



Ocular optical quality dynamics during accommodation in subjects with accommodative dysfunctions

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Introduction

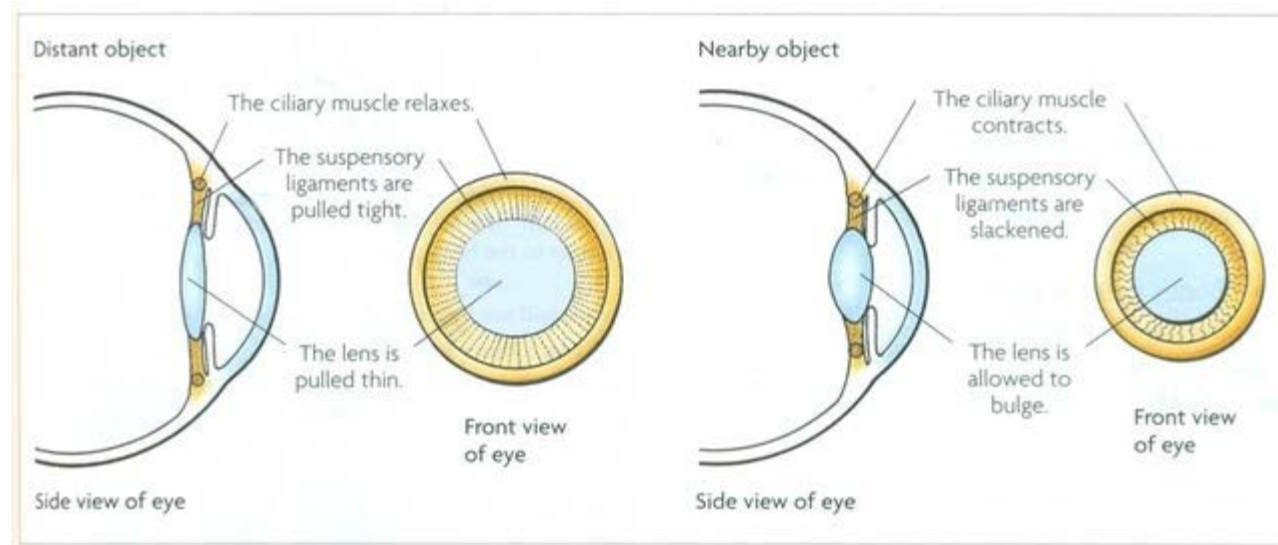
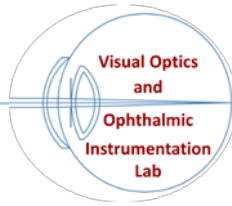


Image from <http://biology-igcse.weebly.com/-accommodation.html>

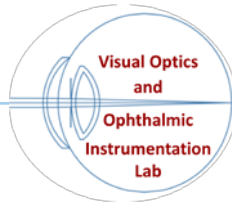
Introduction



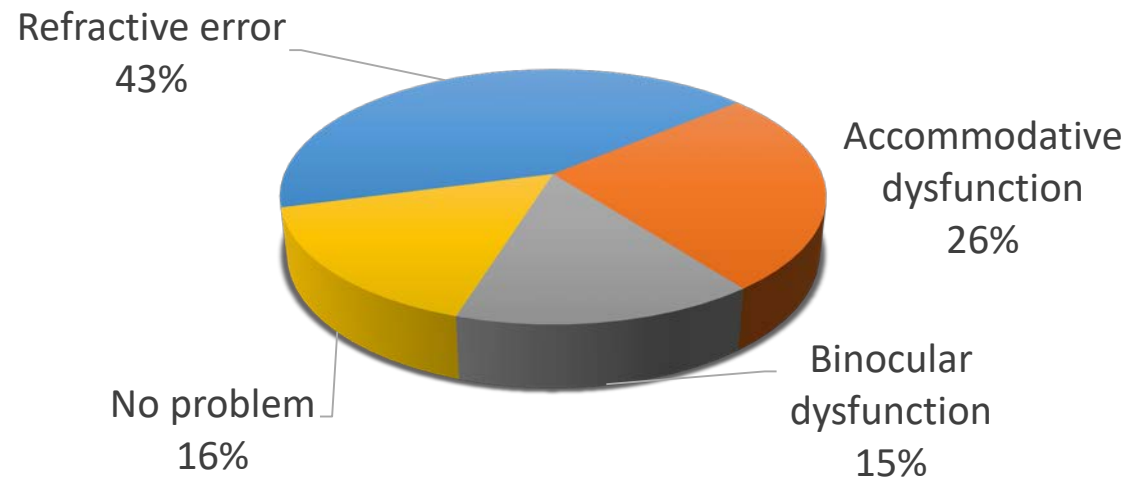
- What are (the) accommodative dysfunctions?
 - Accommodative Insuficiency
 - Accommodative Excess
 - Accommodative Infacility



Introduction



- Prevalence of accommodative dysfunctions

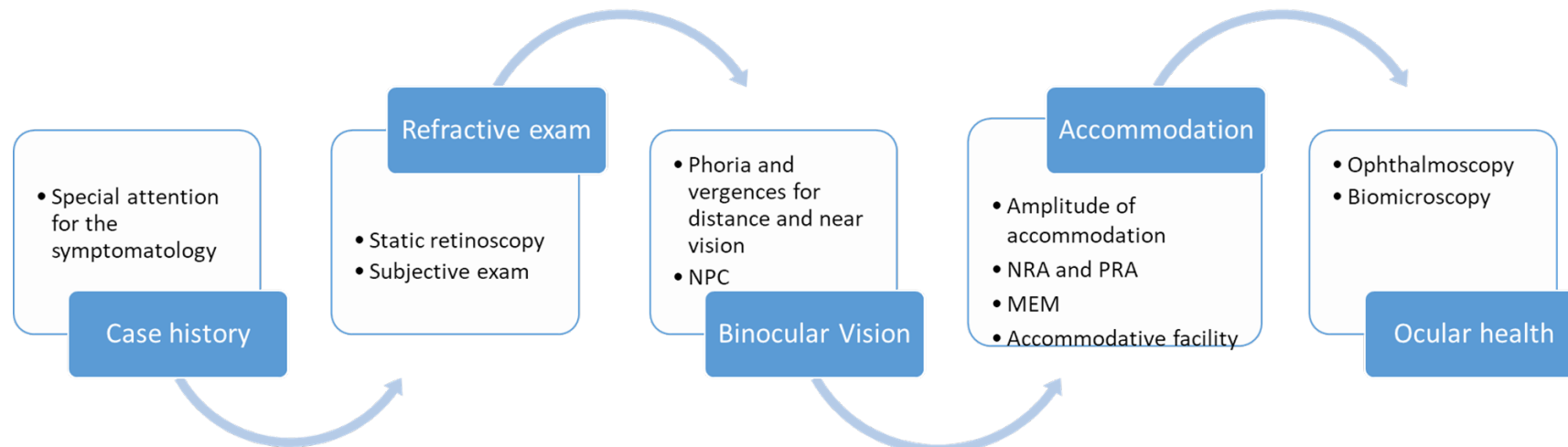


Franco *et al.* 2018 unpublished data

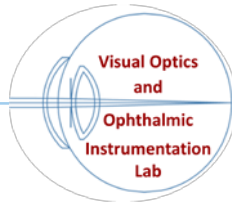


Introduction

- How to diagnose?



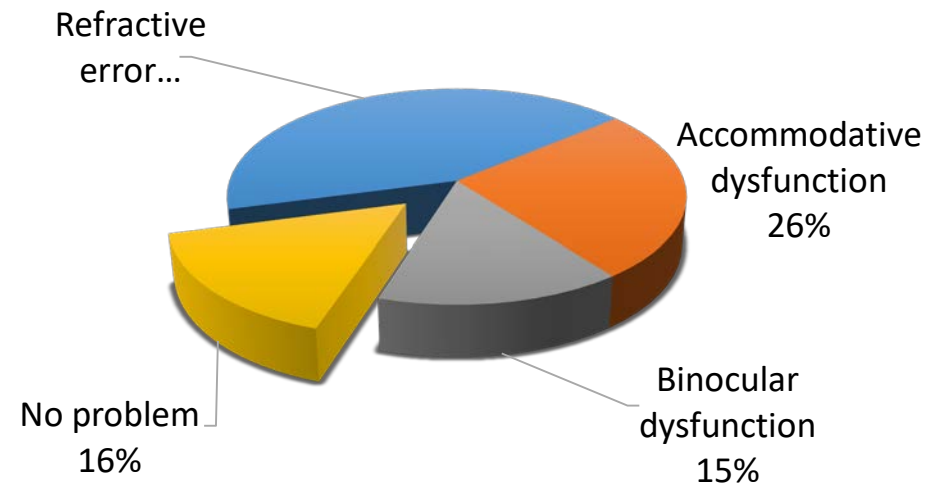
Introduction



- There are several different criteria to diagnose the accommodative dysfunctions.
- There are symptomatic subjects that “pass” all the criteria.

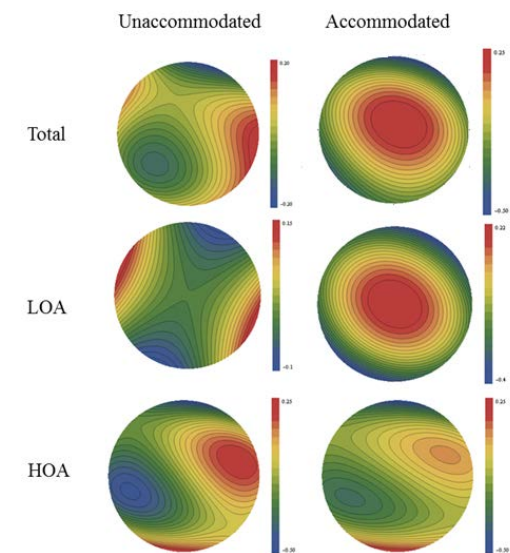
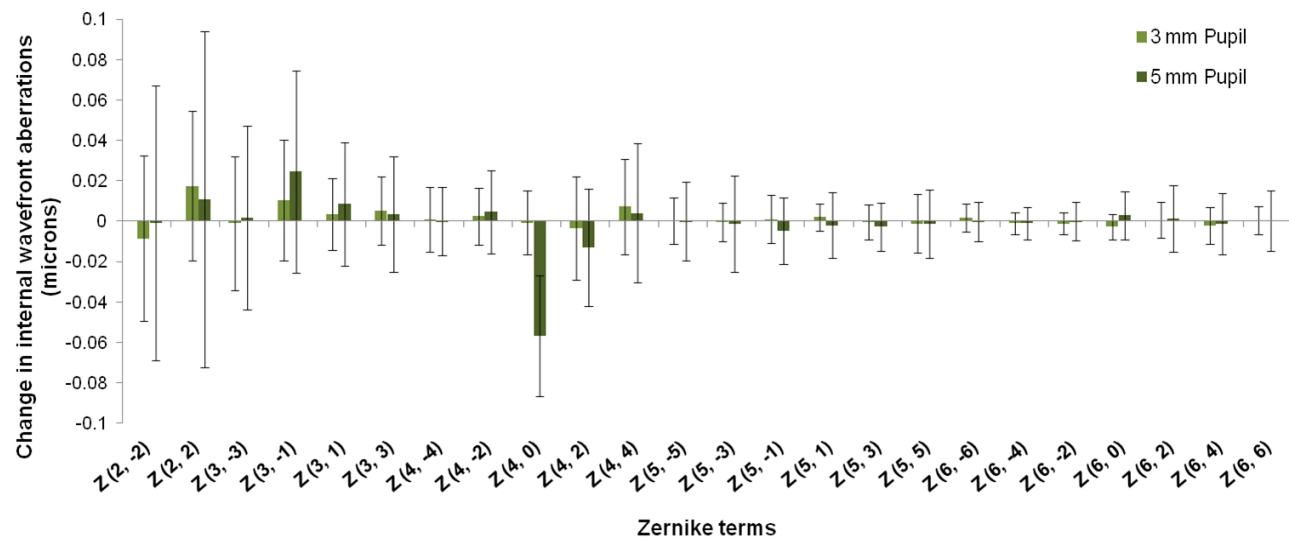
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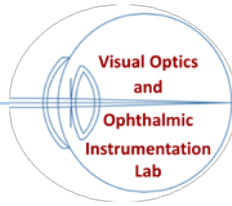




Introduction



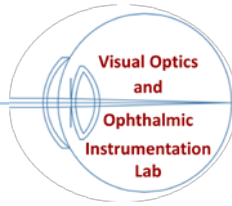
Introduction



Can we use the ocular optical quality data to study/diagnose accommodative dysfunctions?

Do people with these dysfunctions have a different behavior? If so, what is it like?

Introduction



- To evaluate ocular accommodation from ocular wavefront aberrations data continuously measured during the response to different accommodative demands.
- To compare the results of symptomatic and non-symptomatic subjects.



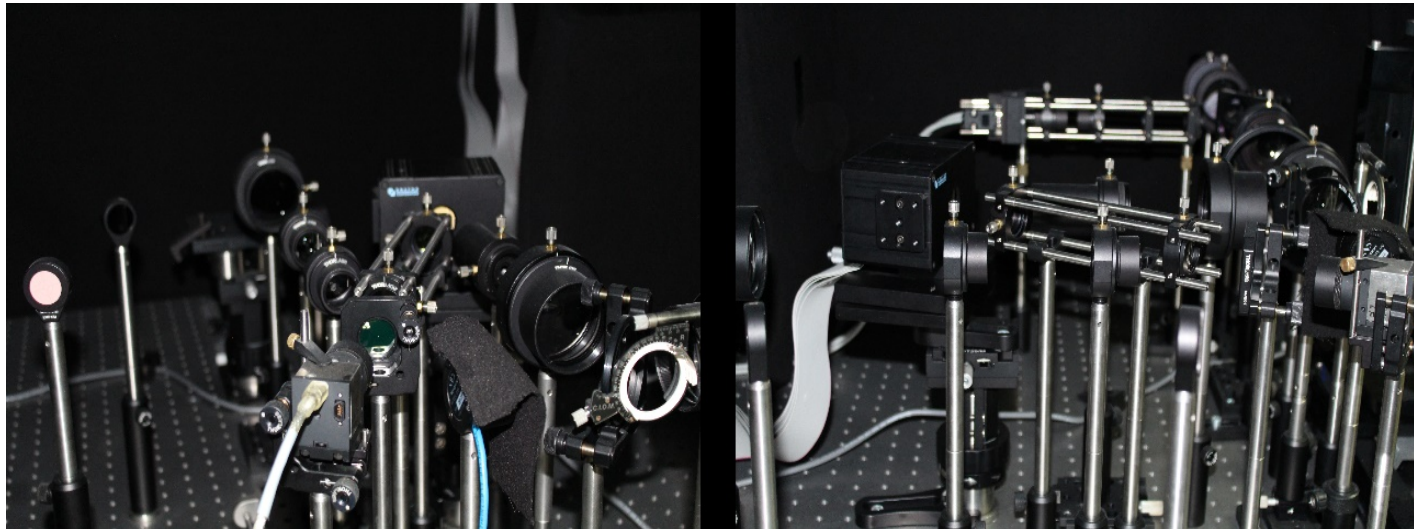
Methods

Ocular optical quality dynamics during accommodation in subjects with accommodative dysfunctions.



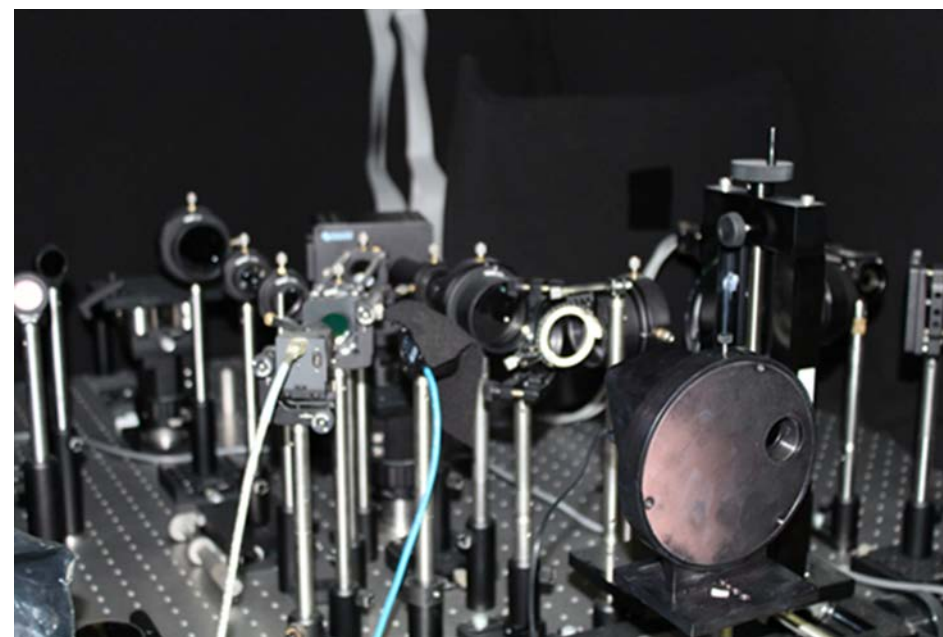
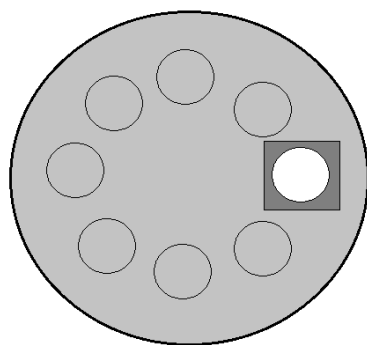
Method

- Hartmann-Shack aberrometer
 - resolution of 1280×1024 , 39×31 lenslets, working with a frequency of 15 Hz



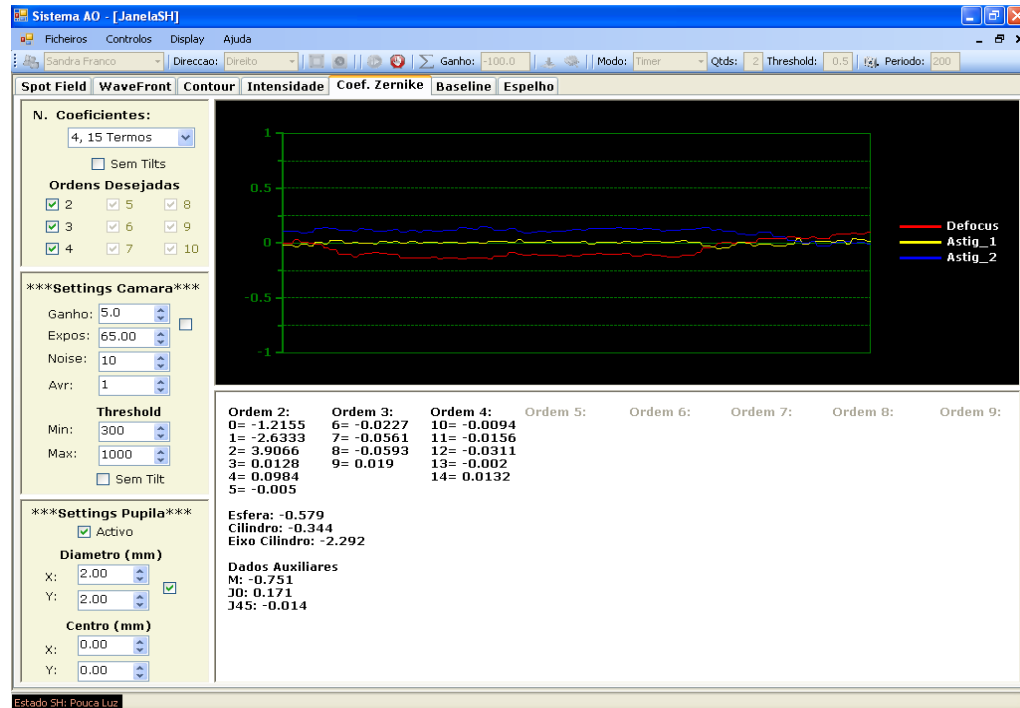


Methods



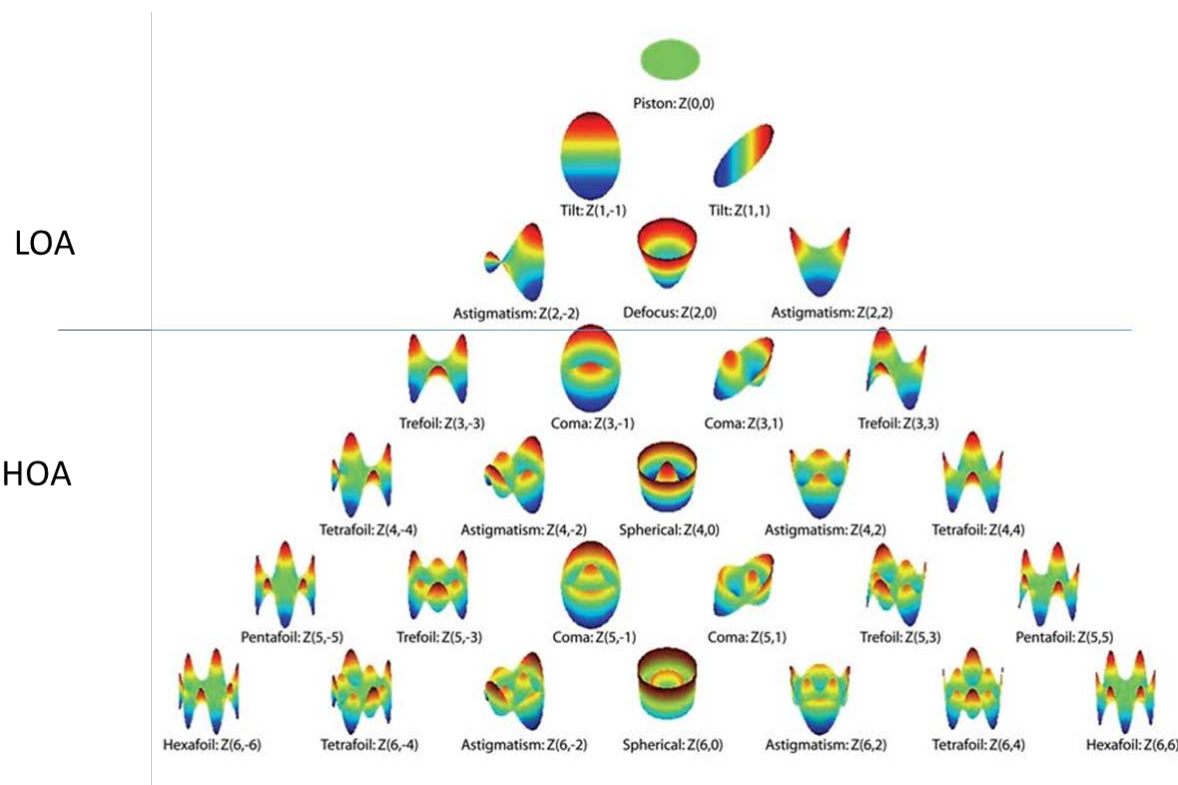
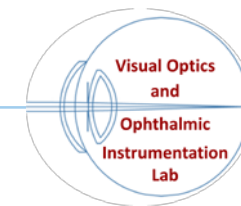
Methods

- The operator can see in real time the time-course of the aberrations.
- The data acquisition is synchronized with the lens system.





Methods



```

****Zernikes****
Zernike 0 7,0109
Tilt 1 -1,6255
Tilt 2 -3,2893
Astigmatism -0,2074
Defocus -1,4604
Astigmatism -0,2277
Trefold 1 -0,1035
Coma 1 0,0094
Coma 2 -0,025
Trefold 2 -0,0283
Quadrifold -0,0661
Astigmatism -0,0003
Sphere 0,0146
Astigmatism 0,0216
Quadrifold 0,0041
Zernike 15 -0,0168
Zernike 16 0,0065
Zernike 17 0,0048
Zernike 18 0,006
Zernike 19 -0,0043
Zernike 20 -0,0029
Zernike 21 -0,0023
Zernike 22 0,0039
Zernike 23 0,0055
Zernike 24 -0,0063
Zernike 25 -0,0113
Zernike 26 0,001
Zernike 27 -0,0109

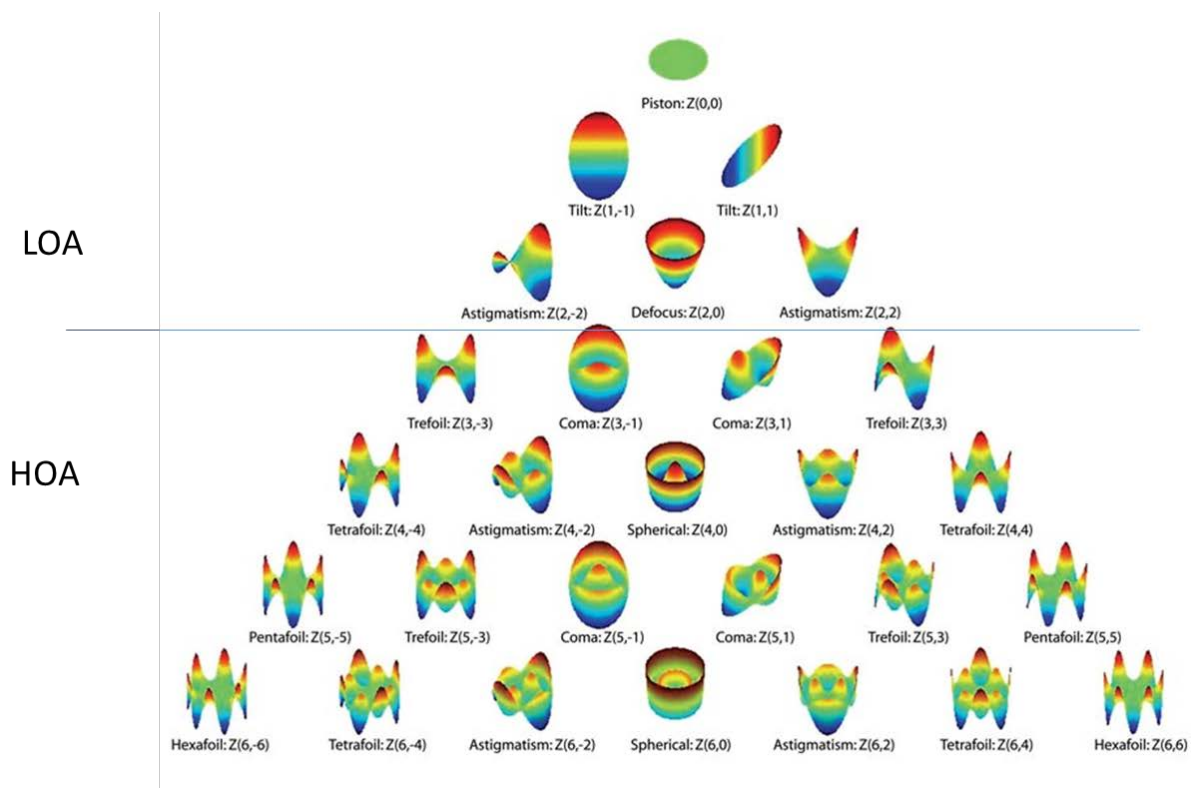
***Wave Settings***
PV 14,9448
RMS 3,931

****SH Settings****
Exp 66,5594 ar 5
Pupil_X 2,5 and Pu 2,5
Center Pup. 0 and Cent 0
Cancel tilt 0
DM status 0
SH status 0
Filter Positi 0

****Acquisition time****
Time 7 52 27 468
Qty 1 and Dew 0
  
```

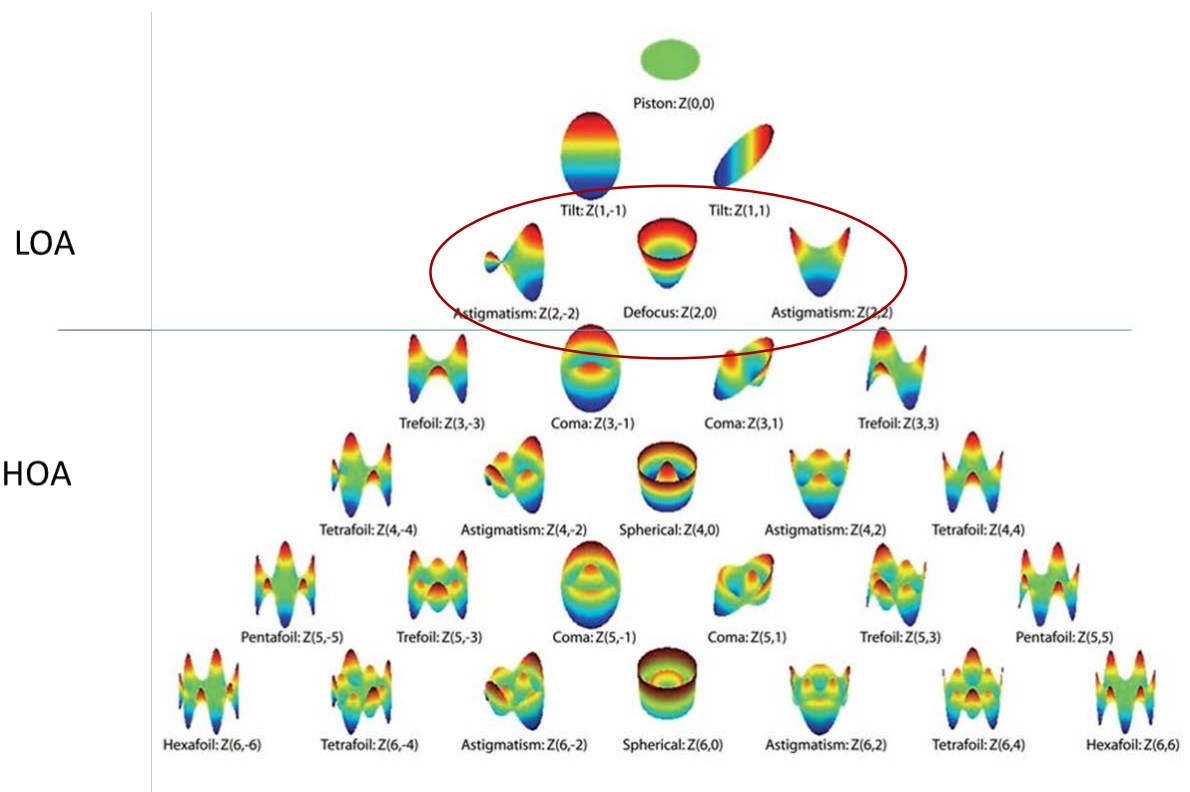


Methods





Methods



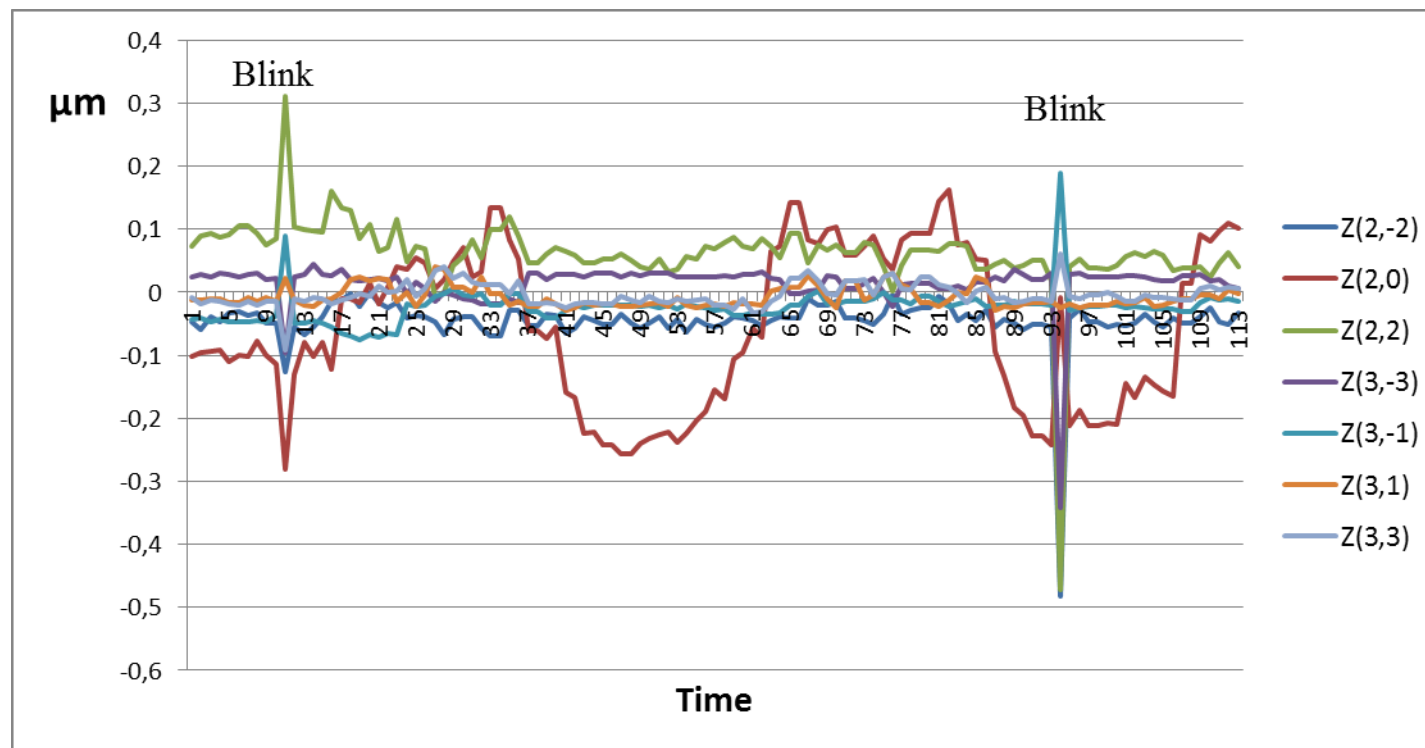
$$M = \frac{-4\sqrt{3} \times Z(2,0)}{r^2}$$

$$J_{45} = \frac{-2\sqrt{6} \times Z(2,-2)}{r^2}$$

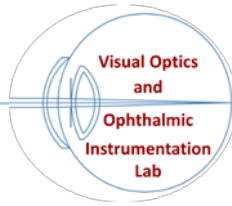
$$J_0 = \frac{-2\sqrt{6} \times Z(2,2)}{r^2}$$



Methods



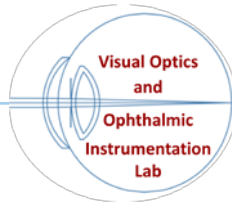
Methods



- In addition to the optical quality parameters, several accommodative parameters were computed from the collected data:
 - accommodative response,
 - lag of accommodation,
 - response time.
- These parameters were computed for all the accommodation stimulus.



Methods



| | Age (years) | Am (D) | M.E.M. retinoscopy (D) | AF (cpm) | Observations |
|-----------|----------------|-----------|------------------------------|-------------|--|
| Subject A | 22 | 9.00 | +0.50 | 19 | Far blurred vision after performing a near vision task |
| Subject B | 28 | 8.50 | +0.50 | 12 | No symptoms |

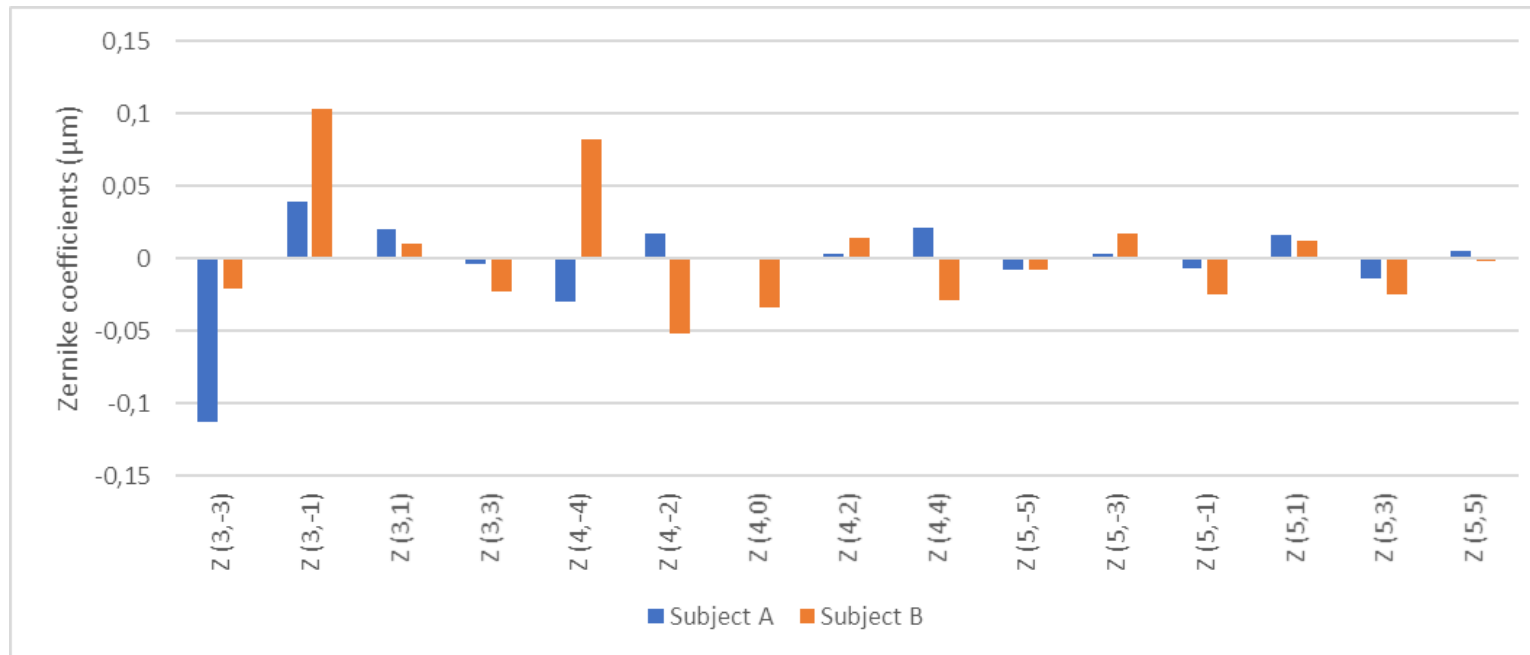


Results

Ocular optical quality dynamics during accommodation in subjects with accommodative dysfunctions



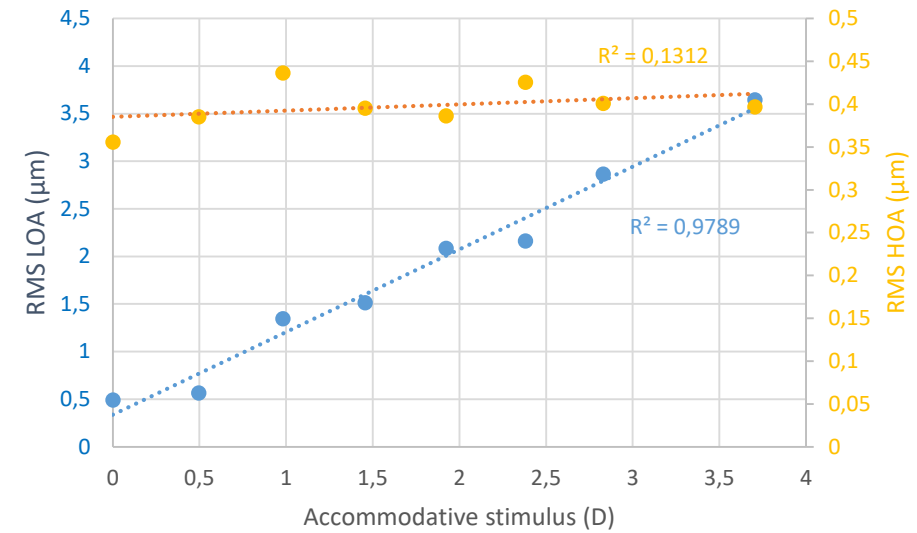
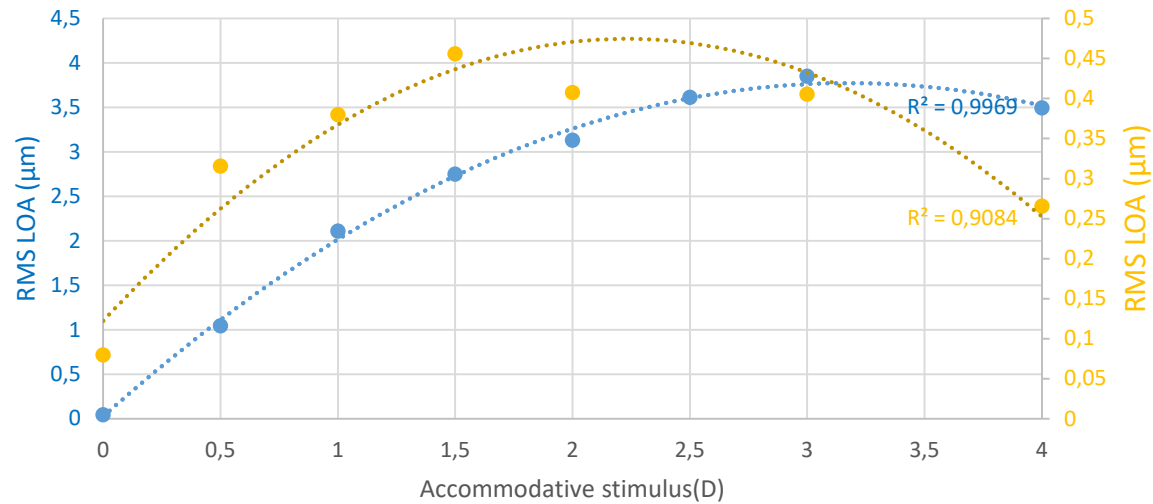
Results



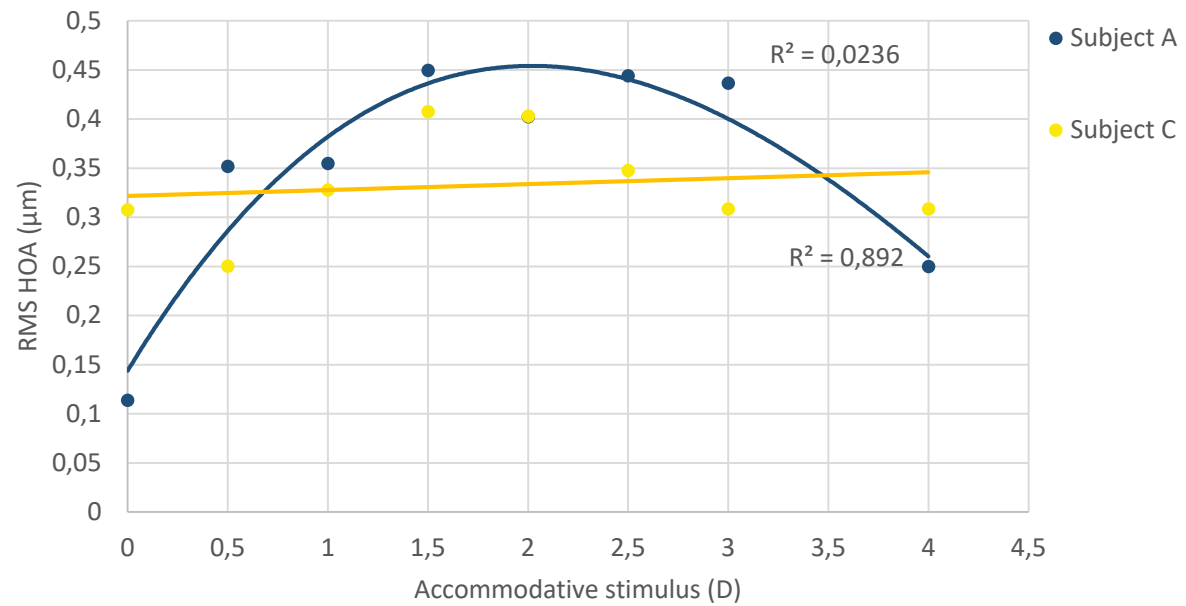


Results

- RMS vs Accommodative stimulus



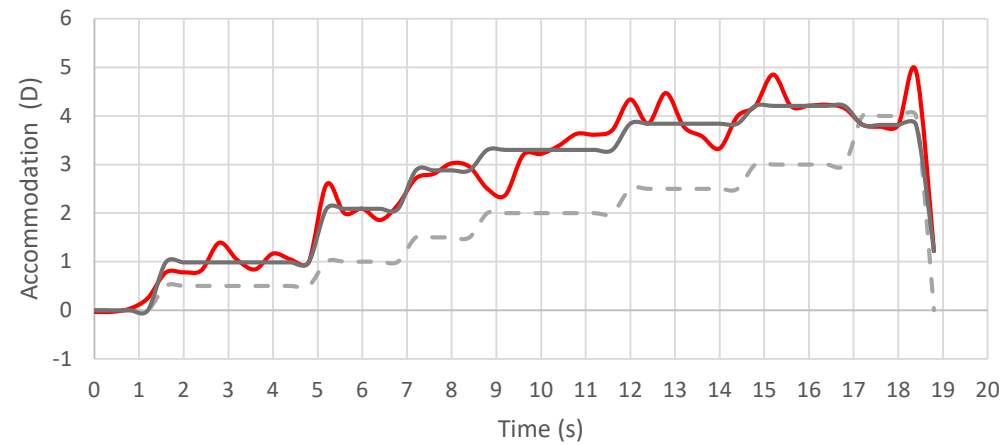
Results



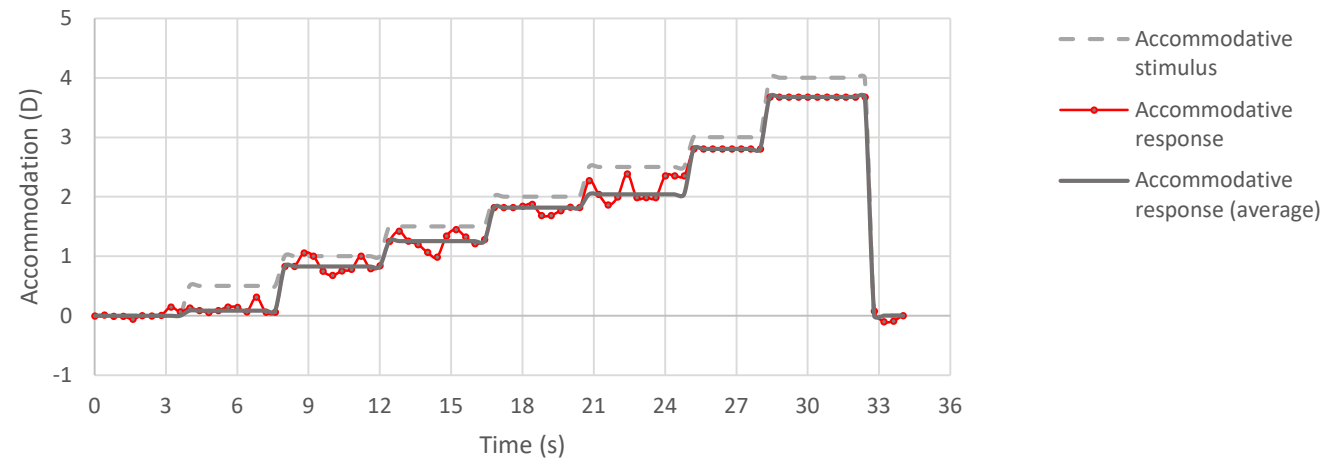
Results

- Accommodative response

Subject A

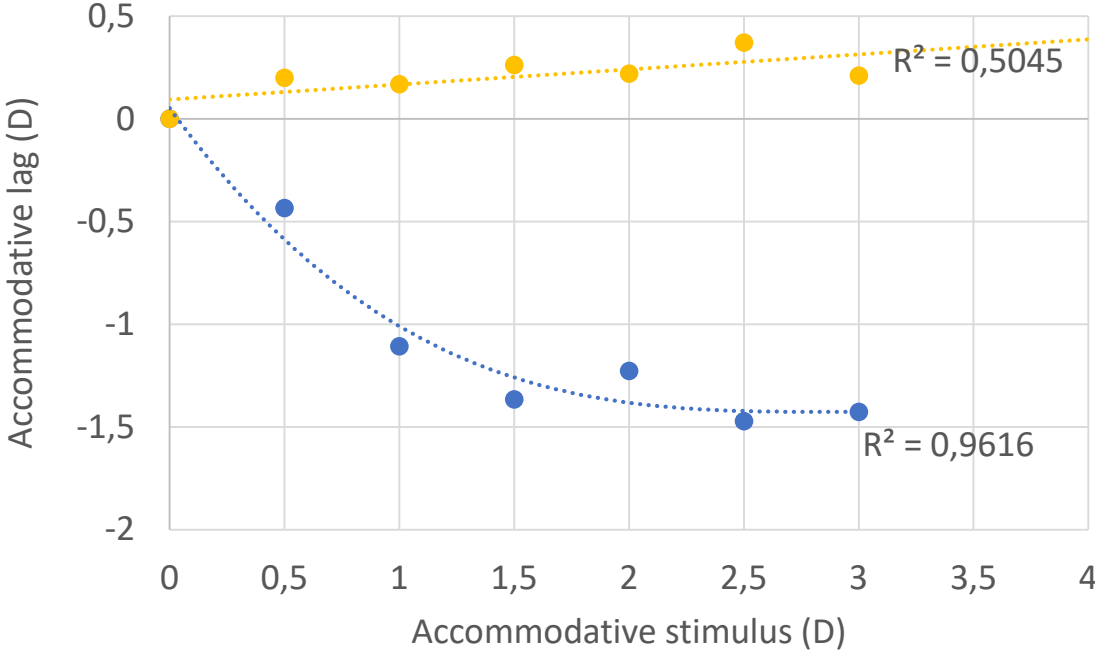
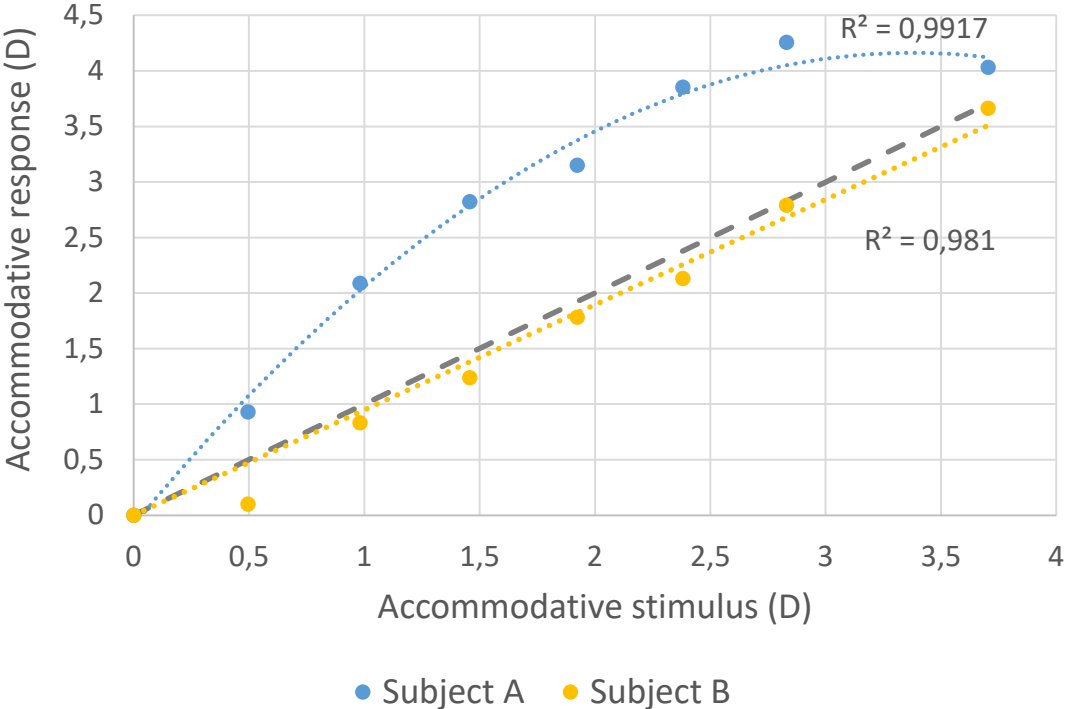


Subject B



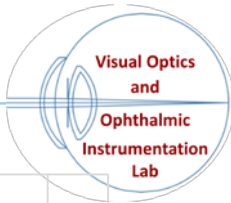


Results





Results



$$y = y_0 + a(1 - e^{t/\tau})$$

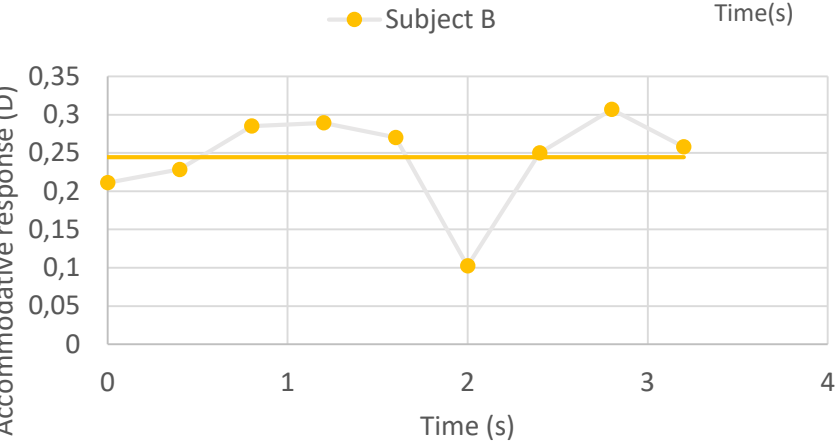
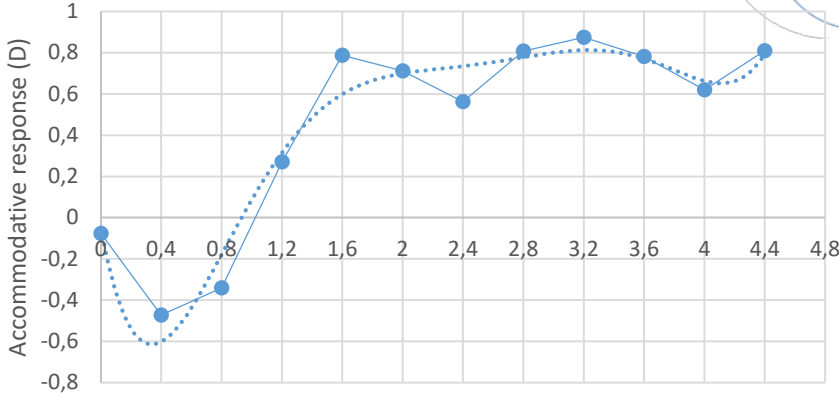
a represents the amplitude of the response, t represents time in seconds, and τ represents the time constant.

Stimulus: 0,45 D

Subject A took 1.41 s to achieve a stable accommodation response of 0.66 D.

Subject B took 0.05 s to achieve a stable accommodation response of 0,19 D

$$a = 0.17; r=0.4147; t=0.009$$

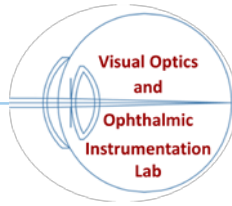




Conclusions

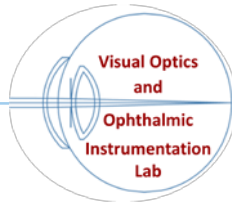
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Conclusions



- The patient with symptoms after a near vision task, presented several alterations in his accommodative performance that were not found in the optometric exam.
- This method shows the presence of anomalies even before they can be detectable in a optometric exam.
- The measurement of wavefront ocular aberrations can be a tool to diagnose accommodative disorders.
- It might also be useful to analyse the effects of visual therapy as a treatment option.

Acknowledgements



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