Notes for Class 10: Interaction and Navigation

Objectives
By the end of the class, you will be able to…
• Explain why a “mouse-over” query is better than a “mouse-click” query.
• Explain why dynamic queries and “brushing and linking” are important interaction techniques.
• Critically compare different spatial navigation metaphors, including 3D metaphors, zooming, and multiple windows.
• Evaluate the interaction techniques in a visualization tool.

Agenda for Class
• Dynamic queries HomeFinder video
• Discussion of interaction techniques
• Zooming: Pad++, Autozoom videos
• If time:
  o Using Deformation for Browsing Volumetric Data video
  o Snap-together-visualization video

Reading Assignment
Ware Chap 10: Interacting with visualizations (pp. 317-338, 345-350, okay to skim 3D navigation stuff)
Ware Chap 11: Thinking with visualizations (pp. 370-379)

Notes:

1. Queries:
What are dynamic queries? How do they help users to more effectively interact with data? What are some disadvantages of dynamic queries?
Interactively changing the data that is displayed through a visual mechanism. (E.g., filtering the data by moving sliders as in the HomeFinder or FilmFinder applications).

Key features of dynamic queries:
• Display updates automatically and immediately as the query is changed (rapid and continuous feedback).
• Visual presentation of query components and results.
• Reversible control.
• Selection by pointing not typing.

Dynamic queries are effective because:
• You can quickly explore the data (sliders can be faster than typing in SQL)
• Moving the slider automatically updates the display so you can see patterns in the data through motion (appearance / disappearance). E.g. move the “bedroom”
slider in the HomeFinder application to see 3 bedroom homes appear and disappear so you can identify how many there are.

- Easy for both novices and experts.

Disadvantages:

- Database management systems may not be able to keep up with the queries if there is a lot of data.
- Simple queries only.
- So many controls.

**What is a hover query? Why is it often better than clicking a target?**

Mouse-over a target shows details for that target. Details are typically shown in a tooltip or pop-up window but could also be shown in a fixed designated area. (E.g., in a graph of relationships between various plant species, mouse-over each node shows the name of the species).

Faster and better than mouse-click queries because:

- Dispenses with the mouse click (time to do the click not needed)
- Enables you to rapidly scan details of a series of objects by simply moving the mouse (no need to click each one).

**Should objects be large or small for efficient interaction?**

As large as possible. Fitts’ law says that moving to larger, closer targets will be faster.

BUT larger items means fewer can be shown (lower information density), so there is an important trade-off here. Often visualization uses very small objects, at least for overviews, to show as much information as possible.

**2. Brushing & Linking.**

Brushing allows you to select items in one window and have them highlighted in all windows. This helps overcome the disconnection between windows when you have several because you can interactively see which parts of one display correspond to another.

We’ve seen this before: e.g. Cluster & Calendar visualization, TreeJuxtaposer.

**Continuous mouse movements when brushing**

Like hover queries, it is faster to brush data using a continuous mouse movement (no clicking). This allows rapid scanning of data.
3. **3D navigation metaphors**

World-in-hand and Eyeball-in-hand
- The user is outside the virtual world and navigates by either spinning the world in their hand or moving their eyeball around the world.
- World-in-hand usually easier for people.
- + You can get an overview by zooming out
- Good for 3D objects, not so good for terrains.

Walking and Flying
- The user walks along the ground (walking) or flies through 3D space in a helicopter (flying).
- + Fewer degrees of freedom (especially for walking) makes the interaction simpler
- Best for terrain, not as good for 3D objects. Walking in particular requires a ground plane to walk on.
- “Flying” may be easier for novices than pilots since it usually does not model real flight dynamics.

Egocentric vs. Exocentric
- Egocentric shows the world as you would see it.
- Exocentric shows some other viewpoint (e.g. from above and behind).
- These are useful for different tasks (e.g. egocentric good for driving a vehicle but not for estimating distances between objects)

**Example of 3D Navigation:**

*Deformation for Browsing Volumetric Data (McGuffin et al. Vis 2003)*

Exocentric viewpoint with either world in hand (or perhaps eyeball in hand) navigation.

Uses graphical widgets with “handles” to deform volumetric data so that you can look inside.
+ Uses navigation metaphors from books or sheets of paper that should be intuitive.
+ Variety of deformations possible so you can get a variety of views.
- Interaction widgets appear complicated, need to click small handles, handles clutter the view.

4. **Design strategies to help people avoid getting lost in maps.**

Landmarks:
- Provide visually distinct landmarks in the map.
- Make sure there are enough landmarks that some landmarks are always visible.
- Make sure landmarks can be seen and recognized at all zoom levels.

Overview:
- Provide an overview of the entire map, in one of these ways:
  - Allow people to rapidly zoom in and out
  - Have an overview window, visually linked to a detail view.
Use focus + context
- Landmarks should be visible at both the overview & detail levels.

View direction:
- Indicate in an overview the direction of travel. E.g. Use a track-up map rather than a north-up map, or show an icon indicating the direction the person is facing or traveling.

5. Zooming vs multiple windows?
It depends on the task, and specifically the amount of visual working memory required (see graph on Ware p. 379). Although multiple windows allow you to directly compare things, there is an overhead required to set the up and understand their relationships. If the pattern you need to remember is simple, it is often faster to zoom, whereas if the pattern is more complex, it is better to have windows side-by-side for direct comparison.

Key Concepts for Today:
1. Rapid interaction / querying of data can be important for identifying patterns and trends. This can be accomplished using dynamic queries, hover queries, or brushing.
2. The best interaction or navigation technique depends on the task.