PYRAMID WAVEFRONT SENSOR ADAPTIVE OPTICS FOR RETINAL IMAGING

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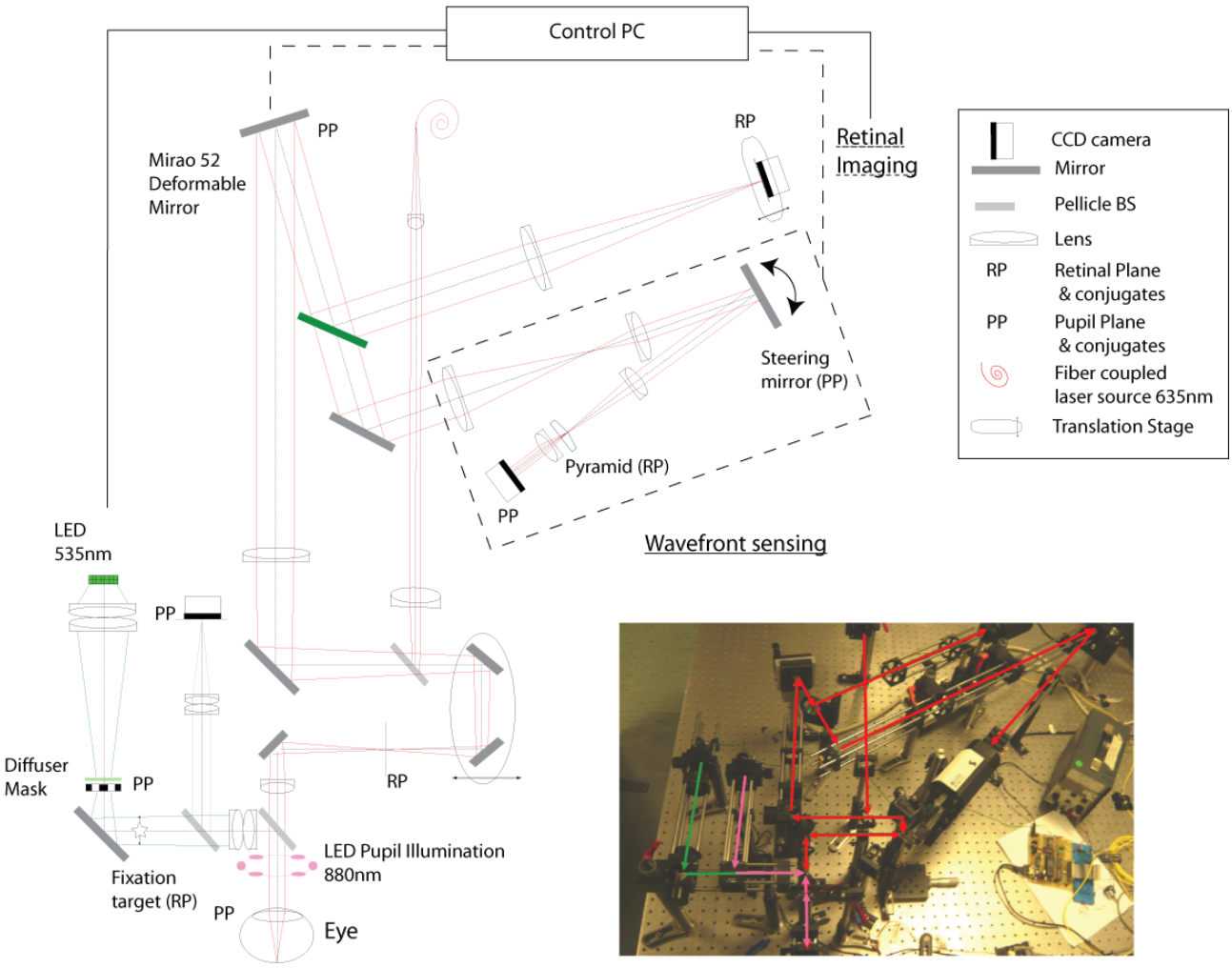
1. Pyramid wavefront sensor adaptive optics

Numerical studies [1, 2] showed that the adaptive optics closed-loop performance reached with the previous optical system [3] could be improved through use of a mirror with large stroke and number of actuators.

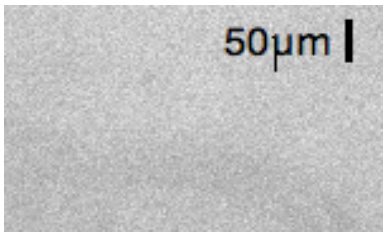


(A) Optical system layout

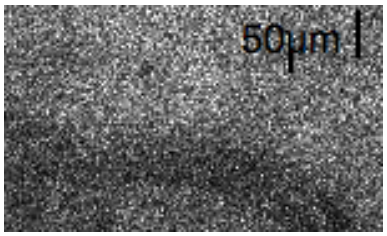
In its current configuration the adaptive optics system thus incorporates the Mirao 52-d (Imagine Eyes, France) deformable mirror, driven in LabVieW (National Instruments, USA), at 10Hz to 40Hz frame rate in function of the wavefront sampling.

2. Retinal imaging

Low light levels and short exposures are used for illumination of the fundus.
The retinal illumination is based on an LED (530nm, peak emission, 70nm bandwidth) - delivering flashes of typically 1ms to 10ms duration.



(A) Raw retinal image without adaptive optics, 10ms exposure



(B) Same image after readjustment of the brightnes and contrast

Image signal - to - noise ratio are expected to be improved through the use of adaptive optics and appropriate image processing.

References

[1] S. Chiesa, E. Daly, C. Dainty, and S. R. Chamot, "Adaptive optics system for retinal imaging based on a pyramid wavefront sensor," in "Adaptive Optics for Industry and Medicine," Sixth International Workshop National University of Ireland (Imperial College Press, 2008), pp. 336–341.

[2] N. Devaney, E. Dalimier, T. Farrell, D. Coburn, R. Mackey, D. Mackey, F. Laurent, E. Daly, and C. Dainty, "Correction of ocular and atmospheric wavefronts: a comparison of the performance of various deformable mirrors," Appl. Opt. **47**, 6550–6562 (2008).

[3] S. Chamot and C. Dainty, "Adaptive optics for ophtalmic applications using a pyramid wavefront sensor," OPTICS EXPRESS **14**, 518–527 (2006).