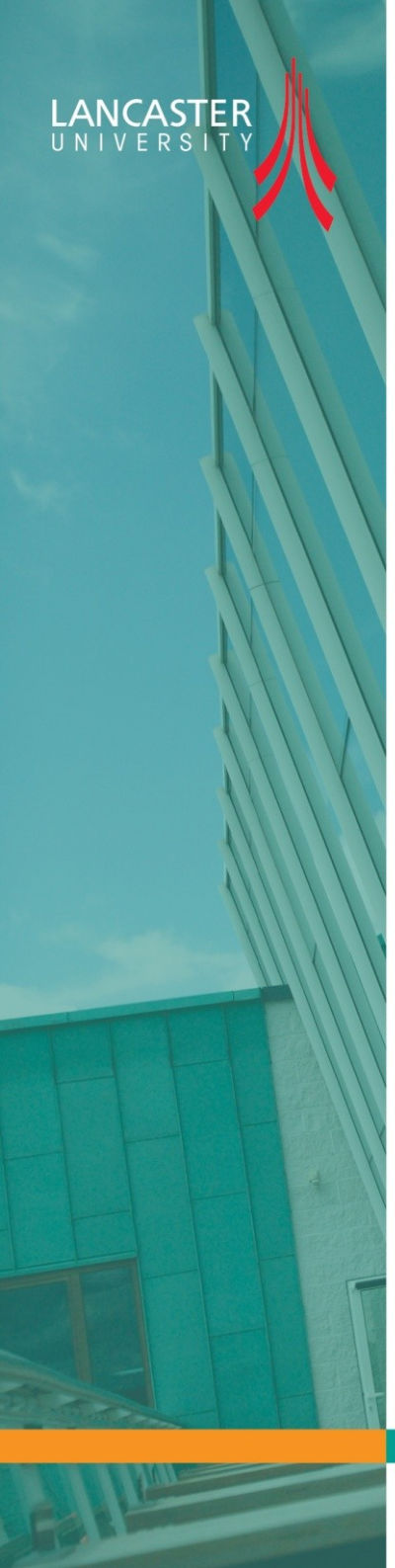


LANCASTER UNIVERSITY

Analysing EOG Signal Features for the Discrimination of Eye Movements with Wearable Devices

Mélodie Vidal, Andreas Bulling, Hans Gellersen

September 18, 2011

Motivations

- Previous research: Clear link between mental diseases and eye movements

    - Smooth pursuit in particular

- Information can be found in eye movements in detail, not just in the gaze

Motivations

- All experiments: done in the lab

  - wearable eye trackers: potential for out-of-the-lab studies and monitoring

  - context recognition...

- No algorithms detects smooth pursuits!

  - same situation for vestibulo-ocular reflex (VOR)

Motivations

- Starting point:

  - 1st step towards online algorithm that detect all eye movements

- Approach:

  - Machine learning

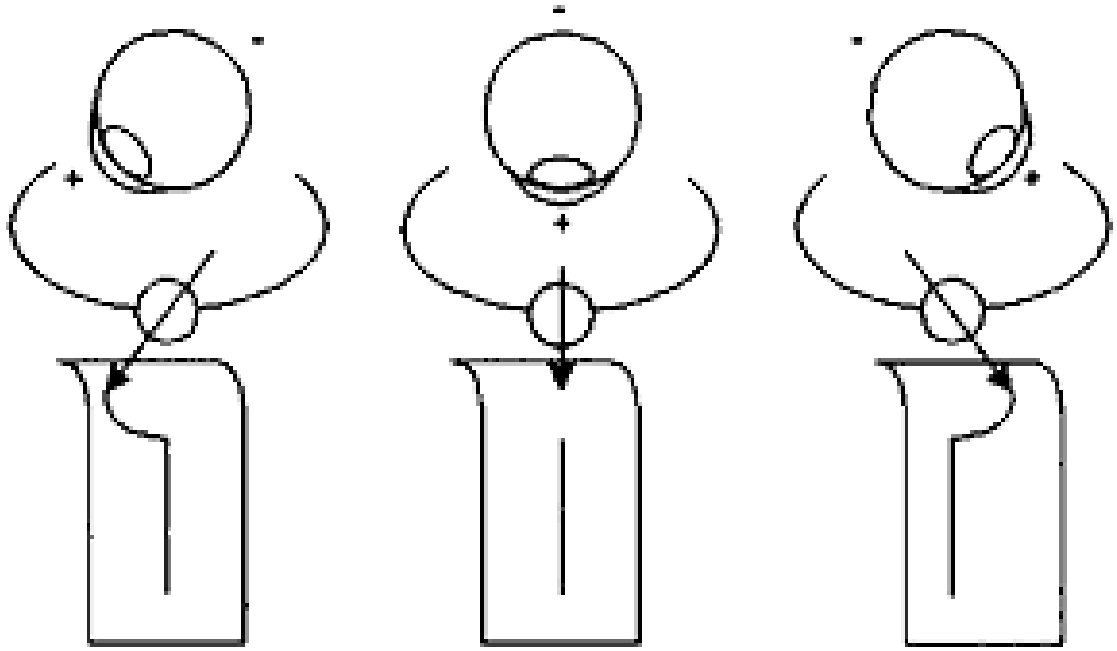
  - Features and classification

Data collection methods

- Get all types of movements
- Get out-of-the-lab-like movements but ensure ground truth: needed for evaluation
- Test possibilities on both EOG and video trackers
    - although in the lab: mobile eye-trackers

Data collection methods

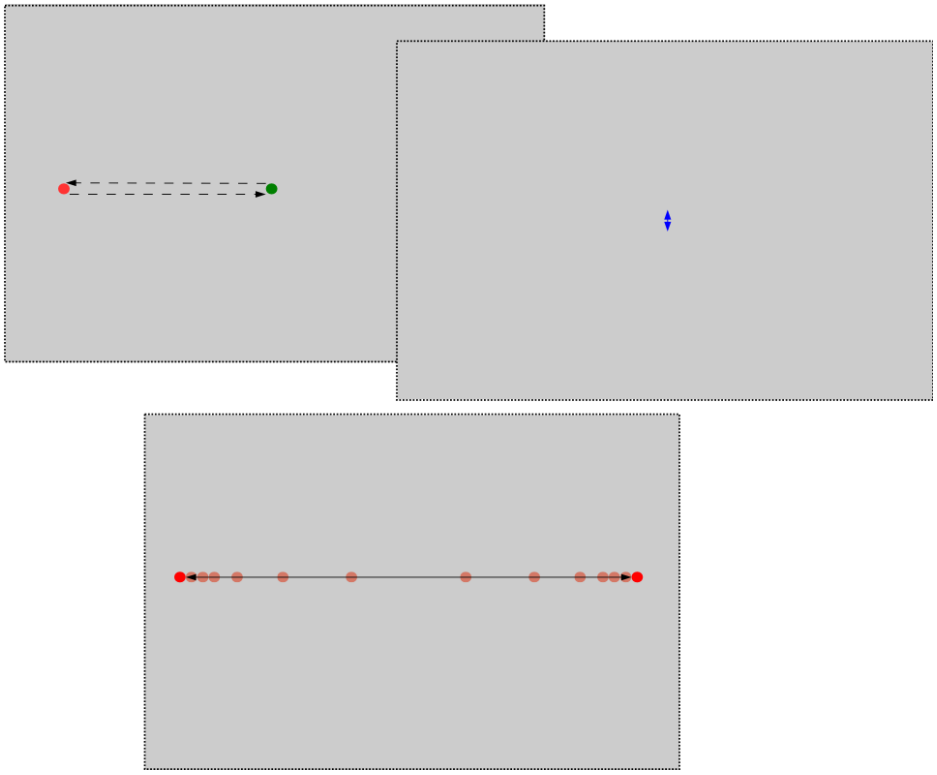
- Electro-oculography (EOG)
  - The eye is a dipole
  - Movement: change of potential
  - Electrodes to get horizontal and vertical data



Data collection methods

- 19 participants - no glasses, perfect vision
- Mobile devices
  - EOG (128Hz)
  - Dikablis video eye-tracker (25Hz)

Data collection methods



- All movements: saccades, fixations, nods and shakes, smooth pursuits

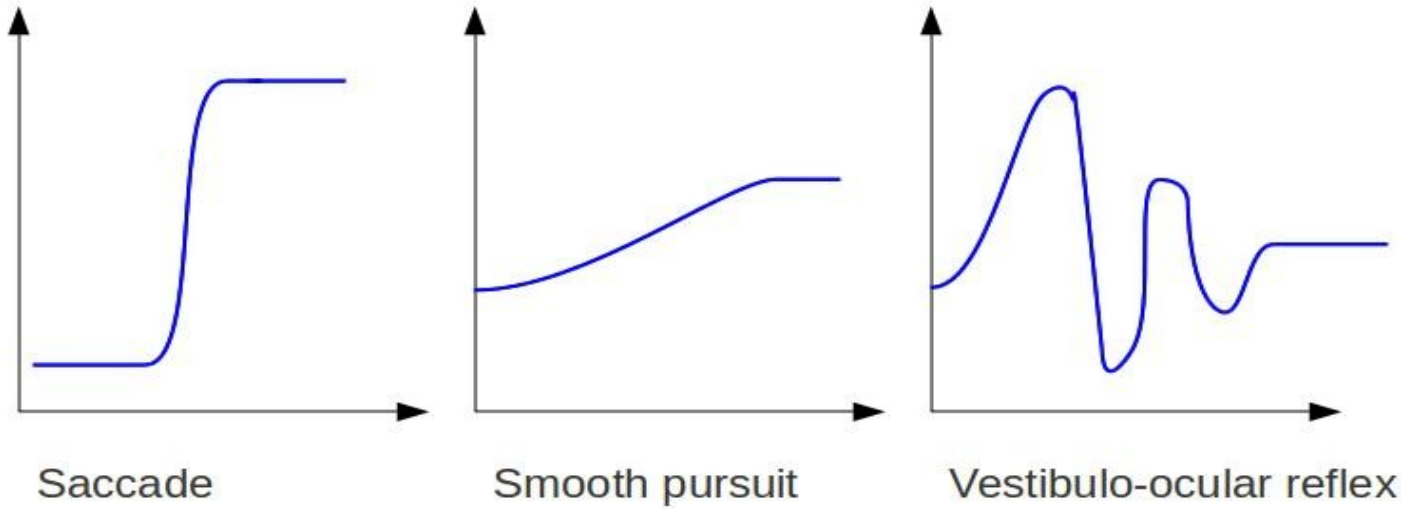
- As natural as possible:

  - Very quick

  - Repetitions to suppress surprise effect

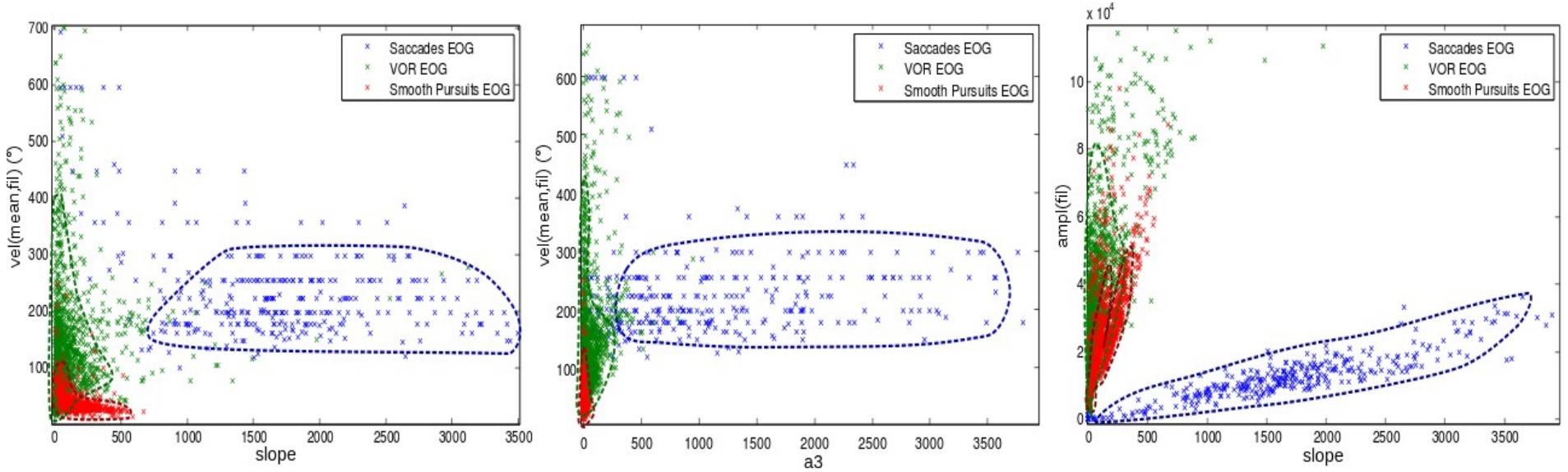
Data analysis

- Ground truth: segmentation of movements
- Extraction of simple, relevant features
  - Mean/max velocity + acceleration
  - Range
  - Slope, 4th order polynome



Data analysis

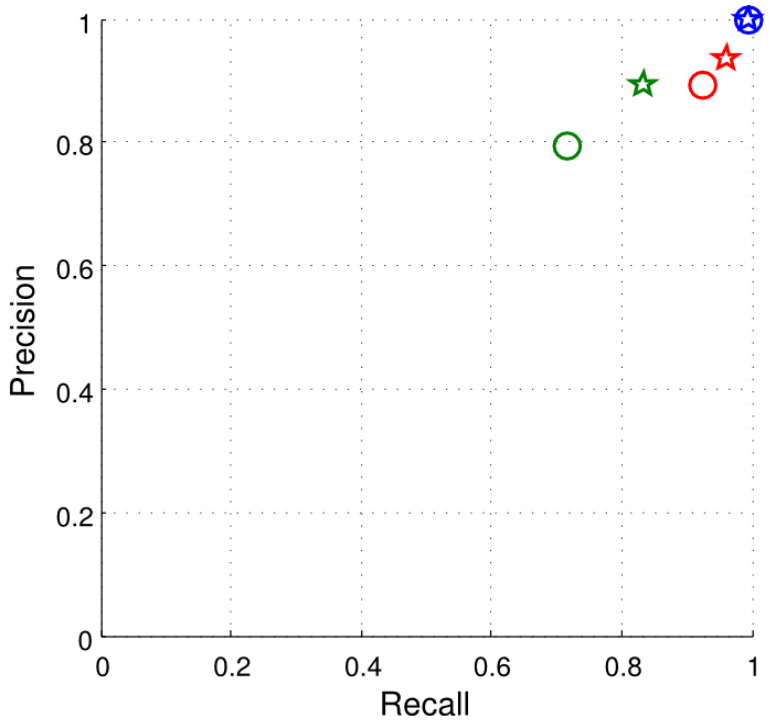
- From this small set: early results show clusters
- Slope and mean velocity particularly interesting



Data analysis

- Test further: try classification.
- K-Nearest Neighbours to categorise movements on our set of features
- 5-fold cross-validation

Data analysis



- kNN classification confirms simple features: promising results for characterisation
- Same results for different k's

Conclusion

- Basic set already enough to categorise saccades
- Promising results for smooth pursuits too, more features necessary for VORs
- Incentive to extract more features and add complete set of movements

Future Work

- Adding features, more complex set
- Considering 2d and all movements
- Running feature selection algorithm