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Aberration retrieval from a single out-of-focus intensity measurement

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Our mission:

To use only one out-of-focus measurement for fast data analysis

The problem:

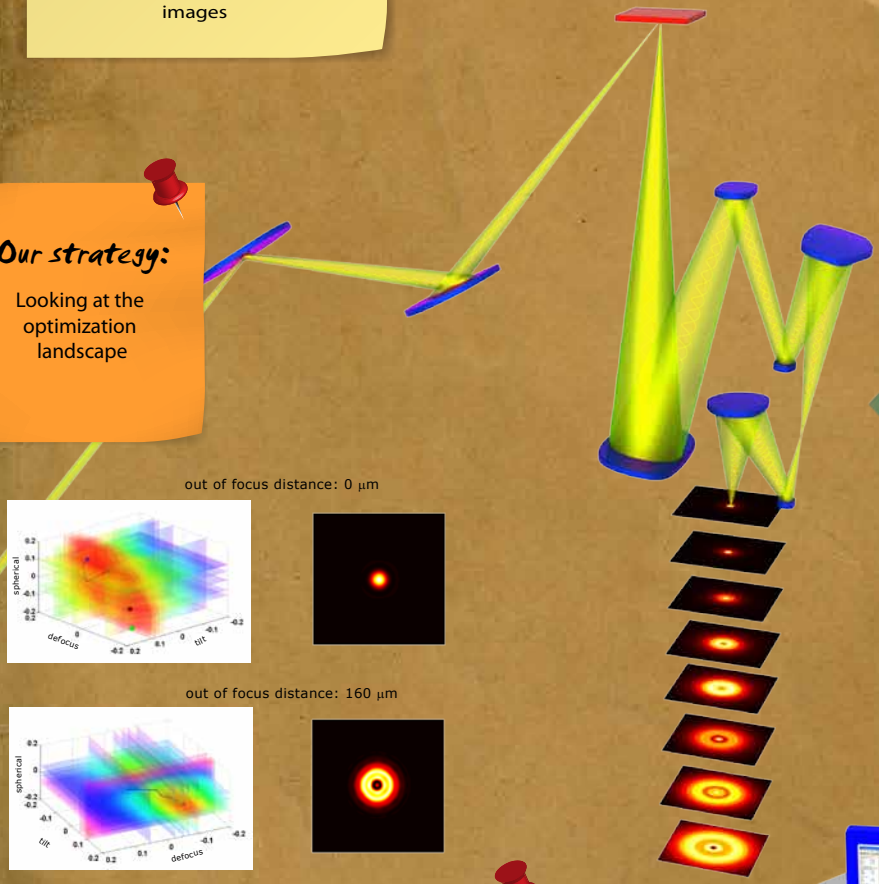
Optical systems assessment can be done by means of phase retrieval algorithms taking multiple out-of-focus images

The question:

Is there any preferable out-of-focus plane where we can efficiently retrieve the aberration in the pupil?

Our strategy:

Looking at the optimization landscape



The tool:

The phase retrieval algorithm

field distribution in the pupil:

$$u(\xi,\eta) = |u(\xi,\eta)| \exp[ik\phi] = |u(\xi,\eta)| \exp[ik\sum_n \alpha_n Z_n]$$

field distribution at a distance L out of focus

$$u(x,y,L) = F^{-1}\left\{F[u(x,y,f)]\exp(iL\sqrt{k^2 - k_x^2 - k_y^2})\right\}$$

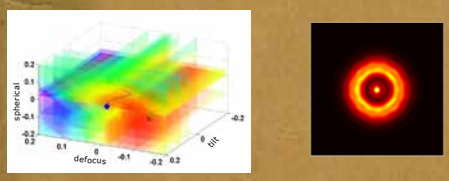
Merit function:

$$E(\alpha_n) = \min\left[\sum |I_{measured} - I_{simulated}|^2\right]$$

out of focus distance: 0 μm

out of focus distance: 160 μm

out of focus distance: 240 μm



experimental setup

Any questions?

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