EXERCISES – BIOLOGICAL SIGNALS

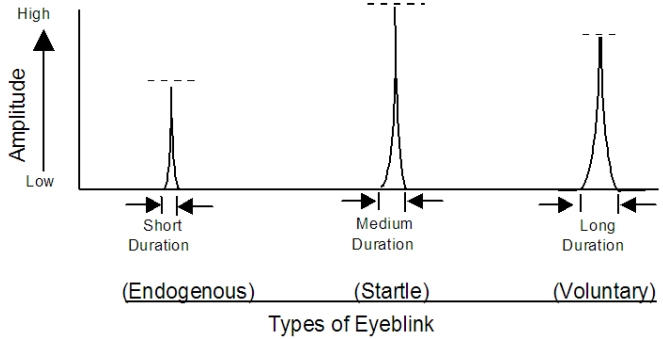
Exercise 8 - SS 2014 – Michel Kana

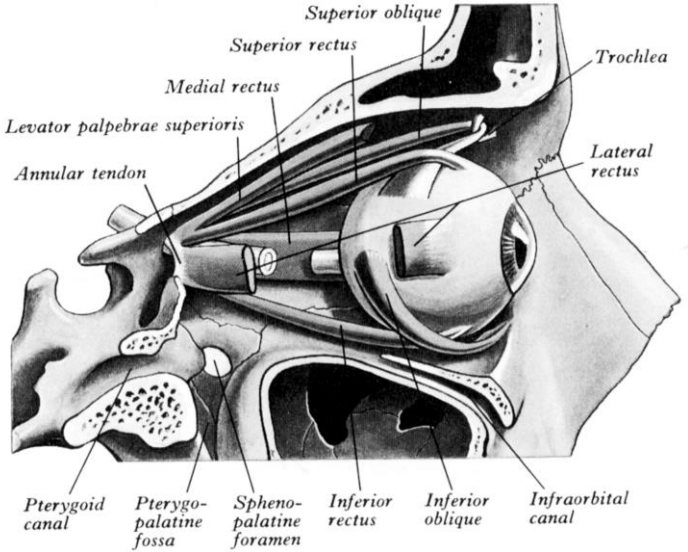
What will we do today?

1. **The physiology of EOG**
2. **Structure of the EOG Signal**
3. **EOG measurement with BIOPAC**
4. **Semester Plan**
5. **Summary**

The physiology of EOG

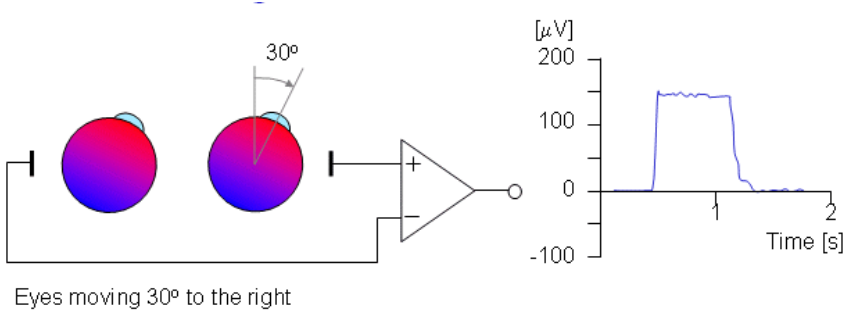
- Eye blinks and eye movements are behaviors.
- There are three types of eye blinks:
  - **reflex blinks** as instinctive response to something invading the eye or startle response to loud noises.
  - **voluntary blinks** as a result of a decision to blink.
  - **endogenous blinks** due to perception and information processing. They reflect changes of attention and changes in thought processes.
- Eye movements are controlled by the brain in conjunction with cranial nerves and extra-ocular muscles
  - Three pairs of muscles work together to control each eyeball.
  - The two eyeballs operate together in tandem although they are not connected mechanically.
  - The superior and inferior rectus control the up-and-down movement.
  - The lateral and medial rectus control side-to-side movement.
  - **Saccadic movements** describe quick jumps of the eye from one fixation point to another.
  - **Smooth movements** are slow, broad rotations of the eye that enable it to maintain fixation on an object moving with respect to the head.

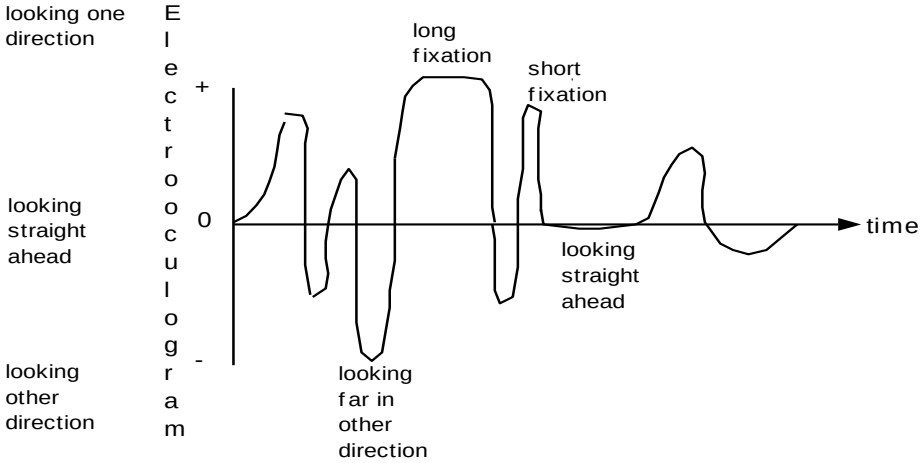


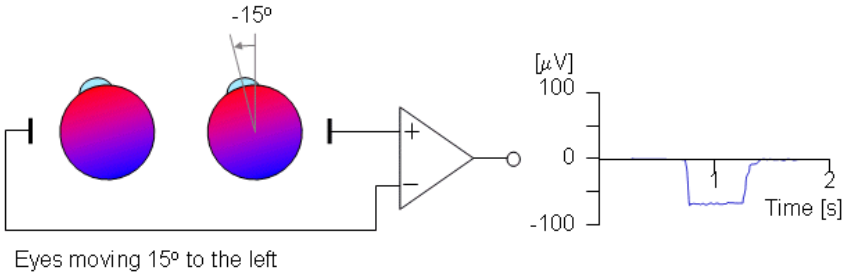


Structure of the EOG Signal

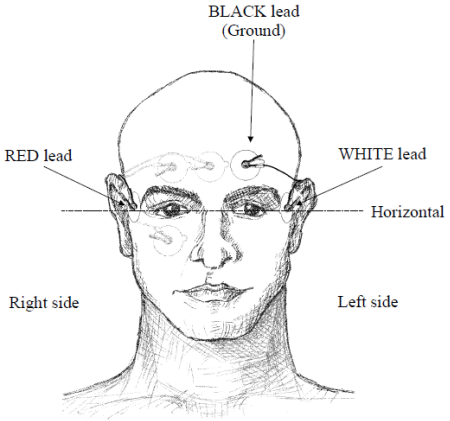
- The rear of the eyeball is negative relative to the front of the eyeball, setting up an electrical dipole.
- The measurement of the potential difference (0.1-1.0 mV) in the dipole is called **electrooculography (EOG).**



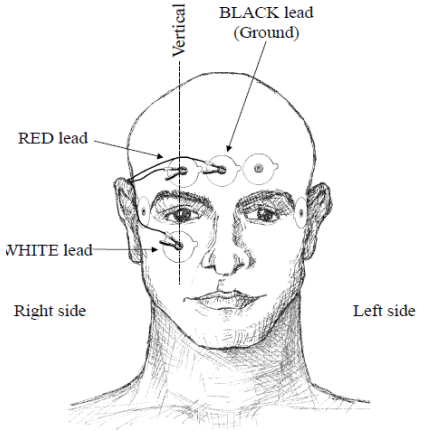




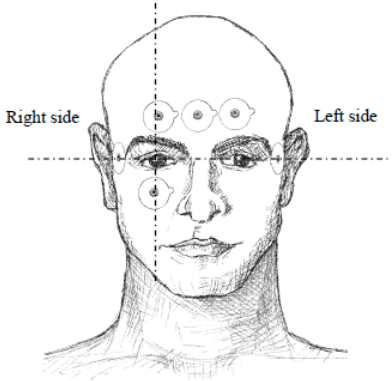
EOG Measurement



Lead Placement for Channel 1 (Horizontal)



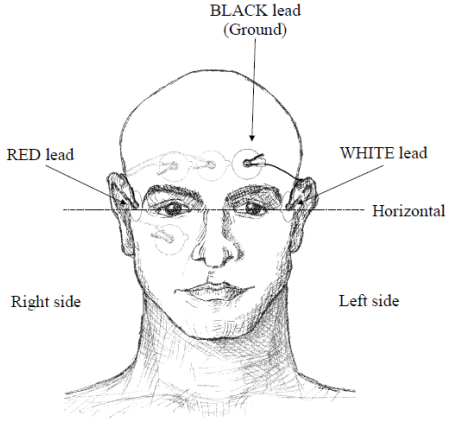
Lead Placement for Channel 2 (Vertical)



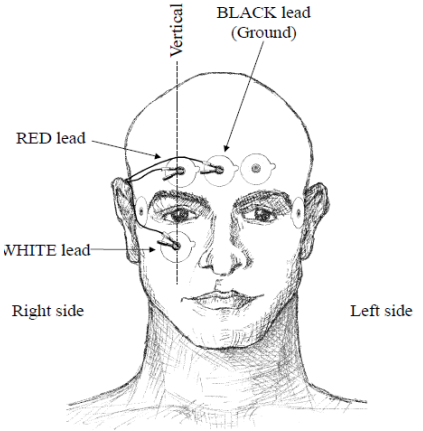
- **Operational configuration**
  - 2 channels for vertical and horizontal movements.
- **Noise sources**
  - Muscle movement artifact (0 to 1000 Hz)
  - Motion artifact from electrode movements (0 to 20 Hz)
  - Power line interference (60 or 50 Hz)

Exercice 1: EOG measurement with BIOPAC

- **Biopac MP35 measurement system**
  - EOG is recorded using 2 Biopac SS2L wires plugged in the first and second channel.
  - The first electrode lead set is attached for horizontal movement.
  - The second electrode lead set is attached for vertical movement.
  - Head movement should be avoided.
- **Biopac Student Lab PRO software**
  - The acquisition is set up at a sampling rate of *200 Hz*.
  - Analog Channel CH1 should have the preset *Electrooculogram EOG (.5-35 Hz)*
- **EOG parameters calculation**
  - Identify eye blinks, moves to the left, right, up or down



Lead Placement for Channel 1 (Horizontal)



Lead Placement for Channel 2 (Vertical)

Exercice 2: Detection of eye directions

- **Procedure**
  - Subject is instrumented for EOG measurement with Biopac.
  - Subject adjust to a vertical seating position.
  - Experimenter should hold a pen about 10 cm in front of Subject's eyes in the center of his visual field.
  - Subject should pick a focal point on the pen so that his eyes remain horizontal.
  - Experimenter should briskly moves the pen 10 cm to the right and back to center in about 3 seconds.
  - Subject should fixate on the pen, track it, and try not to blink.
  - The experiment should be repeated while moving the pen 10 cm to the left, then back to center; 10 cm up, then back to center; 10 cm down then back to center; 10 cm far, then back to the center.
- **Evaluation**
  - Identify relationship between pen direction and what you see on the computer

Exercice 3: Detection of eyes blinks and reading

- **Procedure**
  - Subject is instrumented for EOG measurement with Biopac.
  - The subject should read a text with several lines during 60 sec.
  - The subject should repeat the experiment with different types of reading materials (blank paper, easy text, hard text)
- **Evaluation**
  - Identify the time when the subject changed the line.
  - Identify and count eye blinks.
  - Identify the relationship between reading attention and eye blinks.