Example Videos

- Vis 2008, Wang: vis-1013_final_video.mp4
  - Focus + context display in 3D
- Vis 2008, Wangchao: idtvdi.avi
  - Importance-driven rendering
- Vis 2008, Zhou: 2008 Vis. Visibility Based Mesh Analysis submission.mov
  - Importance-driven rendering from CAD model

Administrative

- Let me know your preferences today
- Team assignments coming in email
  - Team coordinator just gets you together for the first meeting
  - www.doodle.com is your friend
  - Pick team leader and other roles at first meeting
    - Put together responsibilities contract
    - Warning: communication is challenging. Start soon.
Evaluation

• “...we often design and evaluate methods by presenting results informally to potential users.” [Kosara et al 2003]
  – We will be doing this in this course
  – We’ll also add a more formal task but only for a single person doing one task: see instructions
  – Note that even this will be a nontrivial effort – start planning for it now

Potential Types of Evaluation

• Re-use existing designs (art, cartography)
• Hire an expert visual designer to leapfrog into known “best-practice” space
• Videotaping one or more users working with the system
• User Studies: evaluating performance
Why Conduct User Studies?

• Offer scientifically sound method to measure a visualization’s performance
  – Accuracy and speed

• Provide insight into why a technique is effective
  – By varying conditions and parameters to see effect

• Determine if theoretical principles derived from psychophysics apply to visualization design
  – Taking the study up one level of complexity

Types of Studies

• Perceptual studies
  – Very simple tasks and stimuli
    • “Which types of texture enhance surface perception, and which camouflage it?”
    • “What is the best color map to display ratio scalar fields with high spatial frequency data?”

• Usability studies
  – User performs a (perhaps complex) task
What to collect?

- Careful statistical data about performance
  - time and error measures

- Close observation of user behavior
  - when did they get frustrated?
  - when did they make errors?

- Free-form comments from the users

Doing Experiments on People is Serious Business

- Requires serious commitment of time and effort
  - Planning the experiment (seek help from psych!)
  - Evaluating the results (seek help from stat during plan!)
  - Iterating 2-3 times (uncompelling results)

- Requires approval of Institutional Review Board on campus
  - Seeks to preserve respect for and rights of subjects
  - Seeks to prevent new occurrences of egregious past acts of misconduct

- Kosara, et al, report that it is usually worth the effort
Laidlaw Vector Field Study

• Question 1: Where are the critical points?

• Question 2: What type of critical point?
Laidlaw Vector Field Study

• Question 3: Where would the point go?

• Results: Which was the best?
  – It depends on the task
  – GSTR better than average on all metrics

• Of note: Experts and non-experts similar!
  → Brief training sufficient
Laidlaw Vector Field Study

- Of note: Advection was always pretty good! <~5 degrees of error

Laidlaw Vector Field Study

- Of note: Not significantly better, but faster – for critical point type

Compared to Class Guesses...

<table>
<thead>
<tr>
<th>Part</th>
<th>ID</th>
<th>Quiz 1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>No.</th>
<th>WC</th>
<th>CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L</td>
<td>X</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2</td>
<td>L</td>
<td>X</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3</td>
<td>L</td>
<td>X</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>L</td>
<td>X</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>L</td>
<td>X</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Sources and sinks (Identify critical points)
Sources and sinks (Locate critical points)
Fast/slow (Find zero-flow locations)
Center of rotation
Shape of flow
Where is flow laminar vs. turbulent?
Where would a pushed object end up?
Where does concentration come from?
Positive vs. negative field (scalar)?
Evaluation in this class

• Formal
  – Asks primary goal of the scientist
  – On a data set truth is known for (synthetic)
  – Non-team-member who has not seen the data

• Informal client feedback
  – What new things did the client learn?
  – How is it better/worse than existing tools?
  – How do they like it?

3D DDS User Study

• How well does 3DS work?
  – At what?
  – Compared to what?

• More specific
  – At identifying relationships and extracting values.
  – Compared to other glyph-based technique.

Relationships

- What kinds of relationships?
  - Linear
  - Overlap/Intersection
  - Multivariate
  - Etc.

- Data
  - Real? No. goal is to discover relationship
  - Fake? What kind?

Data

- Application driven
  - Controlled, but resembles original data
  - 3D randomly oriented Gaussian splats

- What resolution?
  - Again, application driven
  - 15x15x15

Compare to SQ Glyphs

- Superquadric glyphs

- Recently published for use in multivariate 3D scalar Vis.

- 4 parameters
  - 2 roundnesses
  - thickness
  - color
Legend?

- 2D Legend?
- 3DS
  - It's a 3D glyph, pointless for size-varying
- SQ
  - 4D parameter space.
  - Can't show it all
  - Four examples: full range in 1 var, middle in others.

Other Controls

- Control skill level
  - No mouse, keyboard
  - Spacebar for camera rotate, keypad for value selection
- Control environment
  - Dark room
  - 3D stereo glasses, Eye-separation corrected
Value Extraction

- Easy in 2D, how to label a spot in 3D?
  - Dot, sphere, cube...

- Wireframe cube
  - What color?
  - White probably a bad choice. Oops.

- Average value? Interpolated value?
  - Confused users...

Between Sub vs. In Sub

- Between subject
  - Compare absolute performance of different participants between conditions
  - Compare Sphere avg to SQ average

- In subject
  - Compare relative performance of different participants between conditions.
  - Average improvement
How to pick?

- Variability between subjects
  - First-person-shooter-playing students might be better?
  - Experts vs. non-experts
- Fewer controls → Variability → More subjects
  - Oh boy...
- Lead David to pick In-Subjects design

What to capture?

- Ideally: everything
  - System Interaction
    - Mouse events, keyboard events, etc
  - Interviews
  - Timing
  - Performance

Details details...

- How many subjects do we need?
  - Run a pilot, ask stats person
- How many trials should each participant do?
  - Run a pilot, ask stats person
- How much training do I need to do?
  - Run a pilot
- What age range do we sample?
- Do you offer compensation? How much?
- How much help to give?
- What do you do with outliers?
- How do I know this applies to my real data?
  - Uh...
- Help, I don’t know statistics!
  - Me neither...
Vector Visualization Redesign

- Keller & Keller

- How does wind velocity correlate with temperature?
  - Magnitude
  - Direction
  - Critical Points
Credits

• This lecture is drawn from Chapter 7 of Colin Ware’s “Information Visualization” book.