

Eye-Tracking and Visualization

Keywords

Eye Tracking, Visualization, Cognition, Visual Analytics, User Studies, Evaluation, Eye Tracking Metrics, Information Visualization, Visualization Systems, Study Design, Human-Computer Interaction, Statistics, Big Eye-Movement Data

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Introduction and Motivation

Eye tracking has become a widely used method to analyze user behavior in marketing, neuroscience, human-computer interaction, and visualization research. Apart from measuring completion times and recording accuracy rates of correctly given answers during the performance of visual tasks in classical controlled user experiments, eye tracking-based evaluations provide additional information on how visual attention is distributed and changing for a presented stimulus. Due to the wide field of applications of eye tracking and various kinds of research questions, different approaches have been developed to analyze eye tracking data such as statistical algorithms (either descriptive or inferential), string editing algorithms, visualization-related techniques, and visual analytics techniques. Regardless of whether statistical or visual methods are used for eye tracking data analysis, a large amount of data generated during eye tracking experiments has to be handled.

Where statistical analysis mainly provides quantitative results, visualization techniques allow researchers to analyze different levels and aspects of the recorded eye tracking data in an explorative and qualitative way. Visualization techniques help to analyze the spatio-temporal aspect of eye tracking data and the complex relationships within the data. This more qualitative exploration aims at finding hypotheses that can be investigated with statistical methods later on. Due to the increasing complexity of tasks and stimuli in eye tracking experiments, we believe that visualization will play an increasingly important role in future eye tracking analysis.

Evaluation has become an important step in the development of new visualization techniques. Eye tracking is one means of evaluating those newly developed approaches. Thus, analyzing eye tracking data with visualization techniques is just a logical step that followed. However, in most cases only state of the art visualization techniques are used, such as scan path or attention map visualizations.

In this tutorial we will present an overview on further existing visualization techniques for eye tracking data and demonstrate their application in different user experiments and use cases.

Outline (full day tutorial, 2X3h with breaks)

9:00 – 9:15	1. Introduction (presenter Tanja Blascheck) <ul style="list-style-type: none"> ▪ Introduction of speakers ▪ Organization of the tutorial ▪ Motivation of attendees to participate in tutorial
9:15 – 10:00	2. Fundamental Concepts of Visualization (presenter Tanja Blascheck) <ul style="list-style-type: none"> ▪ General introduction to visualization ▪ Taxonomy ▪ Point-based visualizations
10:00 – 10:30	3. Eye Tracking and Visualization (presenter Kuno Kurzhals) <ul style="list-style-type: none"> ▪ AOI-based visualizations ▪ Task taxonomy and when to use what visualization
10:30 – 11:00	Coffee break
11:00 – 11:15	3. Eye Tracking and Visualization (presenter Kuno Kurzhals) <ul style="list-style-type: none"> ▪ AOI-based visualizations ▪ Task taxonomy and when to use what visualization
11:15 – 12:00	4. Eye Tracking and Visual Analytics (presenter Kuno Kurzhals) <ul style="list-style-type: none"> ▪ General introduction to visual analytics ▪ Methods and approaches of VA and eye tracking
12:00 – 13:00	Lunch break
13:00 – 13:45	5. Visualization of Gaze Data on 3D stimuli (presenter Patrick Renner) <ul style="list-style-type: none"> ▪ Mobile eye tracking in virtual reality ▪ Mobile eye tracking in the real world ▪ Automatic annotation and 3D attention mapping
13:45 – 14:30	6. Cognition (presenter Michael Raschke) <ul style="list-style-type: none"> ▪ Cognitive simulation ▪ Ontology based visualization methods ▪ Eye tracking data visualization
14:30 – 15:00	Coffee break
15:00 – 15:45	7. Demo session (all)
15:45 – 16:00	8. Discussion, Summary and Future Challenges

Target Audience and Necessary Background

The tutorial is designed for the general audience of ETRA, and is especially suitable for PhD students. Eye-tracking and eye-tracking visualizations are becoming a new approach and research area. PhD students and researchers will benefit from this tutorial by finding a new and exciting topic and broaden their research horizon. The tutorial requires a minimal level of pre-requisites. Fundamental concepts of eye-tracking and visualization will be explained during the tutorial.