



## Thesis Project Form

**Title (tentative):** Synchronous merging of heterogeneous eye movements signals: system integration and data analysis for clinical applications

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### Description

#### Motivation and application domain

Eye movements represent the first and more direct output of the sensory motor system, by which the human brain interact with the external world. Moreover, the real-time and synchronous recording of gaze, pupil size variations and blinking provide a large amount of neurophysiological data each of which is reportable to a specific brain functional network or area.

#### General objectives and main activities

The goal is the integration of 3 different signals arising from eye movements: (1) fixations and saccades, (2) pupil diameter variations, and (3) blinking rate. Eye movements will be recorded in normal subjects, using a high speed eye tracker (240Hz sampling rate, 16 bit resolution, accuracy of 0.16 deg). Rough data will be pre-treated by appropriate filters for saccade identification.

Data on pupillary size will be also provided by the eye tracker. Proper filters will be designed and signal analysis methods will be adopted in order to identify different components of pupillary diameter variations in various light conditions and task execution.

The spontaneous blinking rate will be used as an additional indicator of cognitive effort during the execution of cognitive tasks. Data will be obtained by the eye tracking as a sequence of eye signal loss.

The final step will be the integration of different signals and the implementation of user friendly software for clinical applications.

#### Training Objectives (technical/analytical tools, experimental methodologies)

Technical objective: Practical approach to the use of different eye tracking devices and other bio-sensors.

Analytical tool objectives: Learning new skills in human neuroscience, signal analysis, neurophysiology of eye movements and neural network modelling.

Experimental methodology objective: Acquisition of an experimental approach typically used in basic neuroscience and neurophysiology of vision and eye movements in humans.

**Place(s) where the thesis work will be carried out:** Laboratorio di "Eye-tracking & Visual Applications  
EVALAB, Dipartimento di Scienze Mediche Chirurgiche e  
Neuroscienze, Università di Siena

### Additional information

**Maximum number of students:** 2