ETRA 2016 Tutorial
Eye-Tracking and Visualization

Keywords

Coordinators and Presenters
Michael Burch, University of Stuttgart, Michael.Burch@visus.uni-stuttgart.de
http://www.visus.uni-stuttgart.de/en/institute/people/research-associates/michael-burch.html

Tanja Blascheck, University of Stuttgart, Tanja.Blascheck@vis.uni-stuttgart.de
http://www.vis.uni-stuttgart.de/en/institute/people/blaschta.html

Other Presenters
Kuno Kurzhals, University of Stuttgart, Kuno.Kurzhals@visus.uni-stuttgart.de
http://www.vis.uni-stuttgart.de/en/institute/people/kuno-kurzhals.html

Michael Raschke, University of Stuttgart, Michael.Raschke@vis.uni-stuttgart.de
http://www.vis.uni-stuttgart.de/nc/en/institute/people/michael-raschke.html

Patrick Renner, University of Bielefeld, prenner@techfak.uni-bielefeld.de
https://www.techfak.uni-bielefeld.de/~prenner

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.

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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, 4x90 minutes)**

1. Introduction (15 min., presenter Tanja Blascheck)
   - Introduction of speakers
   - Organization of the tutorial
   - Motivation of attendees to participate in tutorial

2. Fundamental Concepts of Eye-Tracking (40+5 min., presenter Tanja Blascheck)
   - Historical overview
   - Eye-tracking
   - Taxonomy

3. Eye-Tracking and Visualization (25+5 min., presenter Kuno Kurzhals)
   - Point-based visualizations
   - AOI-based visualizations

   coffee break

4. Eye-Tracking Metrics (25+5 min., presenter Michael Burch)
   - Classical metrics
   - Scan path comparison algorithms
   - Example eye-tracking study

5. Eye-Tracking and Visual Analytics (25+5 min., presenter Michael Burch)
   - Current approaches
   - Future directions
   - Big eye-movement data visual analytics

6. eTaddy (25+5 min., presenter Tanja Blascheck)
   - Questionnaire
   - Study
   - Circular attention map transition diagram

   lunch break

7. Static Visualization of Dynamic Stimuli (25+5 min., presenter Michael Burch)
   - AOI rivers
   - Saccade plots

8. Dynamic Stimuli (25+5 min., presenter Kuno Kurzhals)
   - ISeeCube
   - Gaze Stripes

9. Eye movements in 3D scenes/stimuli (25+5 min., presenter Patrick Renner)
   - Eye-tracking in 3D scenes/with 3D stimuli
   - EyeSee3D
   - Challenges and Perspectives in 3D eye-tracking
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.