

Report on the Doctoral Thesis: “Investigations of crystalline lens wobbling inertial motion phenomenon by means of numerical simulations”

This thesis presents a dynamic numerical simulation of the so-called “lens wobbling” phenomenon using Finite Element Method (FEM) software. Overall, the thesis is well structured, with clearly defined chapters and well-written content. It is relatively easy to read, and the topic holds interest for the visual optics research community. One of the aspects I particularly appreciated was the attempt to develop a new method for measuring Intraocular Pressure (IOP) based on lens wobbling data.

On the downside, I must mention that I was expecting more in-depth results as I progressed through the reading. For example, I was hoping to see real measurements of IOP as a function of lens wobbling parameters.

In the following paragraphs, I list my specific comments and suggestions for correction:

- **Page 7, last paragraph:** “The lens system consists of four primary parts: ...” It is unclear why “four” parts are mentioned, as only two are listed. Please revise for consistency.
- **Page 8, second paragraph, last sentence:** When introducing IOLs in the discussion, please cite the original work of H. Ridley, who invented the first type of intraocular lenses implanted in the eye.
- **Page 9, section 2.1.6 Iris:** The function of the pupil muscles is inaccurately described. The dilator and sphincter muscles act antagonistically—they always work in opposition.
- **Page 11, second paragraph, last sentence:** Please remove the entire statement, “However, I hope to find a new ...” as it is out of place and lacks scientific content.
- **Page 11, third paragraph:** The pioneering work of H. Deubel and B. Bridgeman on lens wobbling appears to be overlooked. Please include references to their studies here.
- **Page 15, first equation:** As a matter of formality, use boldface or arrow notation to indicate vector quantities (e.g., forces or displacements).

- **Page 20, equation 7:** The Navier-Stokes equations are incorrectly displayed. The time derivative of velocity should include vector notation. The continuity equation should be presented on a separate line for clarity and must include a dot after the nabla operator, indicating the divergence of the velocity, which should equal zero for certain fluid types. Additionally, equations 8 and 9 should each be shown on their own line for better readability.
- **Page 28, first paragraph:** Please cite the paper by Lin He et al. (J. Vis, 2010), which discusses lens wobbling as a combination of lens tilt and decentration.
- **Page 33, first paragraph:** The phrase "... the eye is in a state of full relaxation..." should be revised to "... the ciliary muscle is in a state of full relaxation...". Additionally, this paragraph should cite the work of Tabernero et al. (Sci. Reports, 2016), whose results show that in the non-accommodated eye, there is more zonular tension and less wobbling than in the accommodated state—even in advanced age (indicating muscle activity at those ages).
- **Page 48, first paragraph:** The statement "... death causes the ciliary body to relax, the zonules to contract ..." appears to be inaccurate. If the zonules contract, this would imply a release of tension that leads to a more curved (accommodated) lens. Please clarify or revise accordingly.
- **Page 58, last paragraph:** The phrase "... as IOP level increased, the lens exhibited not only greater displacement but also a ..." seems to contradict your own data. It appears the opposite is true. Please verify and correct.
- **Chapter 5, general comment:** Why is the analysis limited to an IOP of 20 mmHg or less? These values fall within the normal range. In glaucoma, IOP can be significantly higher. Please consider expanding the analysis to include higher IOP values or justify the limitation.
- **Page 63, Materials and Methods:** This section should be expanded, especially to explain the "water drinking test" to the reader. Include details such as how much the IOP is typically elevated during this test. This may not be obvious to readers without a clinical background.
- **Page 68, Table 13:** Please add a row to include the mean values from the six subjects for completeness.

- **Page 71, first paragraph:** The $D_{\max}$ values obtained from the simulations differ considerably from the mean values observed in the actual measurements—both at baseline and after the water drinking test. Please acknowledge and discuss these discrepancies.
- **Page 71, second paragraph:** The first sentence is unclear. How can the data presented here be related to the onset of glaucoma when no glaucoma subjects were measured or simulated in this study? Please revise or clarify.