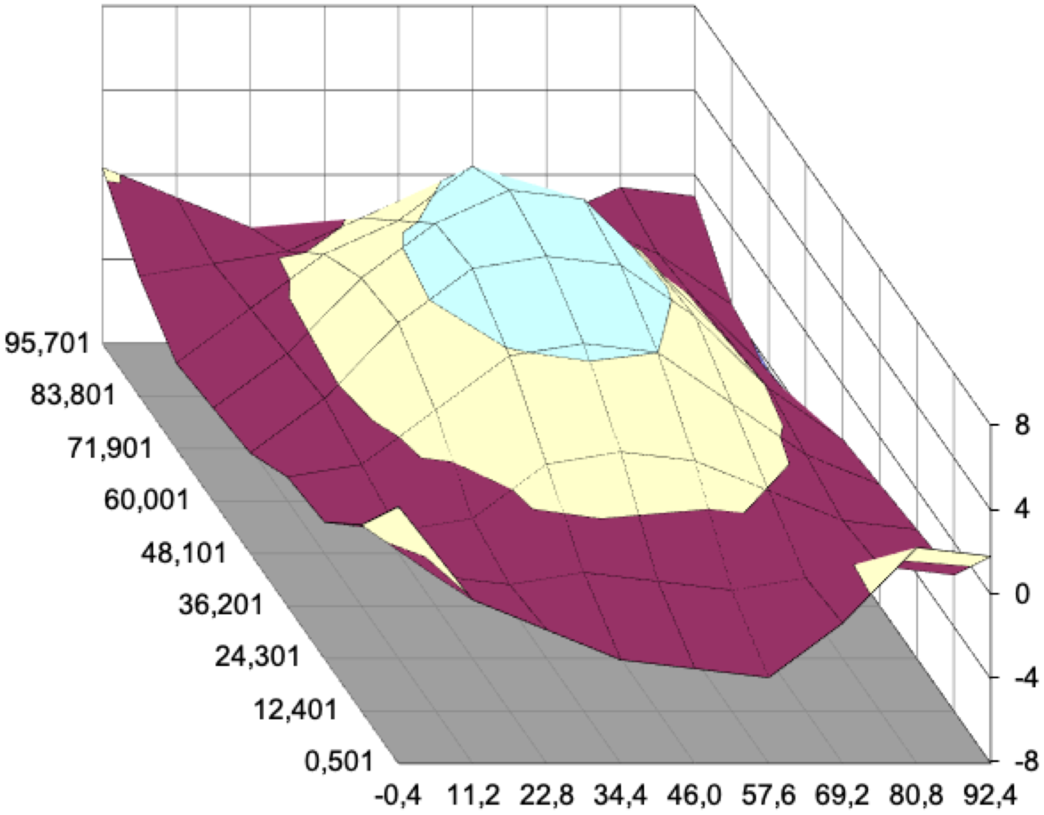
- $730 < \lambda < 880$ nm by steps of 0.1 nm
- $d = 30$ µm
- $r = 0.5$

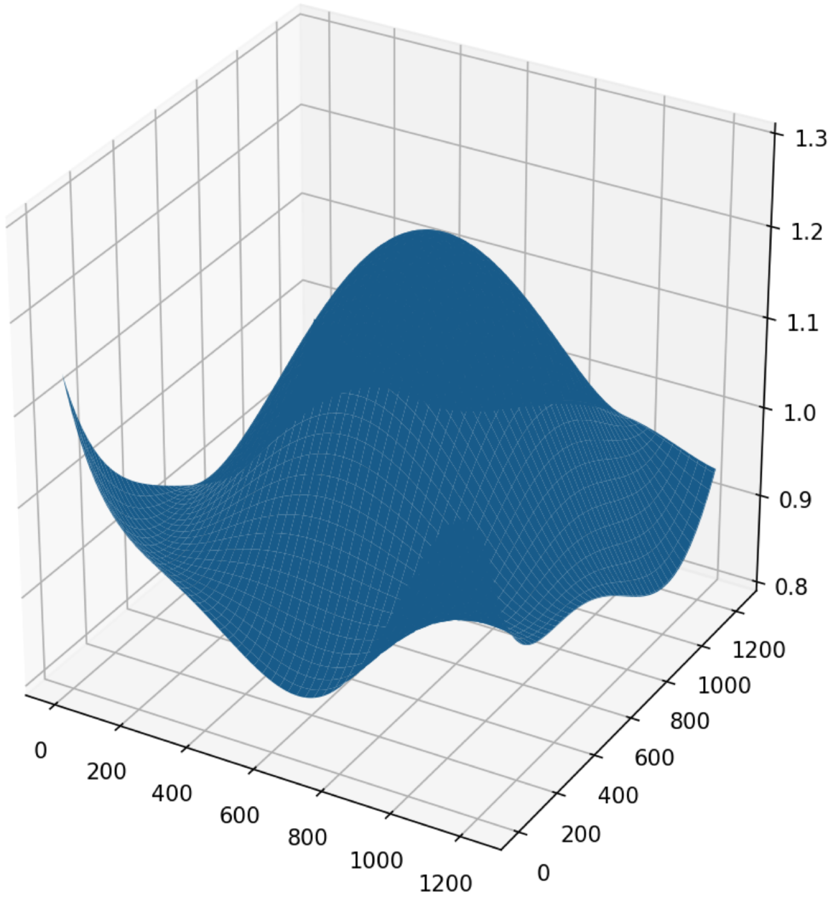




Forward modelling with e2v surface profile

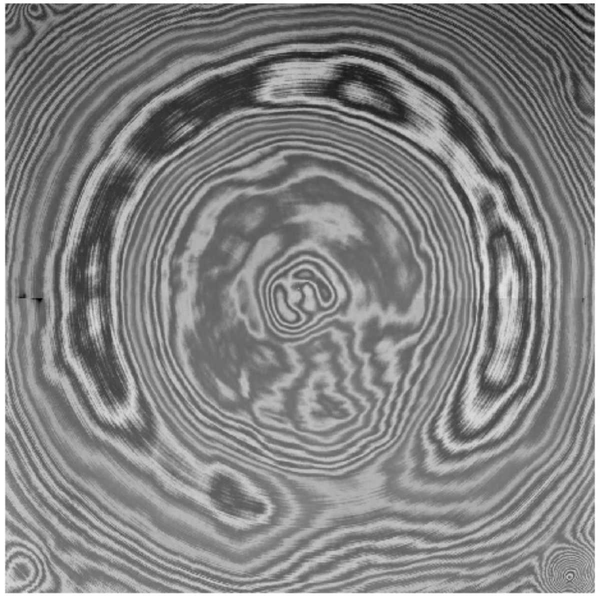
From e2v data points to 2D-spline relative profile

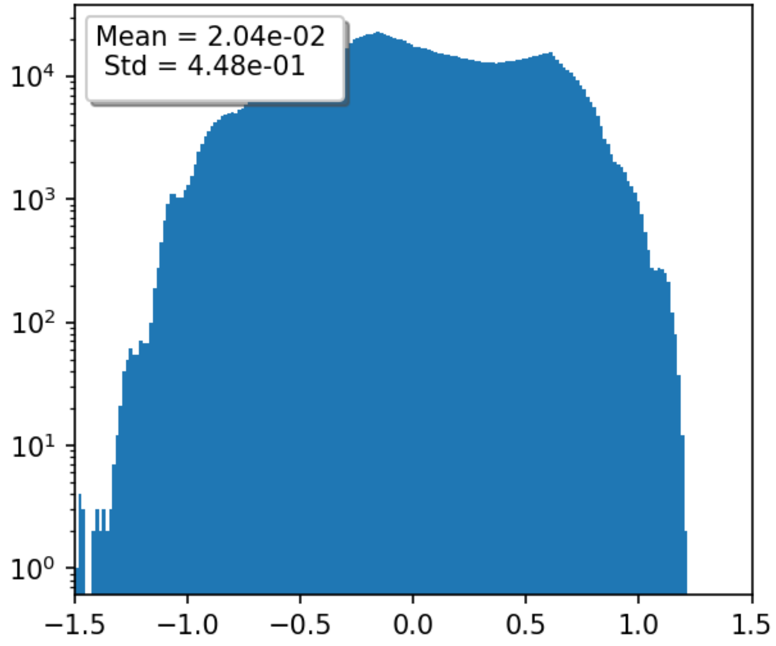




Forward modelling with e2v surface profile

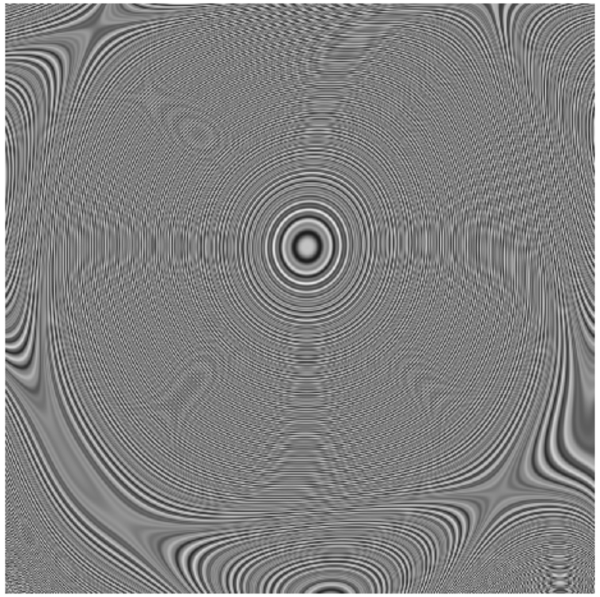
CCD 01 fringing map

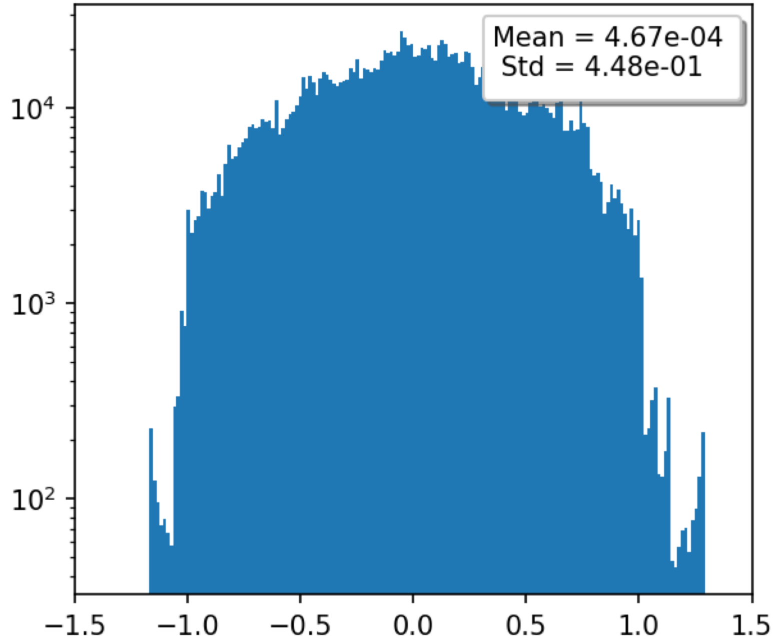




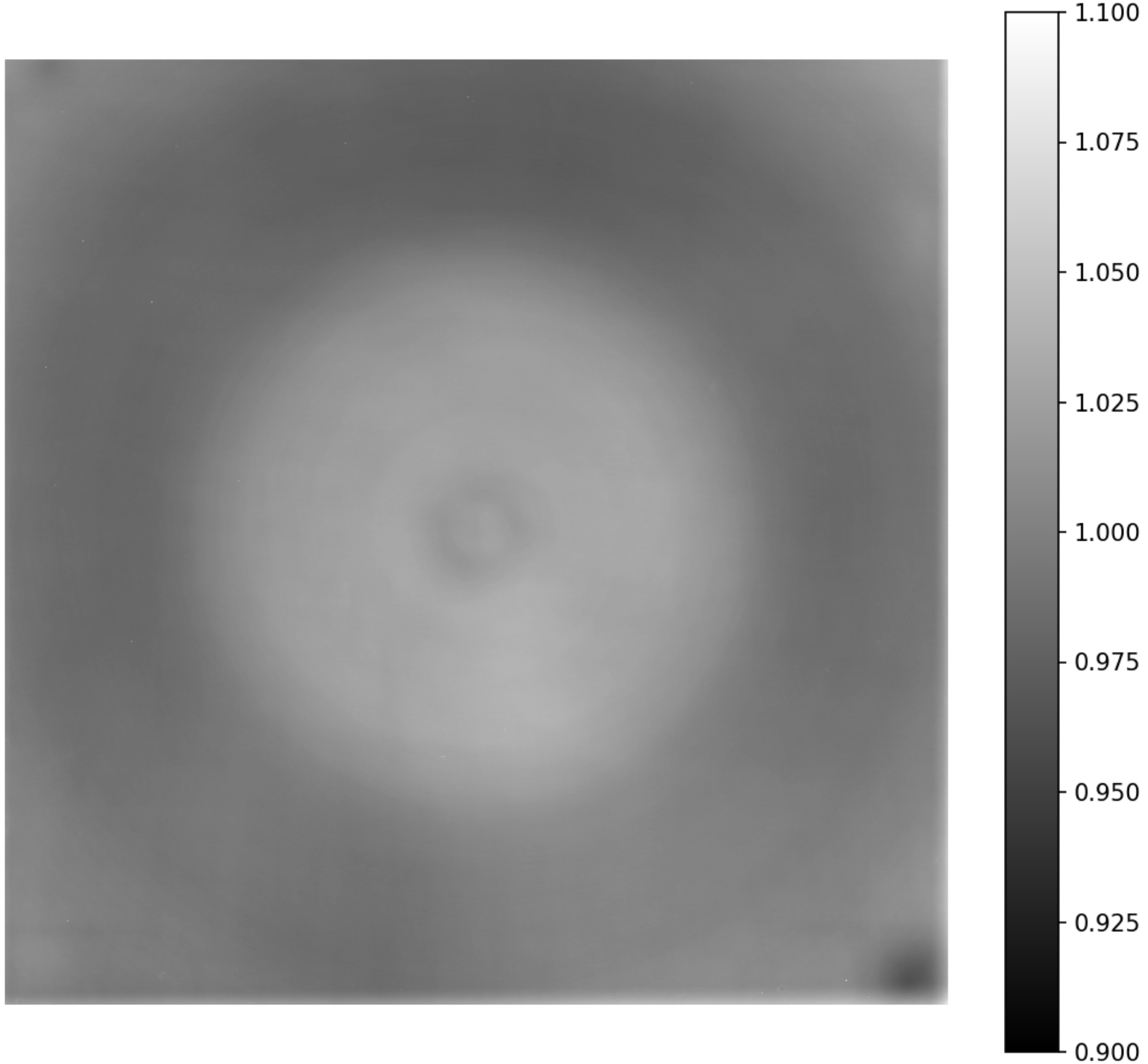
Mean fringing maps with

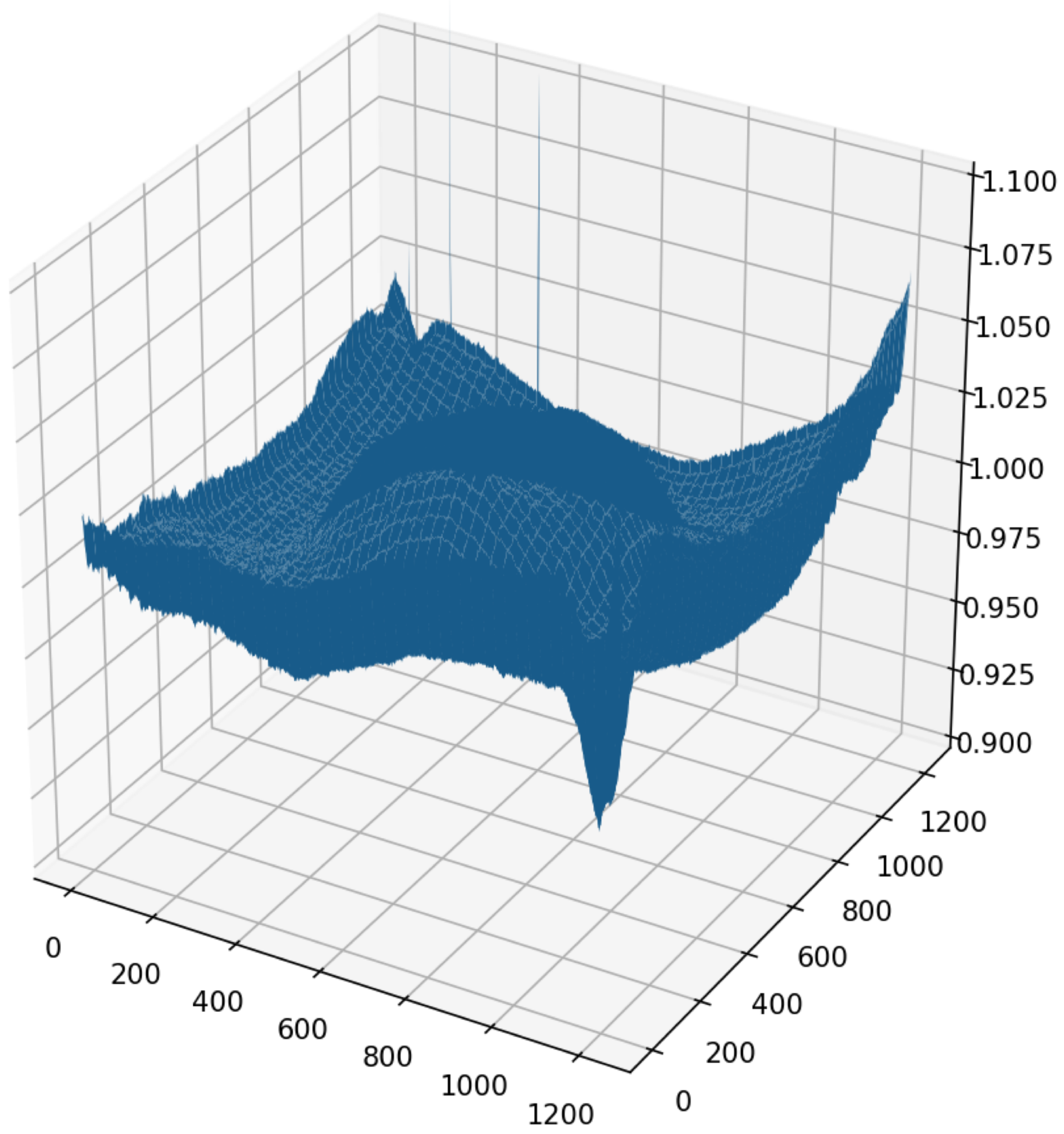
- $730 < \lambda < 880$ nm by steps of 0.1 nm
- $d = 30$ μm
- $r = 0.5$





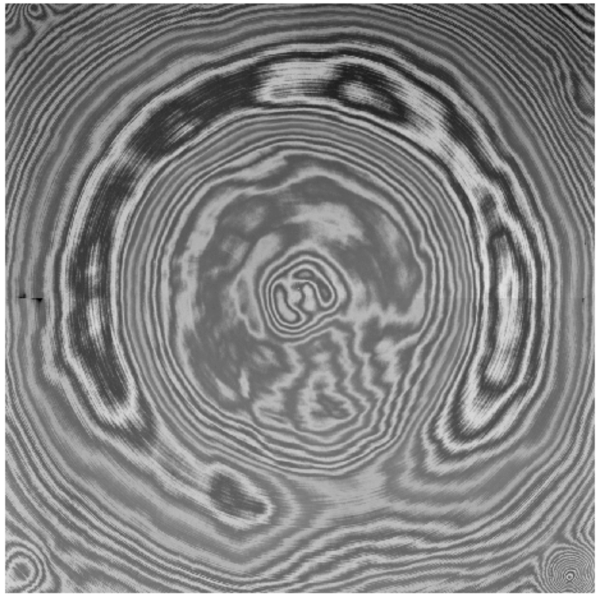
Forward modelling with profile deduce from LED ratio image = LED10 (653 nm) / LED13 (865 nm)

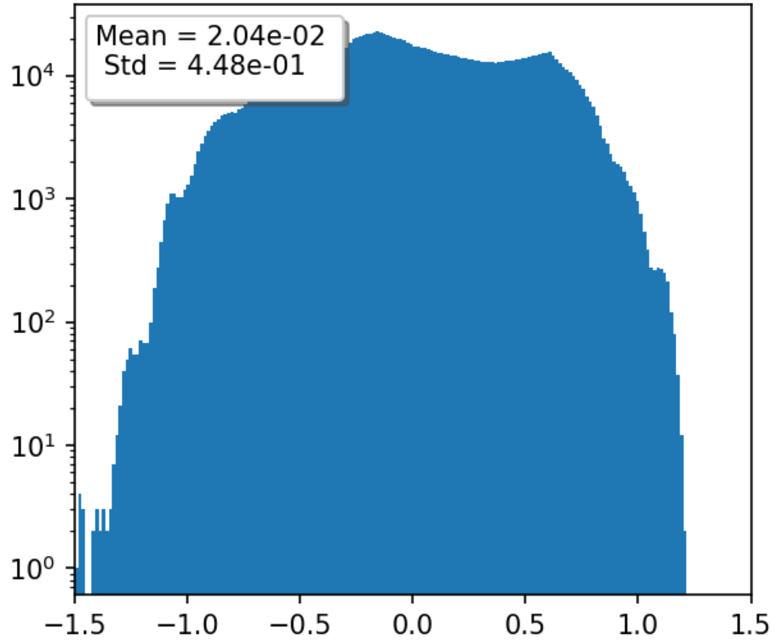




Forward modelling with profile from LED ratio image

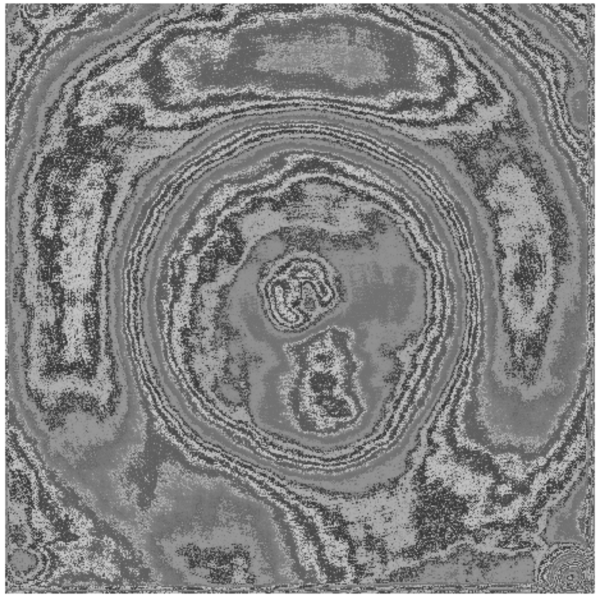
CCD 01 fringing map

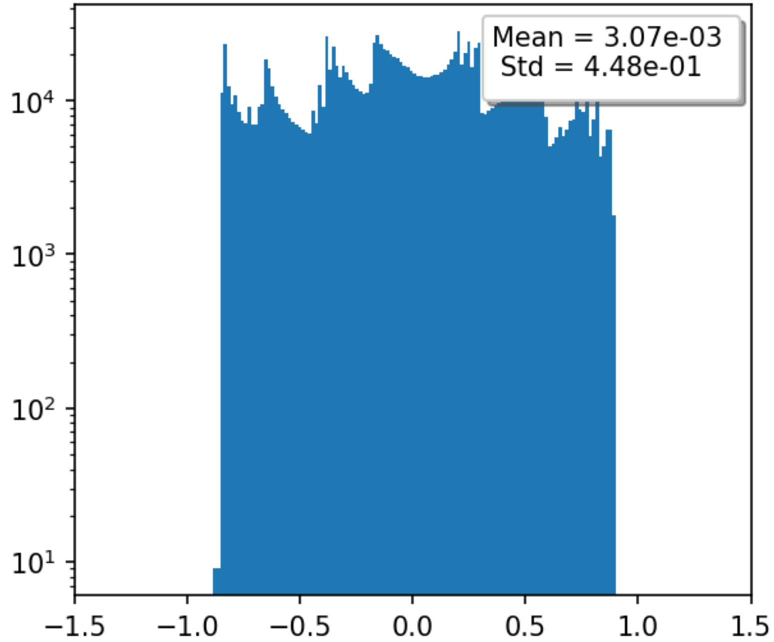




Mean fringing maps with

- $730 < \lambda < 880$ nm by steps of 0.1 nm
- $d = 30$ μm
- $r = 0.5$

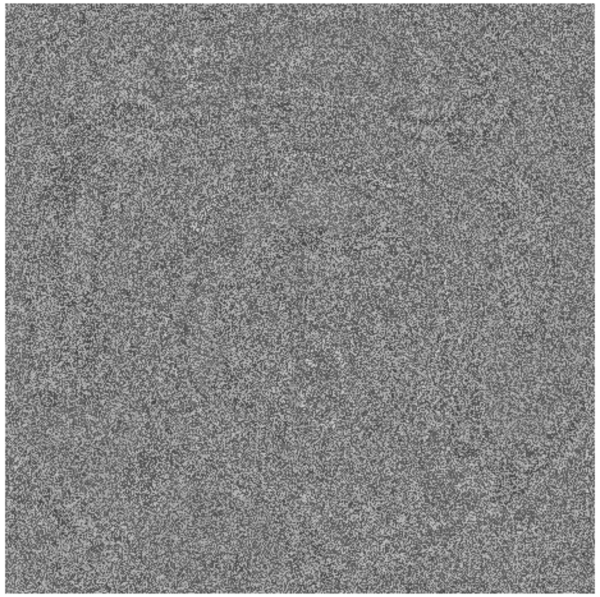


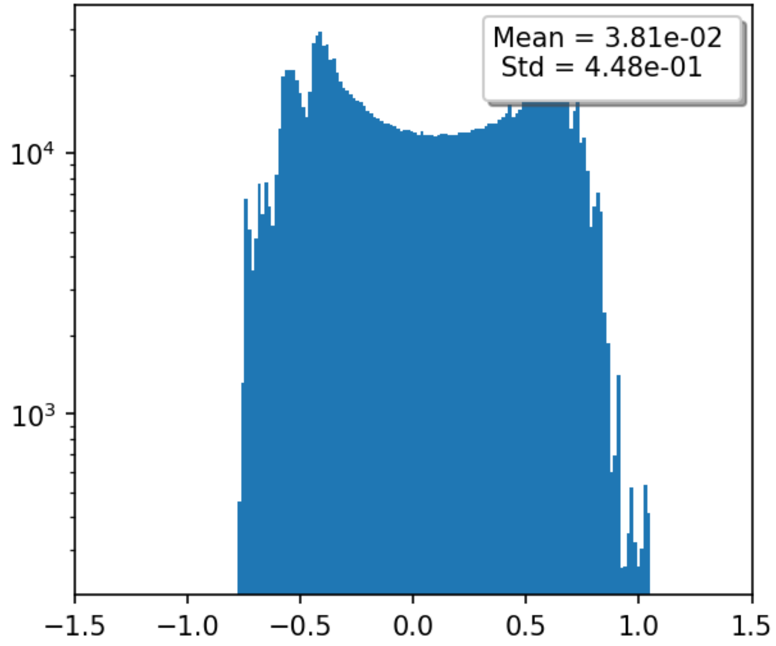


Forward modelling with profile from LED ratio image

Mean fringing maps with

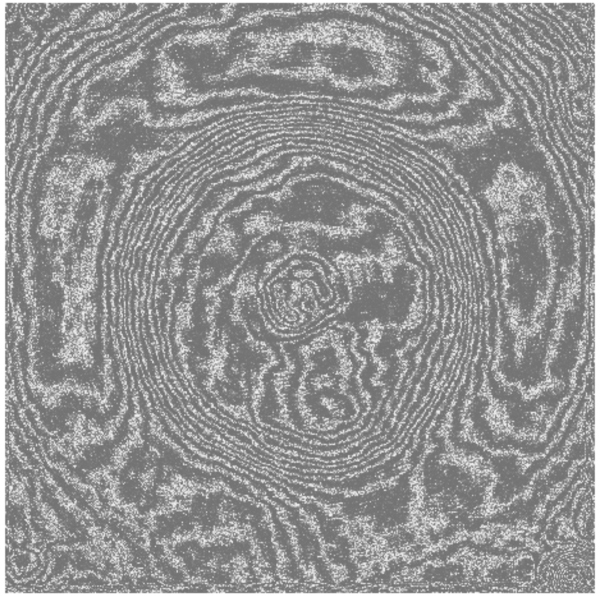
- $730 < \lambda < 880$ nm by steps of 1 nm
- $d = 30$ μm
- $r = 0.5$

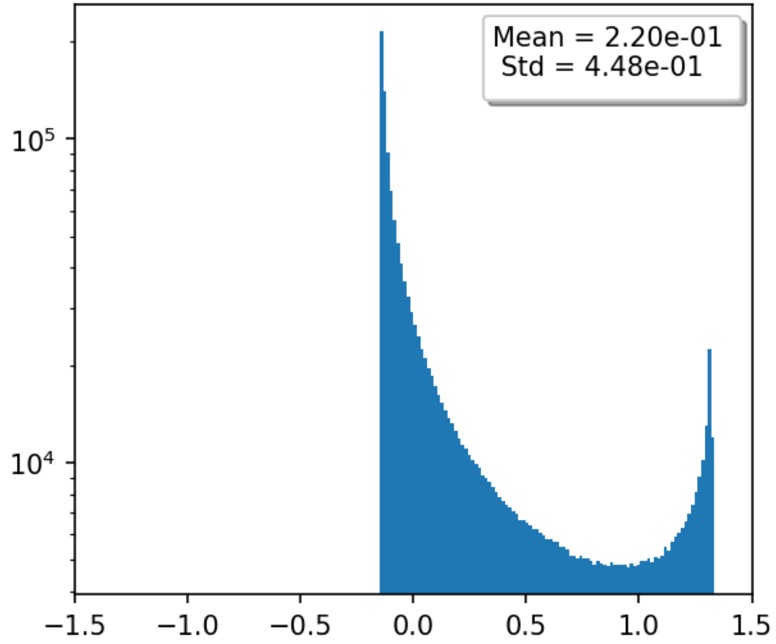




Mean fringing maps with

- $\lambda = 800$ nm
- $d = 30$ μm
- $r = 0.1$

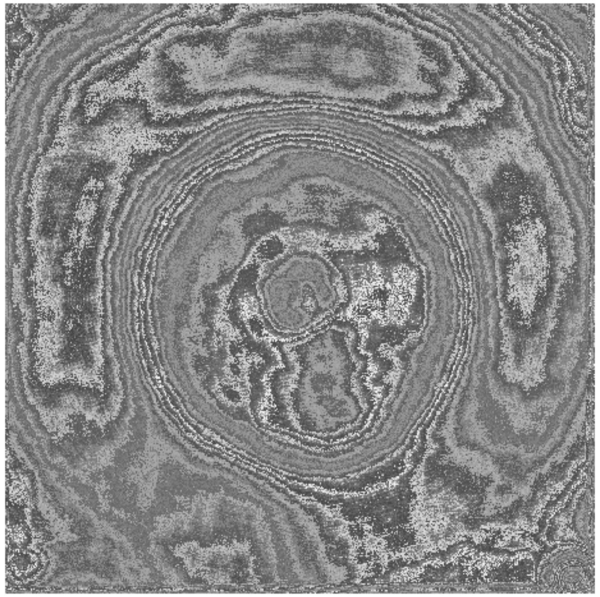


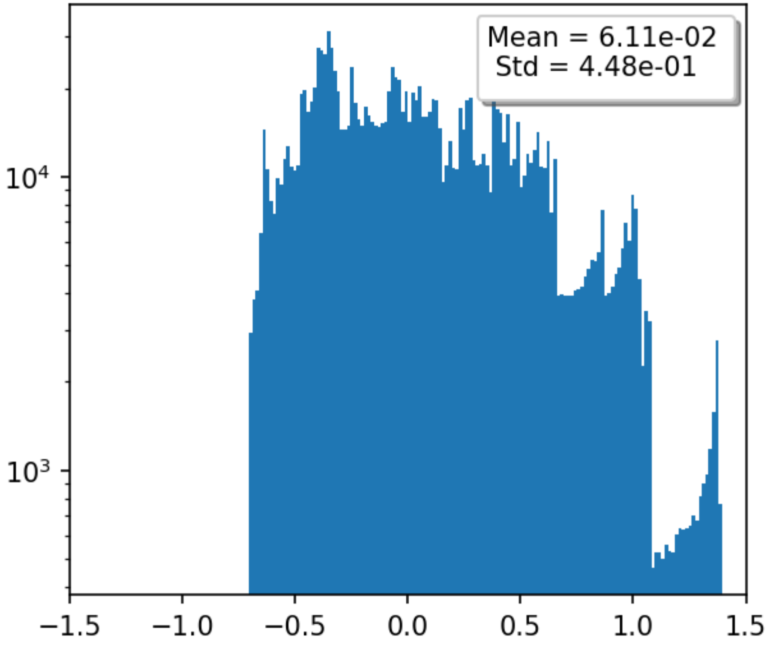


Forward modelling with profile from LED ratio image

Mean fringing maps with

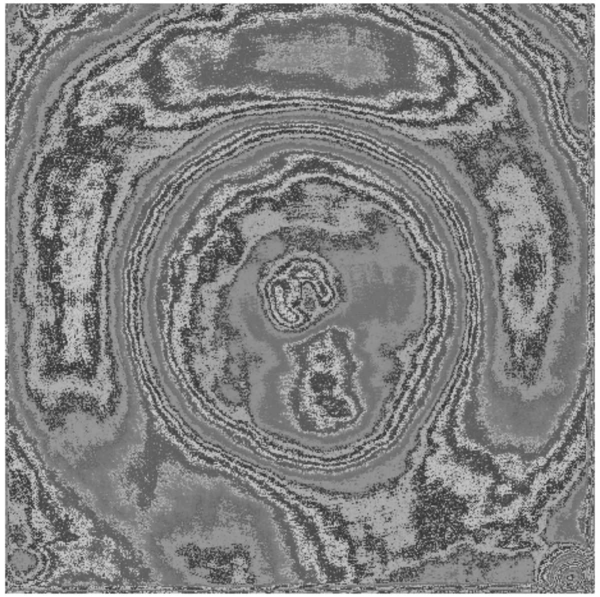
- $730 < \lambda < 880$ nm by steps of 10 nm
- $d = 30$ μm
- $r = 0.5$

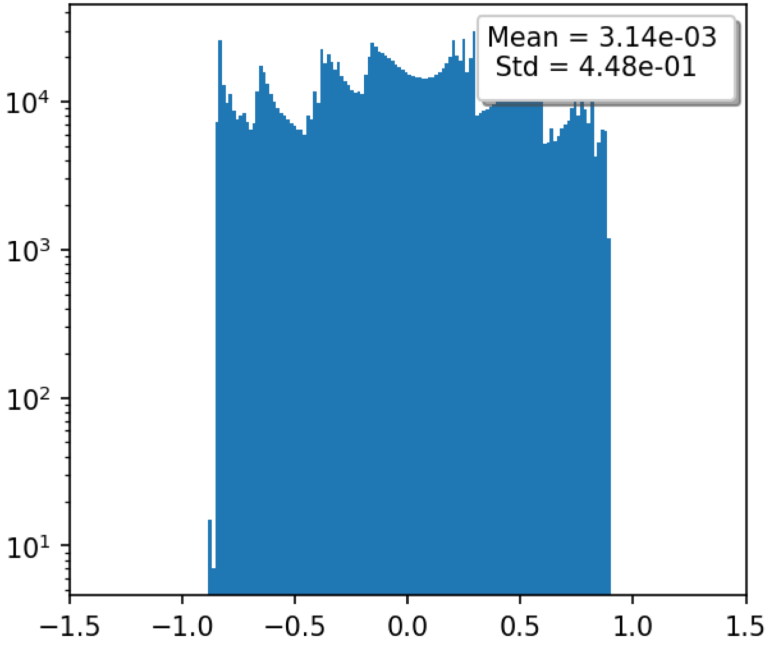




Mean fringing maps with

- $730 < \lambda < 880$ nm by steps of 0.01 nm
- $d = 30$ μm
- $r = 0.5$

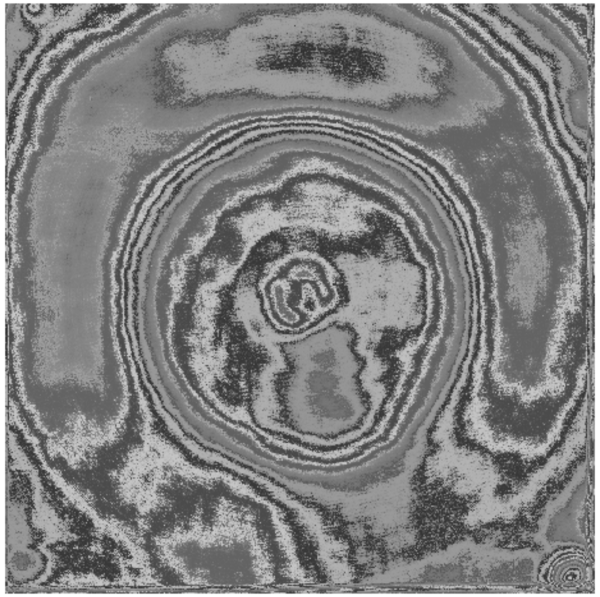


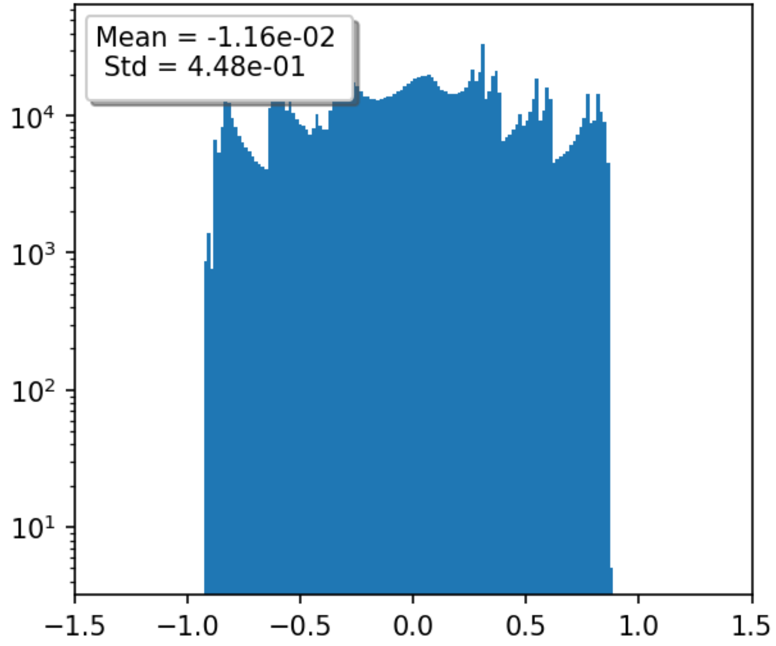


Forward modelling with profile from LED ratio image

Mean fringing maps with

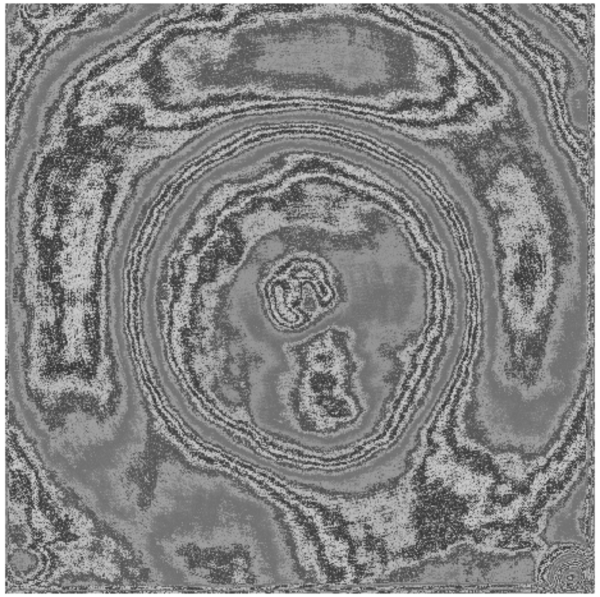
- $730 < \lambda < 880$ nm by steps of 0.1 nm
- $d = 20$ µm
- $r = 0.5$

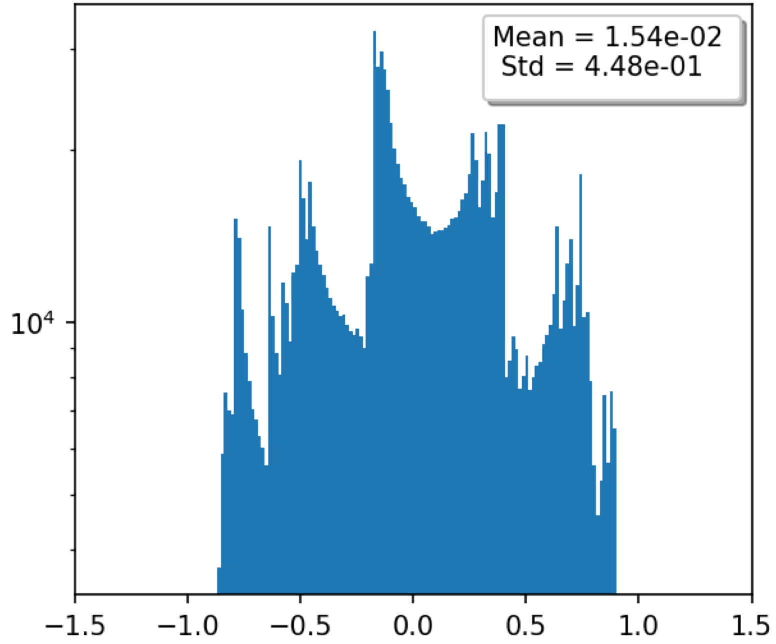




Mean fringing maps with

- $730 < \lambda < 880$ nm by steps of 0.1 nm
- $d = 30$ µm
- $r = 0.1$





What next: try to take into account

- Sky spectrum
- CCD quantum efficiency