Visualization is not Scientific without Reproducibility

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Bullet Points

- There is science, but we can do better
- Whether or not visualization is a science unto itself, scientific impact is bounded by its reproducibility
- Reproducing previous results becomes more daunting as research become more sophisticated, bigger integrations of simpler methods
- Steps for improving reproducibility can be inspired by modern software development, and publishing (open source, and open science)

Reproducibility is non-negotiable

Supposing visualization is in support of science:

- Visualization reproducibility enables enhancements and experimentation, and tools for visual debugging
- Can the reader re-implement the method?
- Does he/she have to (can get published without)?
- Will it generate the same results (are the parameter settings the same)?
- http://www.sci.utah.edu/~vgc/vistrails/

Point of comparison

Lab equipment (lenses, reagents, etc) are essential commodities for science

Lorensen's "Death of Visualization" ('04): the field of research suffers if vis is merely a commodity (e.g. volume rendering), but we should go further:

Compilers meet standards

OpenGL meets standards

Marching Cubes? LIC? Flow field topology?

How is Vis 2006 doing?

Of 63 Vis papers, I found 5 that made reference to available implementations

What can we do to increase the incentives for this?

Insight Journal

http://www.insight-journal.org/

Mechanism for vetting new code for ITK

Very high bar for reproducibility

- Code has to be multiplatform (e.g. CMake)
- Includes tests to verify correct behavior
- Includes code to generate figures

We can scoff at this as too restrictive for researchers

But is your research for the community, or for you?

Example of 3rd party evaluation

"Have you done a user study?"

"Ah, well, its future work."

Who is going to do that work, and how?

Why not outsource the evaluation?

Van Wijk's Vis '05 "Value of Visualization": we can increase its value by enabling others to evaluate it

Example: Laidlaw et al. "Quantitative Comparative Evaluation Of 2D Vector Field Visualization Methods" used Turk & Banks "Image Guided Streamline Placement".

Why you should release your code

The people who would benefit most from seeing your code up close and person is probably **the most** forgiving about the short-cuts, hacks, and lack of flexibility, etc. that you're uncomfortable with.

http://www.opensource.org

http://teem.sf.net used in Blaas Vis '05 "Fast and Reproducible Fiber Bundle Selection in DTI Visualization"

Public Library of Science

http://www.plos.org

New model of electronic publishing

Open Access: source data available, additional electronic resources

Not the author's responsibility to maintain on their web page

Reproducibility is non-negotiable, part 2

If visualization is a science unto itself (strong idea):

With accurate and complete models of data and visualization, we could predict the success of a vis method in a novel context (e.g. other panelists).

Then the visualization result is scientific by definition only if it is reproducible.

Problems

Failure to test and evaluate is a credibility problem for the community (Peter J. Denning ‘05 “Is computer science science?”)

http://cs.gmu.edu/cne/pjd/PUBS/CACMcols/cacmApr05.pdf

Ability to test/evaluate is a software distribution problem

Incentive to test/evaluate is a community problem (what counts as a publication?)

The scientific power of visualization, and the science of visualization, will be enriched and amplified through reproducibility.