QUASID – Measuring Interaction Techniques

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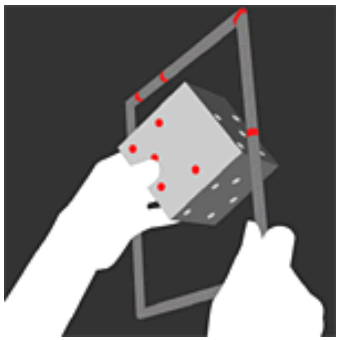
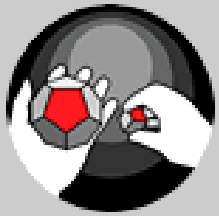




Overview

- QUASID
- Literature
  - Current methodology for interaction techniques
  - Stochastic model of rapid aimed movements
- Exploration
  - Trial
  - Main observation
- Experiment
- Future plan
- Question

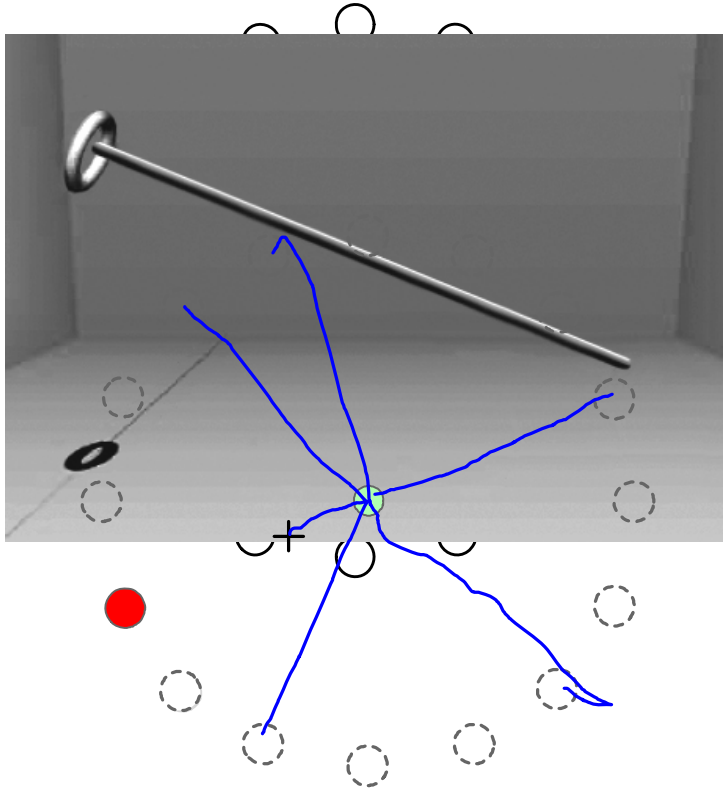
QUASID

3 PhD Projects

- Methodology: extend existing metrics and classifications for the evaluation of spatial interaction techniques.
- Device: developing methods for creating tangible interfaces, and evaluating the effect of the physical shape of interaction devices on interaction efficiency and effectiveness.
- System: studying the usability of tangible interfaces that are based on both (fully) manual and semi-automated spatial interactions.

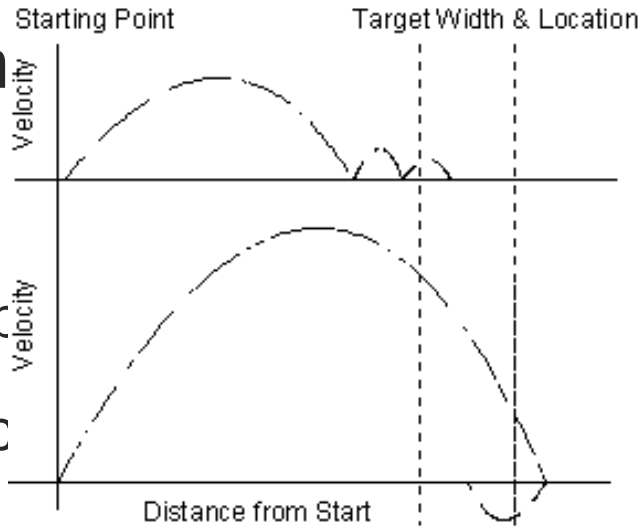
Literature - Current methodology (1)

- Simplified tasks 2D/3D:
  - selection tasks
  - steering tasks
- Paths are recorded and analyzed
- Measurements: summary statistics like Fitts' law



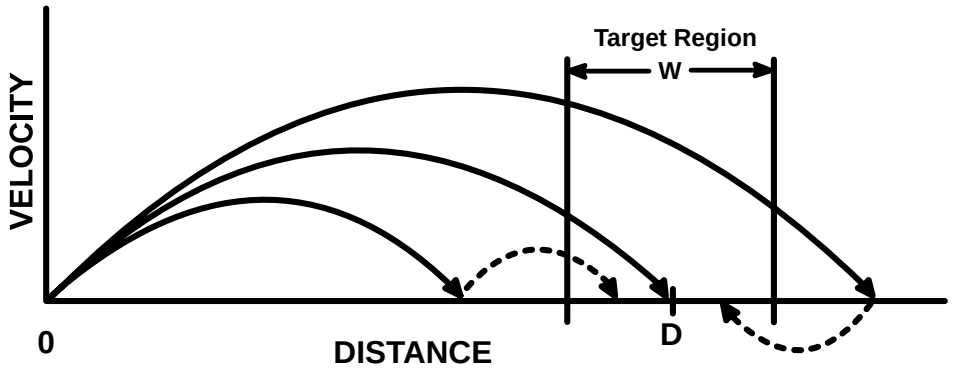
Literature - Current methodology (2)

- Fitts' law
  - logarithmic trade-off between speed and accuracy
  - only information about the starting- and end-point
  - cannot answer ***why*** certain interaction techniques or input devices are better than others
- How can ation from movement paths?
  - From p vement itself)
  - Subjec nents



Literature - Stochastic model (1)

- Motor performance research
- Stochastic optimized submovement model of Meyer et al (1988):
  - Movement production is an ideal tradeoff between durations of primary and secondary submovements

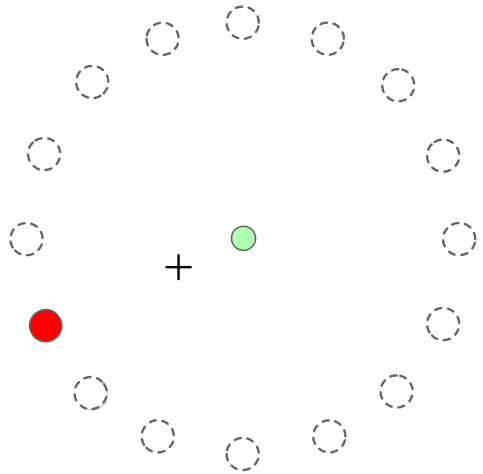


Literature - Stochastic model (2)

- Assumptions:
  - Primary submovement programmed to reach target
  - Variability due to existence of neuromotor noise
  - The faster the primary submovement the larger the error
- Appeal:
  - Non-holistic view on movement
  - Optimization of primary and secondary submovement = strategy

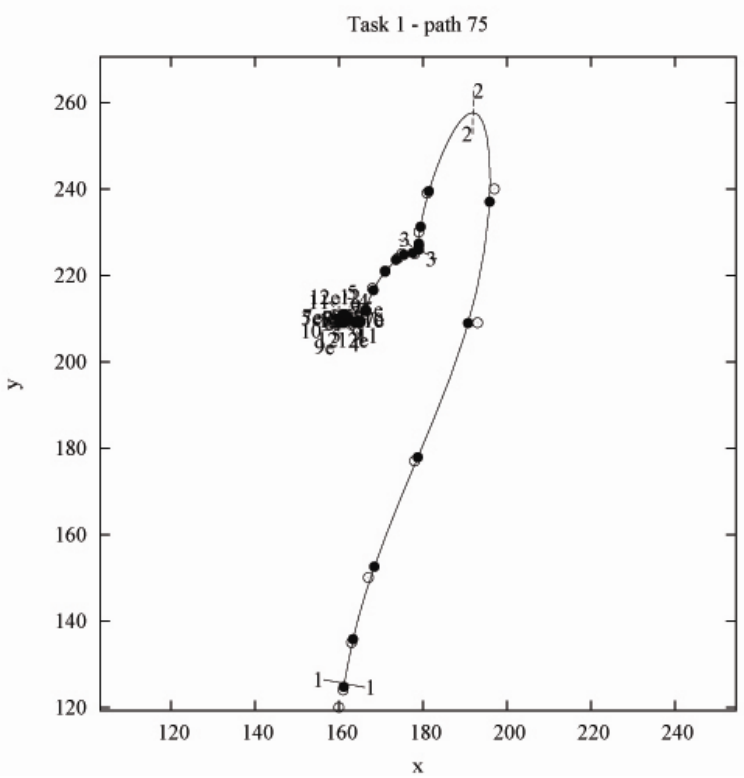
Exploration - Trial

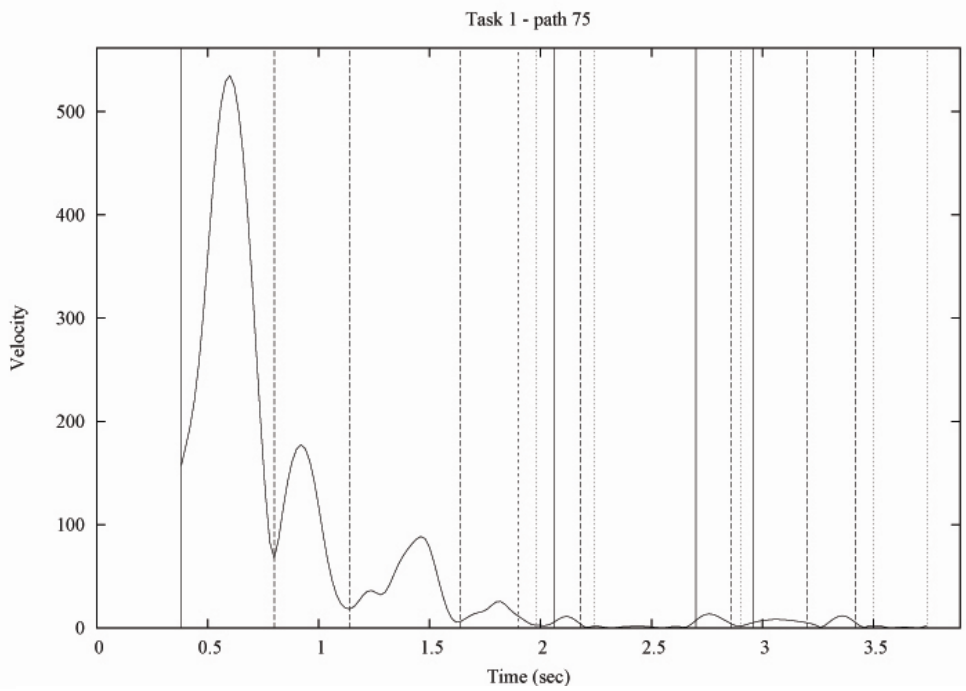
- Method
  - 2D Multi-directional pointing task
  - 2 variables: task difficulty (3 levels) & hand of use (2 levels)
  - Input device: mouse
  - Logging mouse-events
  - Software program to filter data + divide in submovements



Exploration - Observation

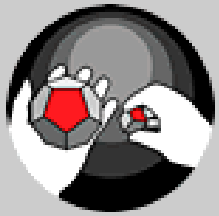
- Main observation
  - Sometimes far more than only 1 correctional submovement





Experiment - Adjustments

- Main goal: to find out if people use different strategies in different situations
- Measurements:
  - Ballistic data (focus on primary submovement)
  - Fine tuning data (e.g. selection problems)
- Problem to solve:
  - To what extent the stochastic model can be used to model correctional submovements



Future Plan

- Developing subjective measurements
- Testing quantitative and subjective measurements in 3D mixed reality systems
- Designing and evaluating taxonomy for 3D interaction techniques
- Developing and testing testbed for 3D interaction techniques

Visualization challenge

- Subjective measurement: visualize movement to let people judge what they think about the movement (for example by comparing 2 movements)

What would be the best way to visualize movements for this purpose?

Literature - Stochastic model

Criteria to determine end of submovement:

- Type 1: velocity zero-crossing (pos to neg) indicating overshoot
- Type 2: acceleration zero-crossing (neg to pos) indicating speedup after prior slowing down
- Type 3: jerk zero-crossing (pos to neg) indicating an abrupt increase of breaking

Literature - Stochastic model

- Measurements
  - Average total movement time & error rates
  - Mean primary submovement duration
  - Mean proportion traveled distance primary submovement
  - Standard deviation of primary submovement endpoints
  - Relative frequency secondary (or higher order) submovements
- Other
  - Number of submovements
  - Movement offset of submovements
  - Peak speed of submovements

Fitts' law

$$MT = A + B \log_2(2D/W)$$

- MT = movement time
- D = distance to target
- W = target width
- A + B = positive constants