Practical No 23

ESTIMATION OF THE DIFFERENCE IN VISUAL LATENCY IN THE PULFRICH EFFECT

A. *Linear Pulfrich effect.*

Experimental setup: physical pendulum oscillating continuously (dumping of oscillations is compensated by electric power), plane table with a moving indicator, test glasses with a filter of a regulated permeability on one eye, ruler, measuring tape.

1. Set the indicator on the plane table in the position of „zero" – lines on the basis of the indicator must match the lines on the plane table. Then set the whole table in a position, where the indicator is located precisely under the pendulum. The table must also be placed perpendicularly to the wall in the background.
2. Plug the electric power supply of the pendulum in the socket. Then the pendulum will start to oscillate. Oscillations will be stabilised (become constant in time) after a short time.
3. Take a comfortable sitting position on a chair placed about 1,5 m away from the pendulum. The lower part of the indicator must be placed exactly in front of eyes of the watching student. The upper part of the indicator must be visible at the angle of 90^0 – this can be done by setting properly the height of the chair. Using the measuring tape estimate the distance between the watching student and the pendulum. Write down the result to the Table I.
4. The watching student is putting on the test glasses with a filter and is checking out whether the Pulfrich effect is occurring. It means, it seems to him/her that the trajectory of movement of the edge of the pendulum is no longer linear, but it has become elliptic (it can be observed while watching the movement).
5. a) Estimate the position of the near point (that is close to the watching student) of the seeming elliptic trajectory of movement of the edge of pendulum. For this purpose a group mate should move the indicator on the plane table until the watching student is reporting that the edge of the pendulum is placed directly above the indicator while the pendulum is passing the near point. **IMPORTANT NOTE! The watching student must fix the vision exactly on the upper edge of the indicator; this will provide the best accuracy of measurements.** Using the ruler measure the distance between the near point of the seeming elliptic trajectory and the actual position of pendulum. Write down the result to the Table I.

   b) Repeat the procedure described above to estimate the position of the far point (that is far from the watching student) of the seeming elliptic trajectory of movement of the edge of pendulum. Write down the result to the Table I.

   Attention: Since adoption of the filter-covered eye, which results in intensifying the Pulfrich effect, is starting immediately after putting on the test glasses, make short breaks after each minute of watching. The better solution would be a total adoption of the filter-covered eye before starting measurements – however, this would require about 20 minutes of time more (about 40 minutes more for a working group) – a time limit of the practical makes us exclude such a procedure.
6. Change significantly the filter's permeability twice and repeat, each time, all the measurements described in point 5a, b. If the distance between the watching student and the pendulum is changed, measure it again. Write down the results to the Table I.
7. Using the scale on the test glasses measure the distance between the pupils of eyeballs of the watching student. Assume that the velocity of pendulum's movement, at the point of equilibrium, is 70 cm/s. Applying the Lit's formulas calculate differences in latencies Δt. Write down the results to the Table I.
8. Repeat all measurements with a group mate as the watching student.

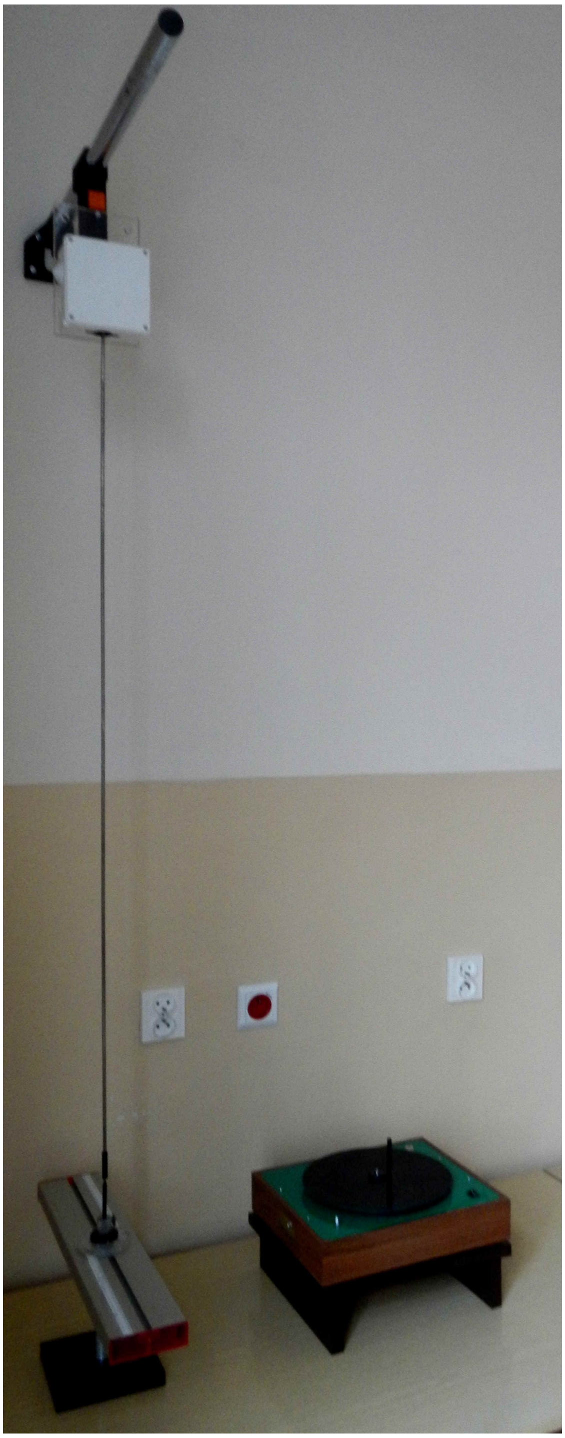
B. Rotational Pulfrich effect.

Experimental setup: a vertical rod placed on a disk rotating continuously with a regulated angular velocity, test glasses with a filter of a regulated permeability on one eye, ruler, measuring tape.

1. Set the white rotation direction switch on the left of the disk in the neutral (vertical) position and turn on the power supply of the disk (set the black switch on the right of the disk in the position „1”).
2. Set the minimal value of angular velocity of the disk by turning the knob on the right of the disk counter clockwise to the left minimum.
3. Take a comfortable sitting position on a chair placed about 1,5 m away from the disk. The upper part of the rod placed on the disk must be visible at the angle of 90^0 – this can be done by setting properly the height of the chair.
4. If the **left** eye of the watching student is covered by the filter**,** the rod should rotate **counter clockwise** (white rotation direction switch should be set in the position „towards me”), if the **right** eye is covered, the rod should rotate **clockwise** (white rotation direction switch should be set in the position „out of me”). The watching student is putting on the test glasses and is starting to observe the movement of the **upper part** of the rod.
5. A group mate is turning the knob on the right of the disk clockwise to increase the frequency of the movement of the rod until the value when the watching student is reporting that it seems to him/her that the rod is moving “back and forth” on a trajectory connecting two opposite extremes of its actual movement (see Figure 5). If it is not visible, increase the frequency of the movement of the rod until the watching student is reporting that it seems to him/her that the rod is moving in the opposite direction to the actual movement. **Attention: changes in frequency of the movement of the rod must not be done too fast!.**
6. Using a timer measure the time period T, which is a reciprocal of the frequency mentioned in the point 5. To reduce the experimental error measure the time period of, let’s day, 10 rotations and divide the calculated result by 10. Take off the test glasses. Write down the result to the Table II. Using the measuring tape estimate the distance between the watching student and the centre of the disk. Write down the result to the Table II.
7. Change significantly the filter’s permeability twice and repeat, each time, all the measurements described in points 2 and 4-6.
8. Applying the Nickalls formula calculate differences in visual latencies Δt. Put the distance between the pupils of eyeballs of the watching student (b) measured in the previous part of the practical to the formula. Write down the results to the Table II.
9. Repeat all measurements with a group mate as the watching student.

Required knowledge:

1. Binocular vision: fixation, retinal correspondence, retinal disparity. Horopter. Sensor fusion, Panum’s fusional area.
2. Idea of the Pulfrich effect (see theoretical supplement).
3. Experimental methods applied in the practical (see theoretical supplement).



Wrocław Medical University Department of Biophysics and Neuroscience	**Practical No 23** **Estimation of the difference in visual latency in the Pulfrich effect**
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Grade:	Tutor's signature:

A. <u>LINEAR PULFRICH EFFECT</u>

STUDENT 1

Distance between the pupils of eyeballs, **b** [cm]	

Table 1

		Near point		Far point	
Position of the filter in test glasses	Distance between the watching student and the pendulum, **d** [cm]	Distance between the near point and actual trajectory, x_N [cm]	Difference in latency, **Δt** [ms] $\Delta t = \frac{b}{v}\frac{x_N}{d - x_N}$	Distance between the far point and actual trajectory, x_F [cm]	Difference in latency, **Δt** [ms] $\Delta t = \frac{b}{v}\frac{x_F}{d + x_F}$
I					
II					
III					

STUDENT 2

Distance between the pupils of eyeballs, **b** [cm]	

Table 2

		Near point		Far point	
Position of the filter in test glasses	Distance between the watching student and the pendulum, **d** [cm]	Distance between the near point and actual trajectory, $\mathbf{x_N}$ [cm]	Difference in latency, **Δt** [ms] $\Delta t = \frac{b}{v}\frac{x_N}{d - x_N}$	Distance between the far point and actual trajectory, $\mathbf{x_F}$ [cm]	Difference in latency, **Δt** [ms] $\Delta t = \frac{b}{v}\frac{x_F}{d + x_F}$
I					
II					
III					

B. ROTATIONAL PULFRICH EFFECT

STUDENT I

Table 3

Position of the filter in test glasses	Distance between the watching student and the centre of the disk, **d** [cm]	Time period of the movement, **T** [s]	Difference in latency, **Δt** [ms] $\Delta t = \frac{T}{2\pi}\frac{b}{d}$
I			
II			
III			

STUDENT II

Table 4

Position of the filter in test glasses	Distance between the watching student and the centre of the disk, **d** [cm]	Time period of the movement, **T** [s]	Difference in latency, **Δt** [ms] $\Delta t = \frac{T}{2\pi}\frac{b}{d}$
I			
II			
III			