

Real-time monitoring of accommodation during subjective refraction

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Refraction and accommodation

Refraction is a procedure based on patient's responses to find the combination of lenses that compensates for refractive errors.



dreamstime.com



Accommodation (ability to focus at different distances) is one of the main factor to be controlled for the success of the test (children and young adults may subconsciously accommodate).

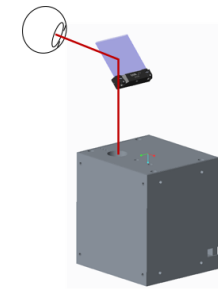
Methods for controlling of accommodation: Use of cyclopegic drops to paralyze accommodation (invasive), and relaxation of accommodation by adding positive lenses (fogging).

Proposed solution: Real-time monitoring of the behavior of accommodation as an objective tool to validate subjective refraction.



Subjective refraction

+



Objective monitoring
of accommodation

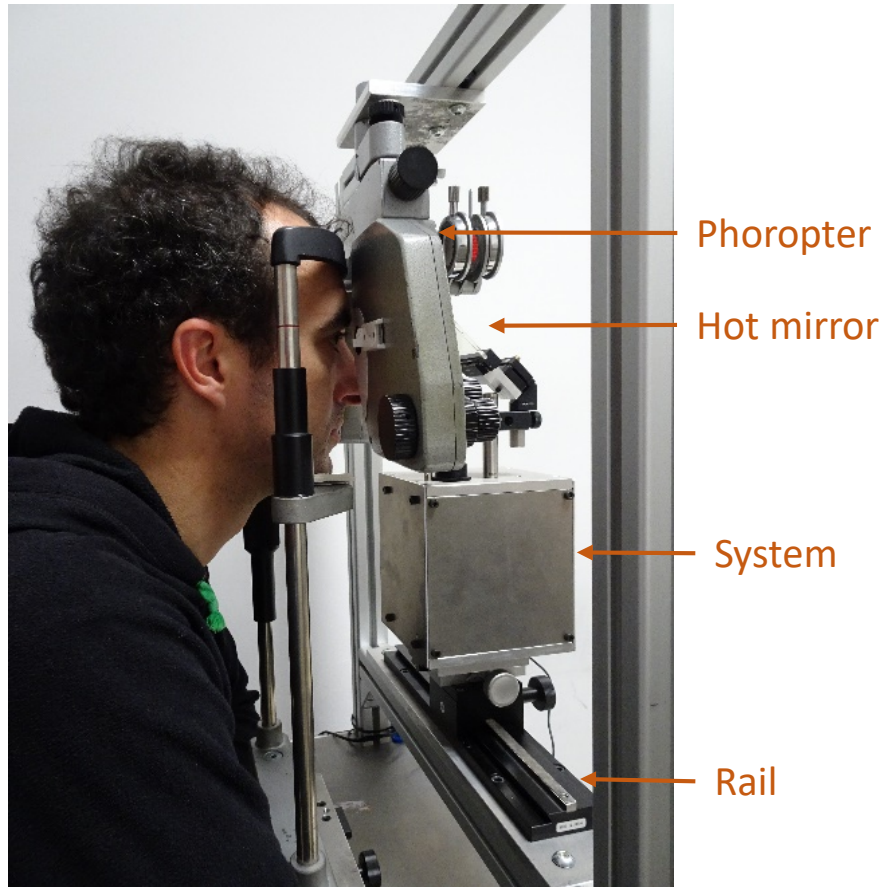


Validated refraction

Purpose of this work

To present a **system for real-time monitoring of accommodation** which can be used as an objective tool during subjective procedures where accommodation plays a role.

System for monitoring accommodation



Hartmann-Shack aberrometer coupled to a phoropter with a hot-mirror able to estimate the behavior of accommodation.

Other characteristics:

- Minor affectations to the visual field (open field, infrared measurements).
- Real time estimations (every 100 ms).

Protocol for system validation

The behavior of accommodation in far vision of 87 volunteers was estimated while adding with the phoropter spherical lenses (ΔP) between ± 2 D with respect to manifest subjective refraction.

Details:

- Set of additional spherical powers: +2, +1.5, +1, +0.75, +0.5, +0.25, 0, -0.25, -0.5, -0.75, -1, -1.5, and -2 D.
- Number of estimations for additional optical power: ~ 100 .
- Measured eye: dominant eye in monocular vision.
- Measurements at *Centre Universitari de la Visió* (CUV-UPC).

Inclusion criteria:

- Spherical equivalent between ± 2 D.
- Astigmatism between 0 and -2 D.
- Pupil diameter of at least 3.5 mm under photopic, natural, environmental conditions.
- Without pathologies associated to accommodation.

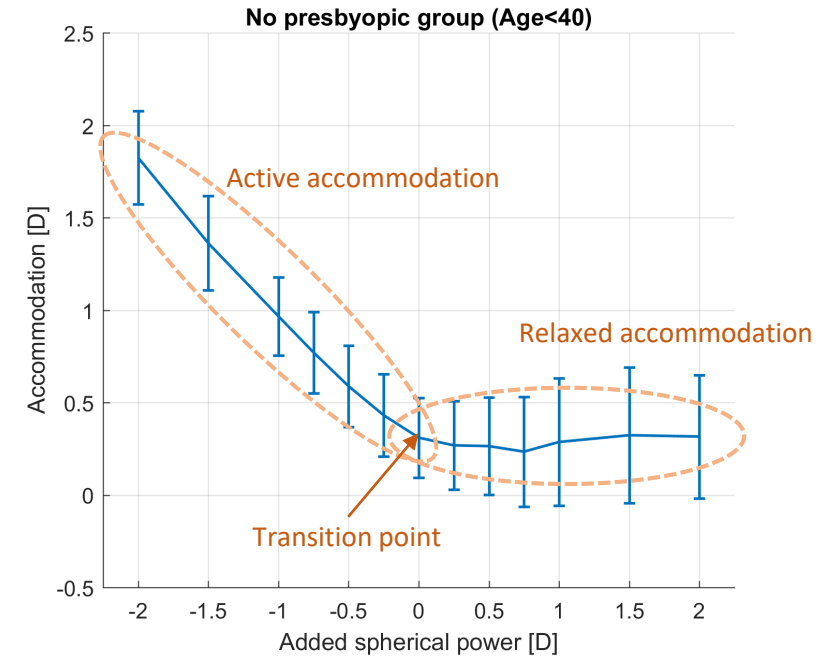
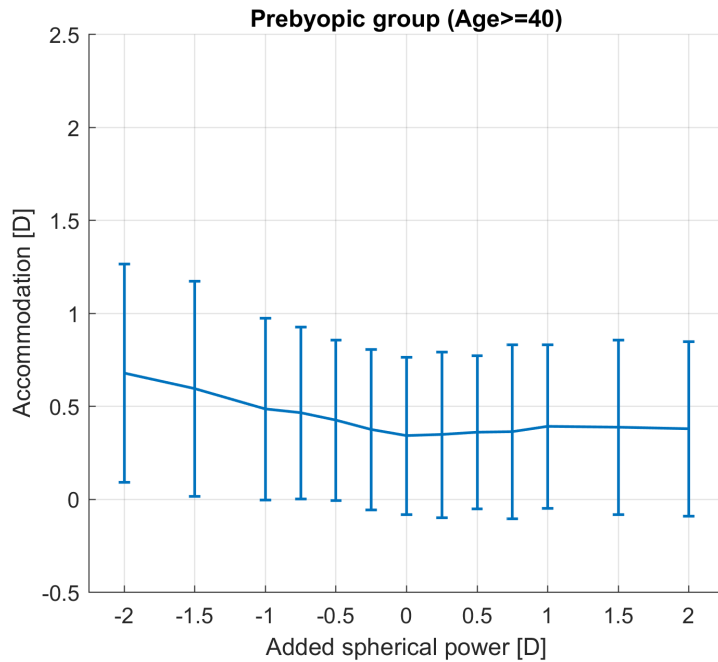
$$\text{Accommodation} \Big|_{\Delta P} = -(\overline{M}_m + \Delta P)$$

Mean measured spherical equivalent per added lens Contribution of phoropter

Results

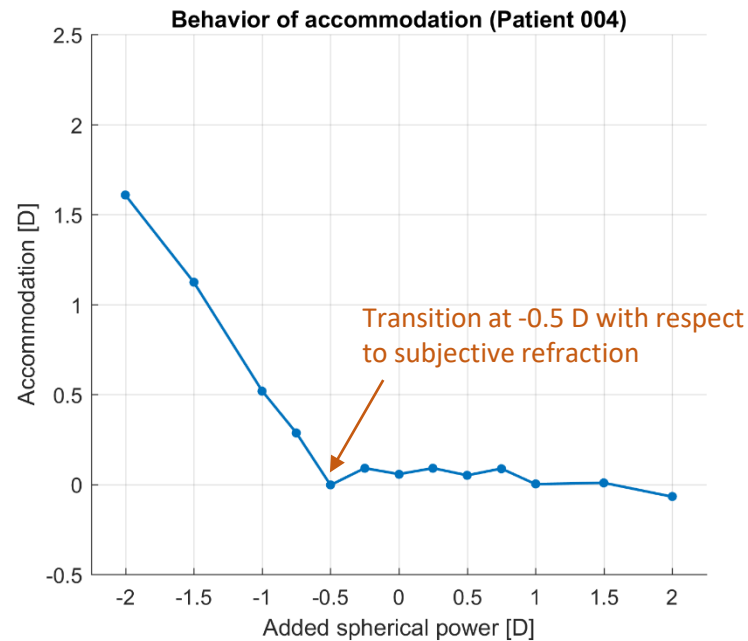
Group	N. of eyes	Age (years)		Subjective spherical equivalent [D]	
		Mean (std)	Max (Min)	Mean (std)	Max (Min)
Presbyopic	21	55.24 (8.99)	73 (41)	+0.36 (0.68)	+1.5 (-1.12)
No presbyopic	44	23.43 (3.41)	37 (19)	-0.30 (0.76)	+1.5 (-1.88)

- 65 of the volunteers satisfied inclusion criteria.
- Statistically significant difference between the presbyopic and no-presbyopic groups between -0.75 and -2 D.
- Two well defined regions in eyes with accommodation capacity.

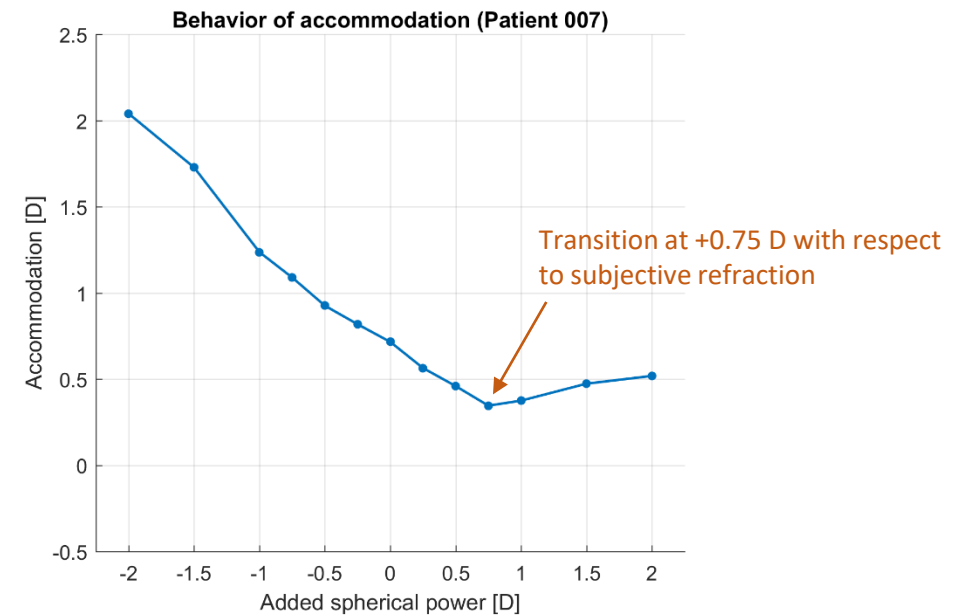


Examples of cases of interest

- The behavior of accommodation may be provided to ophthalmologists and optometrists to know the influence of accommodation for the subjective refraction .



Patient 004 (22 year old, subjective M=-0.375 D)



Patient 007 (22 year old, subjective M=+0.250 D)

Conclusions

- An instrument coupled to a phoropter able of monitoring in real-time not only refractive errors, but also accommodation was successfully validated in a clinical environment.
- The system was used to obtain the behavior of accommodation with a methodology similar to that followed during subjective refraction.
- The objective information given by the instrument might be very useful to support ophthalmologists and optometrists decisions since it would allow corroborating if accommodation plays a role in the subjective refraction found with the phoropter.

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Contact



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