High Frequency Homogenization of Laser Illumination Through Stationary 0.22 N.A. Multimode Optical Fiber.

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DYOPTYKA, Ireland.

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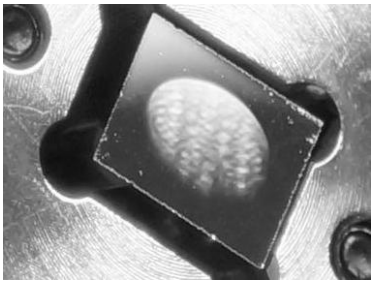
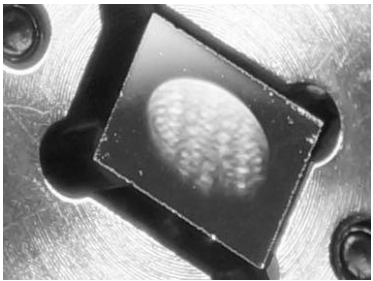
DYOPTYKA deformable mirror technology



Randomly-distributed surface deformations.

DYOPTYKA deformable mirror technology



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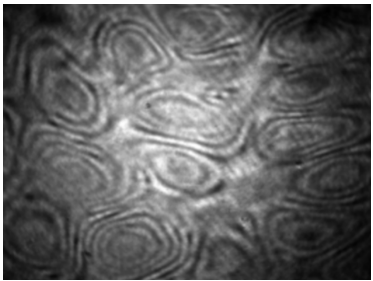
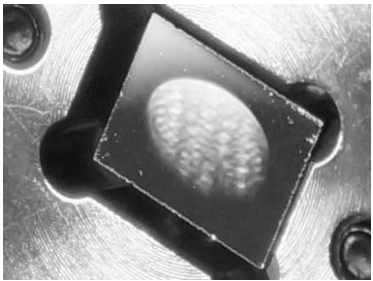


Interferometer fringes showing deformations.

DYOPTYKA deformable mirror technology



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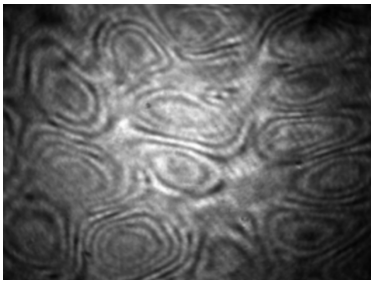

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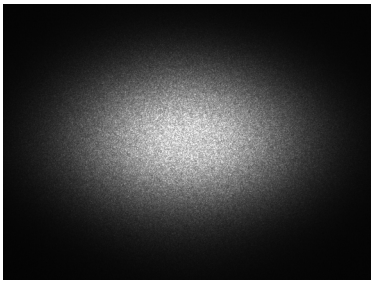
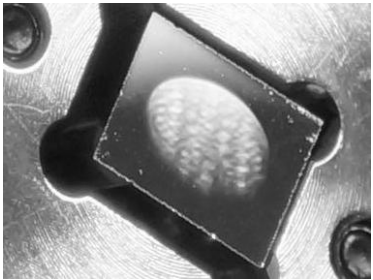


Randomized divergence with small angular extent.

DYOPTYKA deformable mirror technology



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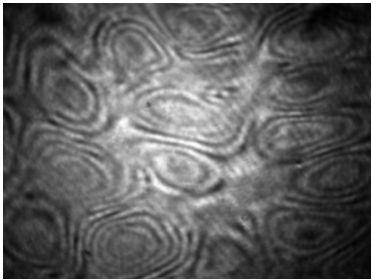

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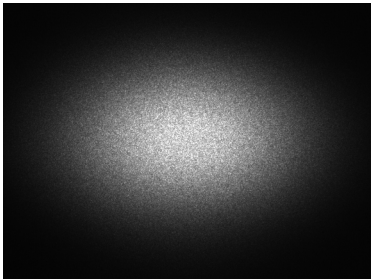
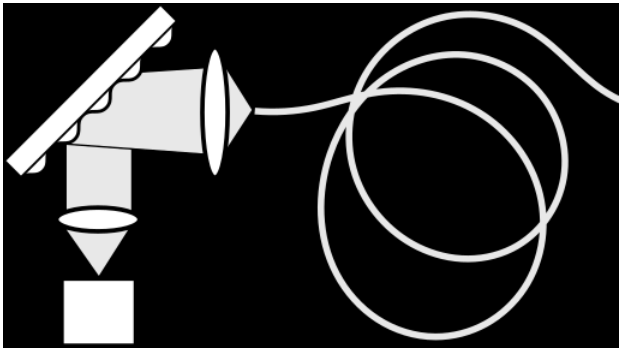
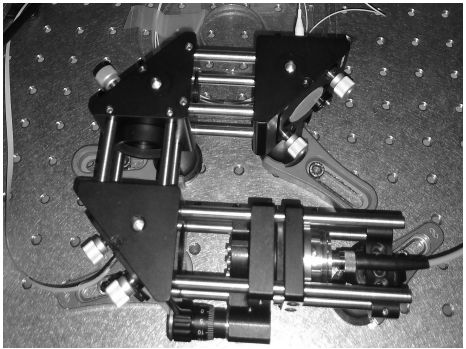


Randomized divergence with small angular extent.

Typical specification: frequency $\geq 1\,\mathrm{MHz}$; area $3\,\mathrm{mm} \times 4.5\,\mathrm{mm}$; reflectance $\geq 96\%$; damage $\geq 1\,\mathrm{W\,mm^{-2}}$.

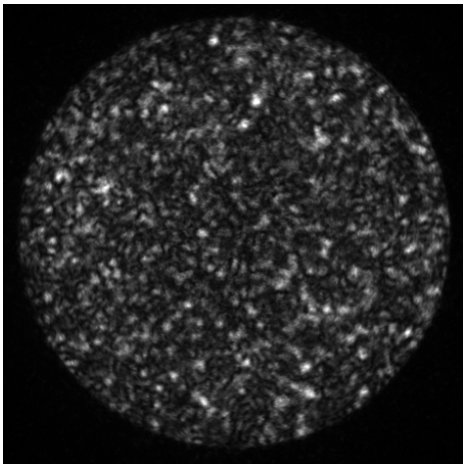
Fiber-coupled apparatus





$\varnothing$500 µm *collimated beam; DM with approx.* 2° *full-angle divergence; coupling lens for approx.* 10× *angular and* 1/10× *size magnification; multimode optical fiber, length* 2 m, *coiled and stationary; exposure* 20 µs.

Circular core exit face, ⌀500 µm, 0.39 N.A.



DM inactive, $C_S = 58.9\%$.

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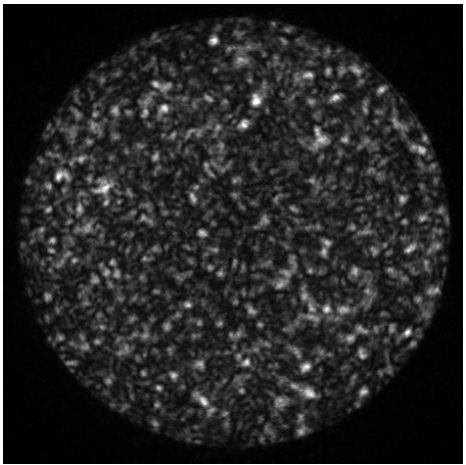

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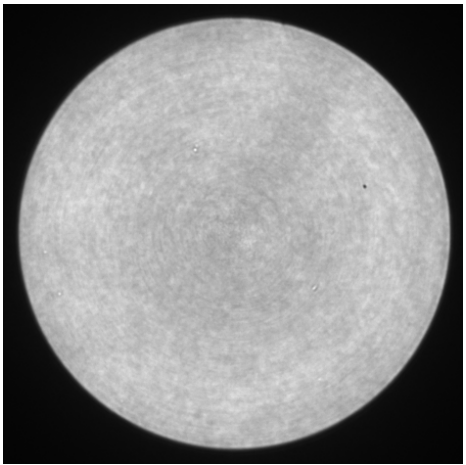
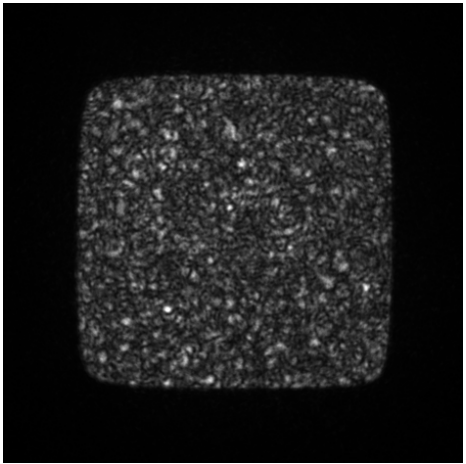


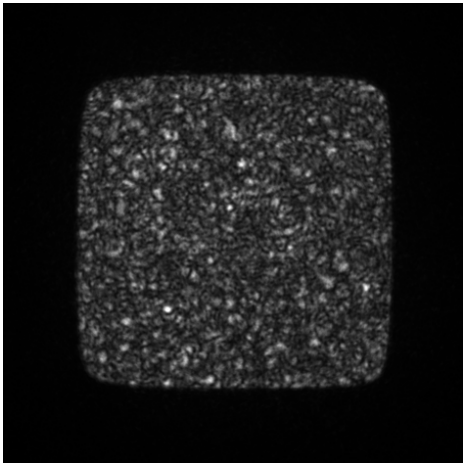
DM active, $C_S = 5.3\%$.

Square core exit face, □150 µm, 0.39 N.A.



DM inactive, $C_S = 47.5\%$.

Square core exit face, □150 µm, 0.39 N.A.



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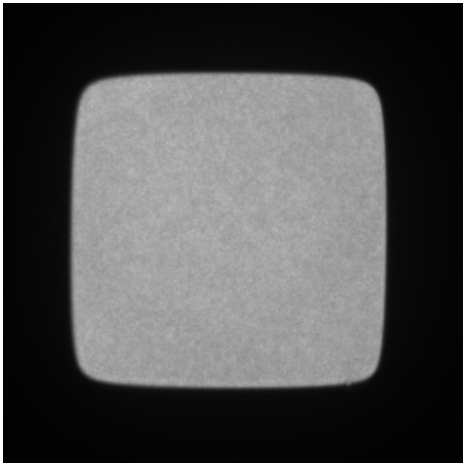

DM active, $C_S = 3.6\%$.

Practical requirements

Some applications require 0.22 N.A.

- For smaller fiber exit face as an extended source of coherent illumination.
- For improved directionality of emission from fiber exit face.
- For compactness of DM-fiber coupling optical system.

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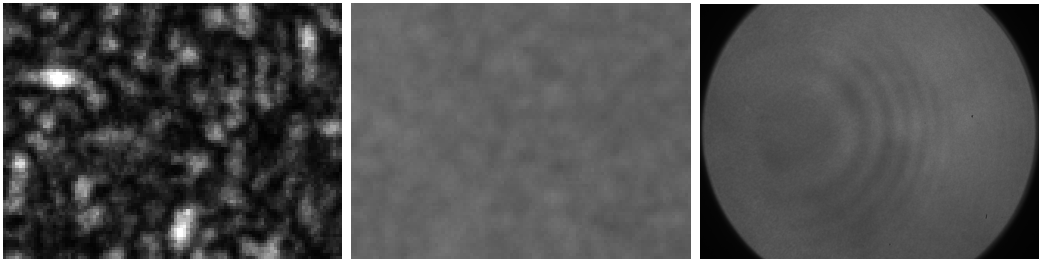
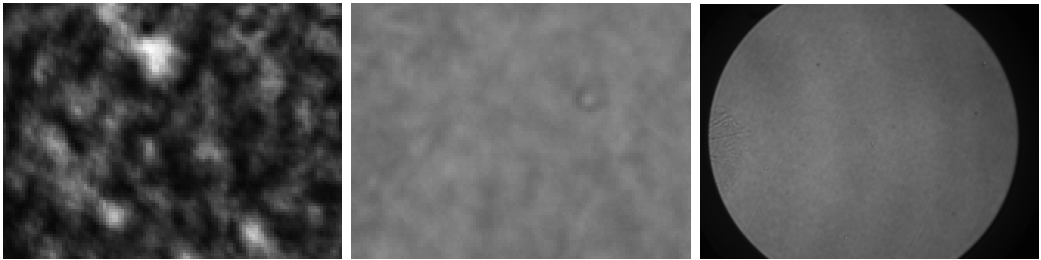
Core ⌀550 µm, 0.22 N.A.



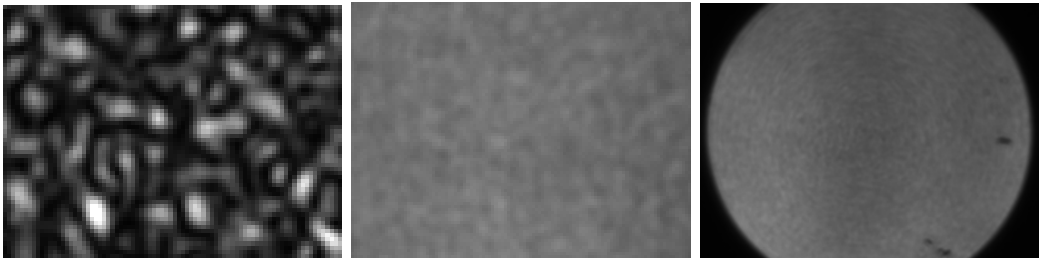
[Left] DM inactive, $C_S = 77\%$. [Center] DM active, $C_S = 5.2\%$. [Right] Larger region, average of nine images acquired with DM active, $C_S = 3.6\%$.

Core ⌀200 µm, 0.22 N.A.



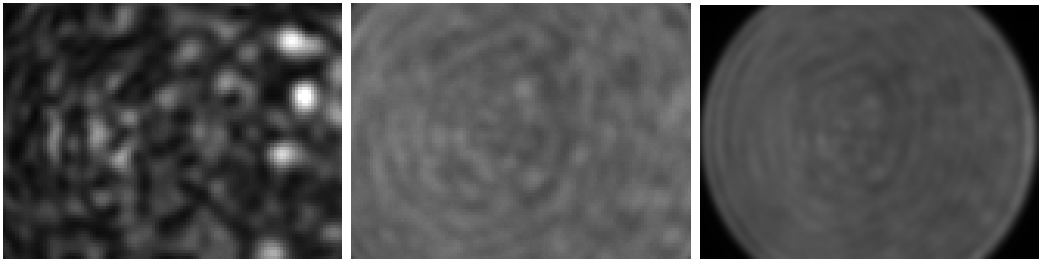
[Left] DM inactive, $C_S = 63\%$. [Center] DM active, $C_S = 5.5\%$. [Right] Larger region, average of nine images acquired with DM active, $C_S = 3.8\%$.

Core ⌀105 µm, 0.22 N.A.



[Left] DM inactive, $C_S = 74\%$. [Center] DM active, $C_S = 7.1\%$. [Right] Larger region, average of nine images acquired with DM active, $C_S = 6.9\%$.

Core ⌀50 µm, 0.22 N.A.



[Left] DM inactive, $C_S = 59\%$. [Center] DM active, $C_S = 9.7\%$. [Right] Larger region, average of nine images acquired with DM active, $C_S = 7.8\%$.

Conclusions

- Good performance demonstrated in 0.22 N.A. stationary multimode fiber.
- Optical efficiency of $> 95\%$ confirmed.
- Excellent temporal stability confirmed.

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Thank You!

Please contact me to discuss:

fshevlin@dyoptyka.com