



TEAR FILM BREAKUP TIME MEASUREMENT BASED ON CORNEAL REFLEX INTERFERENCES PRODUCED BY DRY SPOTS

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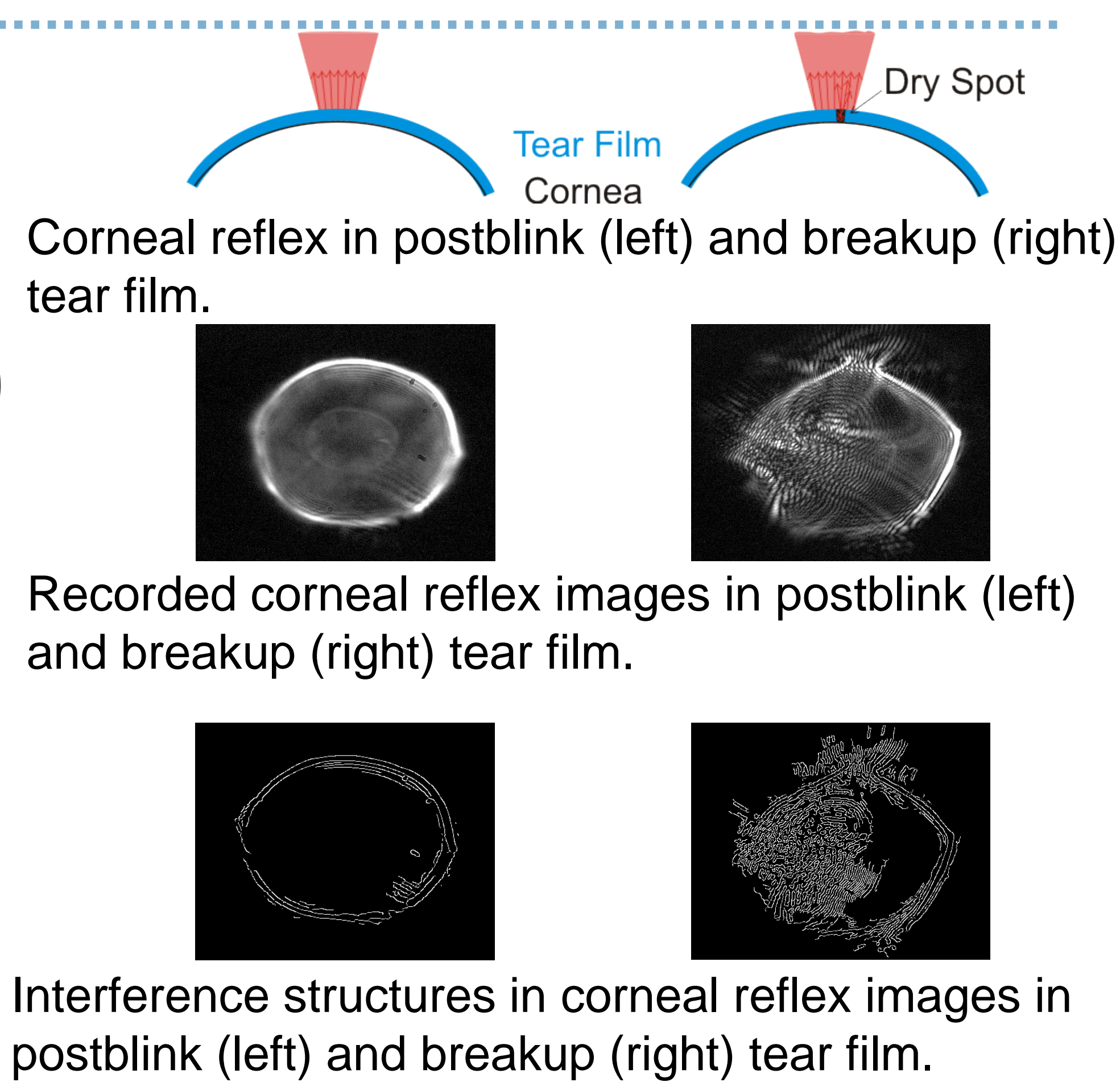
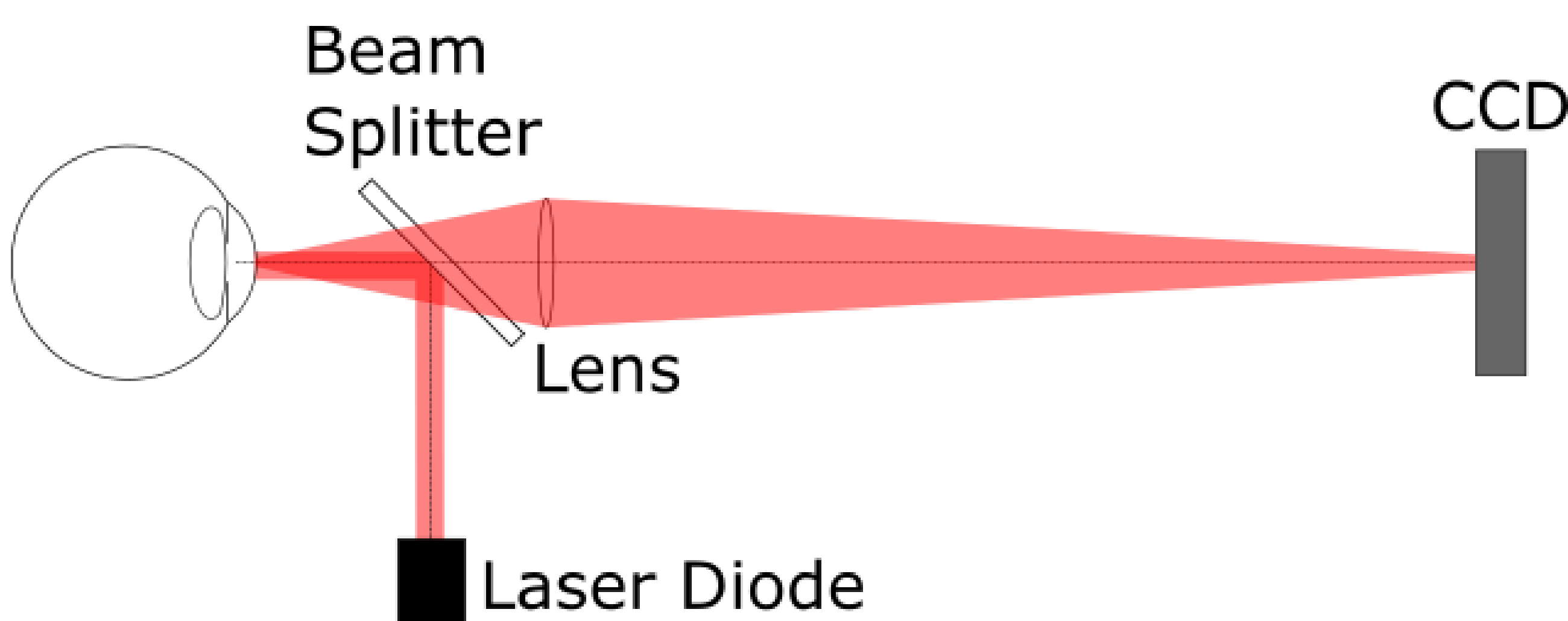
PURPOSE:

To test a new method for measuring the tear film breakup time based on interferences that appear on the corneal reflex. Dry spots in tear film cause abrupt height differences in the first eye surface, also the smoothness could be lost if corneal epithelium is exposed. Thus, the corneal reflex could present interferences caused by the phase differences, diffraction and speckle.

MATERIAL AND METHODS

Setup:

Scheme of the setup for recording corneal reflex or first Purkinje images.



Breakup determination:

Detecting the structures produced by interferences (diffraction, phase difference and speckle) due to the dry spots in the recorded corneal reflex images. The breakup time is determined when the number of interference structures detected in the image is larger than a threshold value (10).

Simulation:

A collimated beam reflected by a surface with changes in its structure was simulated using Matlab software. The changes in the structure were created by using holes of different diameters and depths in the tear film simulating the effect of the dry spots.

Experimental measurements:

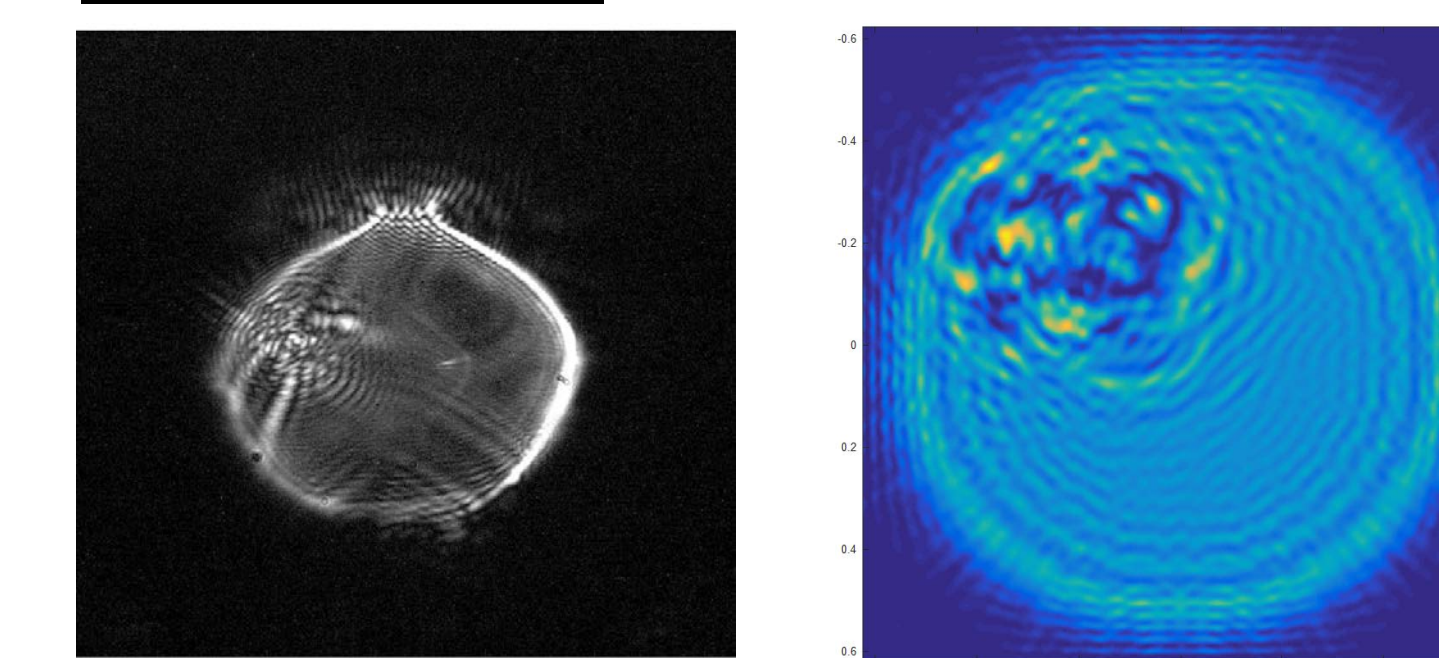
- Breakup time measurement with the laboratory setup.
 - Positioning and centering of the patient.
 - Asking the patient to prevent blinking.
 - Recording images (every 0,5s) from last blinking until breakup.
 - Image processing-> non-invasive breakup time (NIBUT).
- Breakup time (BUT) measurement with fluorescein.

RESULTS

Typical image sequence and breakup determination:



Simulation:



Real (left) and simulated (right) corneal reflex images of broken up tear film.

BUT vs. NIBUT in patients:

- Ten subjects.
- Mean (\pm SD) age of 26.7 ± 3.4 years
- No ocular condition, nor tear film associated disease.
- Mean (\pm SD) NIBUT of 18.1 ± 13.3 s.
- Mean (\pm SD) difference between BUT and NIBUT of 6.7 ± 11.7 s

CONCLUSIONS

- A method for the break up measurement of the tear film, based on corneal reflex interferences caused by dry spots, has been presented.
- The method is noninvasive, objective, simple to use and low-cost.
- It is oriented to clinical practice and could be implemented in regular ophthalmic devices (double pass or Hartmann-Shack).