INTRO TO EYE TRACKING

The first lecture introduces the field of eye tracking, covering different types of eye trackers including current state-of-the-art table-mounted (remote), head-mounted (mobile), and embedded (VR/AR) eye trackers.

GAZE ANALYTICS PIPELINE

The second lecture focuses on customizable software for gaze analytics, starting with digital filters for velocity-based event detection. Calibration error computation will be reviewed along with correction via minimization of least-squares. Advanced, so-called *second-order*, metrics will also be covered, including transition matrix entropy and ambient-focal fixation dynamics via computation of the K-coefficient. Metrics will be showcased in the context of various eye-tracking applications, e.g., panoramic scene viewing, reception of subtitles, and viewing of text and pictures. Data produced by the custom software will then be available for further evaluation via inferential statistics, including ANOVA, Linear Mixed Models, etc.

HANDS-ON GAZE ANALYTICS

In the third lecture, attendees will download and use a suite of Python scripts to process raw gaze point data to yield fixations, as filtered by a combination of the Butterworth and Savitzky-Golay filters. Python code will be dissected to highlight filter settings that attendees will iteratively change to examine their effects on visualizations produced by the Python code.

Attendees require no specific background other than a general knowledge of programming principles, basic code constructs, e.g., if-then-else, looping, etc. Knowledge of Python is not required although some experience would be preferred.

The lecture will introduce the following topics:

- Data pre-processing (Python scripting).
- File parsing with Python (e.g., .csv files, HDF5, XML, etc.).
- Basic filtering (convolution) with the Butterworth and Savitzky-Golay filters.
- Filter fine-tuning (setting sampling rates, thresholds, etc.).
- Ambient/focal K coefficient computation.
- Basic visualizations (scanpaths, heatmaps) with Python's matplotlib.
- Brief introduction to R and Transition Matrix construction.

The lecture ties in to the remaining Winter School lectures by focusing on processing raw eye movement data from a hands-on eye tracking session producing performance and process metrics suitable for subsequent statistical analysis.

Hands-on Session

In the hands-on session, students will work with PsychoPy software to build simple image-based studies. An eye tracker is used as the testing apparatus. Additional software such as HDFView and Scribus will be used to define Areas Of Interest, and to view .hdf5 files recorded by PsychoPy. This lecture focuses on data collection, organization, and preliminary analysis, prior to subsequent statistical analysis.

Prof. Dr. Duchowski

Andrew Duchowski is a professor of Computer Science at Clemson University. He received his baccalaureate (1990) from Simon Fraser University, Burnaby, Canada, and doctorate (1997) from Texas A&M University, College Station, TX, both in Computer Science. His research and teaching interests include visual attention and perception, eye tracking, computer vision, and computer graphics. He joined the School of Computing faculty at Clemson in January, 1998. He is a noted research leader in the field of eye tracking, having produced a corpus of papers and a textbook related to eye tracking research, and delivered courses and seminars on the subject at international conferences. He developed and maintains the eye tracking laboratory at Clemson University, and teaches a regular course on eye tracking methodology attracting students from a variety of disciplines across campus.