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Ron's Rules For Tools

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Acknowledgments

National Alliance for Medical Image Computing
www.na-mic.org

Neuroimage Analysis Center
nac.spl.harvard.edu

Surgical Planning Laboratory,
Brigham and Women's Hospital
spl.harvard.edu

National Center For Image Guided Therapy
www.ncigt.org

Fraunhofer MEVIS

- Ferenc Jolesz, MD, my mentor
- Collaborators and colleagues

Medical Image Computing

- The major focus of Medical Image Computing (MIC) research today is on automated pipelines, processing a large number of data from “healthy looking” subjects acquired in controlled studies
- MIC has mostly failed to produce solutions that are actually used in clinical practice
- This is mostly due to failure of handling variability of both normal and pathologic anatomy

Examples from the Clinic

- Manual slice by slice outlining is the standard of care in radiation therapy and surgical planning
- Automated MS lesion segmentation has failed to translate from ivory tower research into clinical practice
- Comparing time series is mostly performed through visual side by side comparison due to lack of registration that is fast, robust and automated

The Opportunity

We need "**User In The Loop**" (Use-it) algorithms

- The way that the user and algorithm interact is of outmost importance
- Leverage the respective strengths:
  - Users have no problem with the big picture
  - Algorithms have no problem analyzing every voxel in the volume

What we need

- Segmentation algorithms
- Registration algorithms
- Intuitive ways to organize and present complex patient data and processing approaches
- These methods must:
  - be interactive
  - require minimal knowledge of the underlying algorithms

===> **Ron's Rules For Tools**

Ron's Rules For Tools

- You make it, I break it.
- Your tool does not exist, until it works on my laptop with my data.
- I am lazy. I do not like to move the mouse or to type.
- No more than one simple parameter.
- I have ADD. Make your algorithm fast.

You make it, I break it

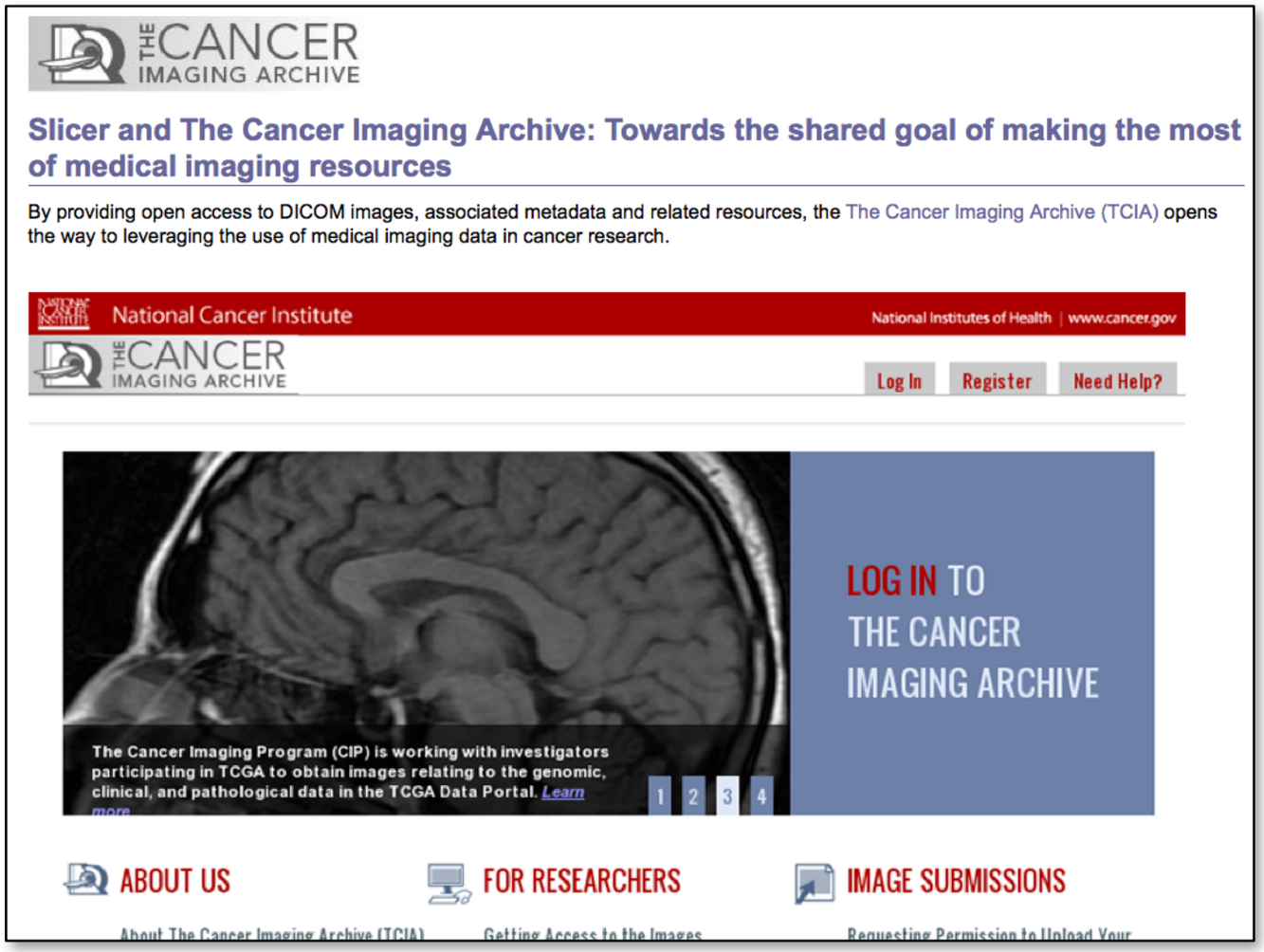
Tools need to be robust and function with a variety of workflows, not only the one envisioned by the developer

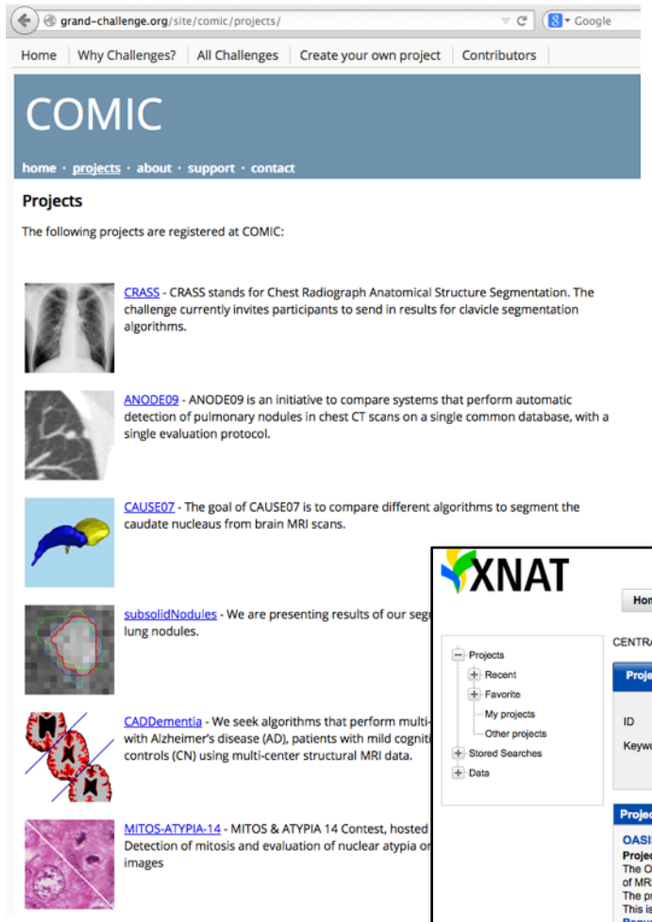
How To ensure robustness in the presence of biological variability

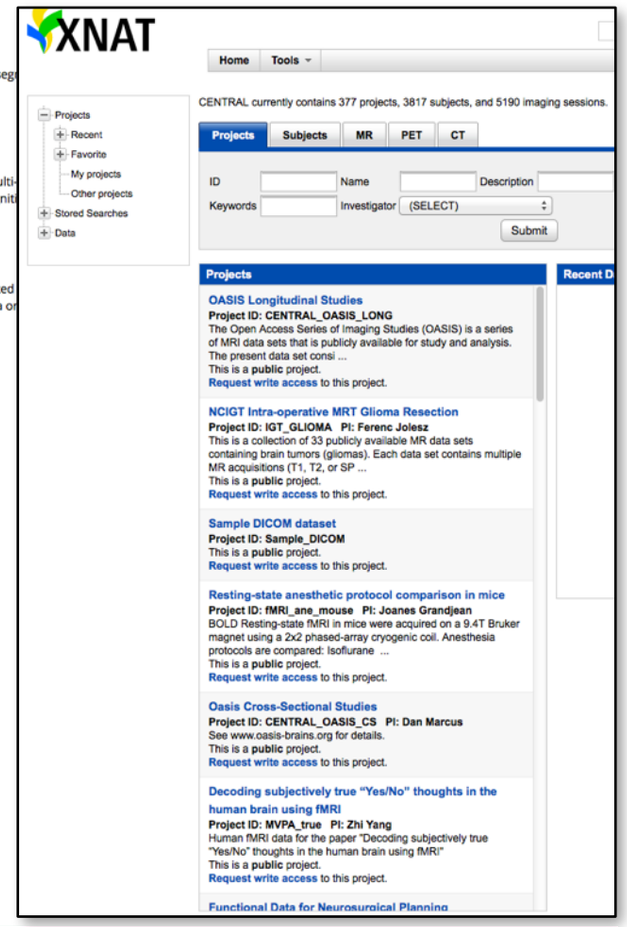
- Build a case library
- Use half the cases for development
- Cycle through the cases daily
- Use the other half for testing

An increasing number of repositories are publicly available. E.g. TCIA, XNAT Central, MICCAI Challenges, etc.

Public Repositories







Your tool does not exist, until it works on my laptop with my data.

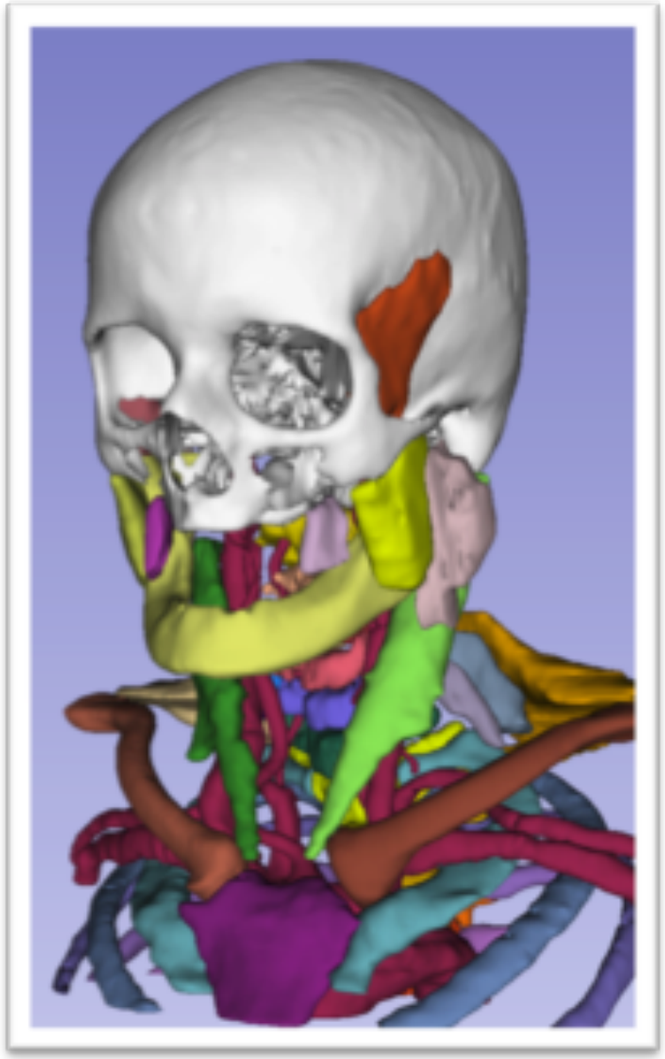
- Turning a prototype into a tool requires work but makes your algorithm accessible to others. This, in turn:
  - Increases the impact of your work
  - Is an important part of the scientific method:

Experimental and theoretical results must be reproduced by others within the scientific community. (http://en.wikipedia.org/wiki/Scientific_method)

Prototype versus Tool

Translation Requires Tools

- A **prototype** works for the grad student's thesis
  - Not portable
  - Unstable, no support
- A **tool** works in your environment
  - Easy to install
  - Easy to use
  - Stable, documented, supported
- Significant resources are needed to get from a prototype to a tool



I Do Not Like To Type Or Move The Pointer

User-friendliness in the interface:

Minimalist designs are a default in mobile computing.

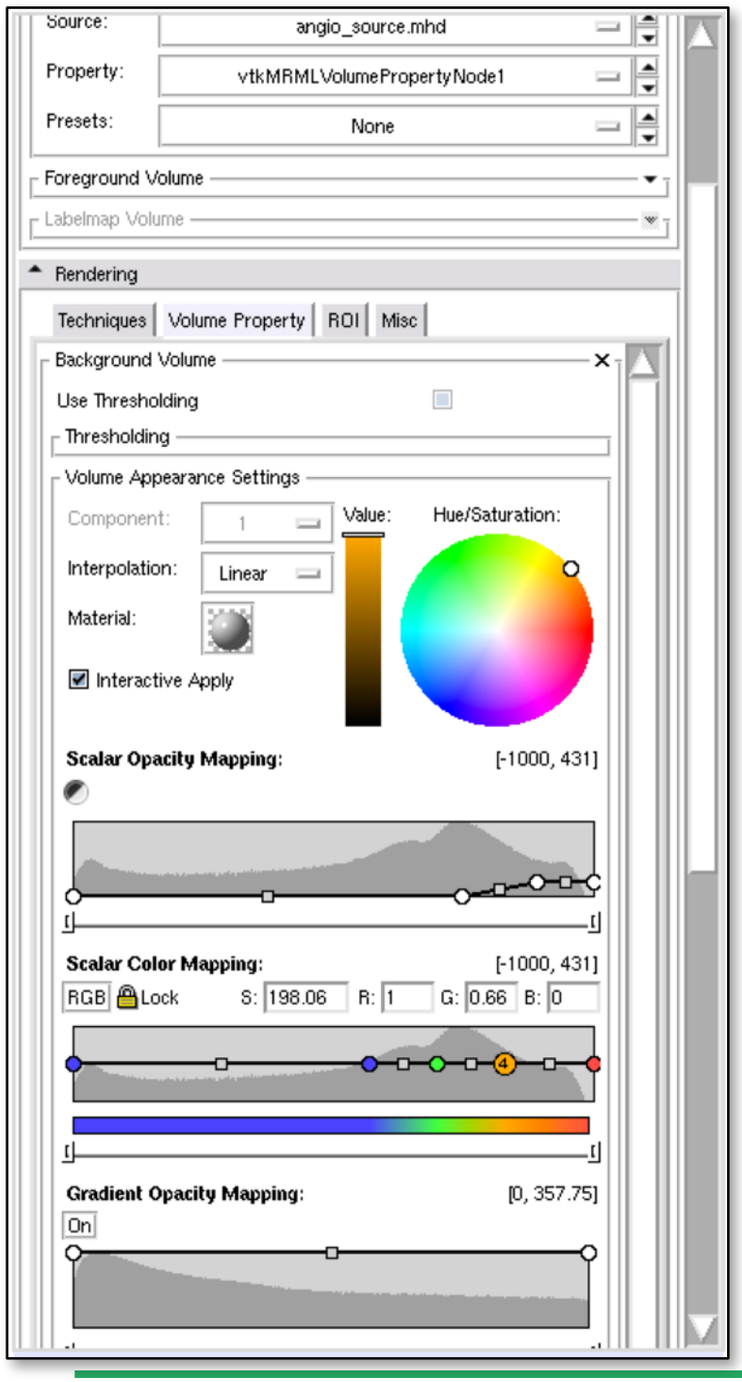
Users expect minimalist designs.

Recommendations:

- Minimize the number of clicks
- Minimize the distance the pointer has to travel
- Have good default values

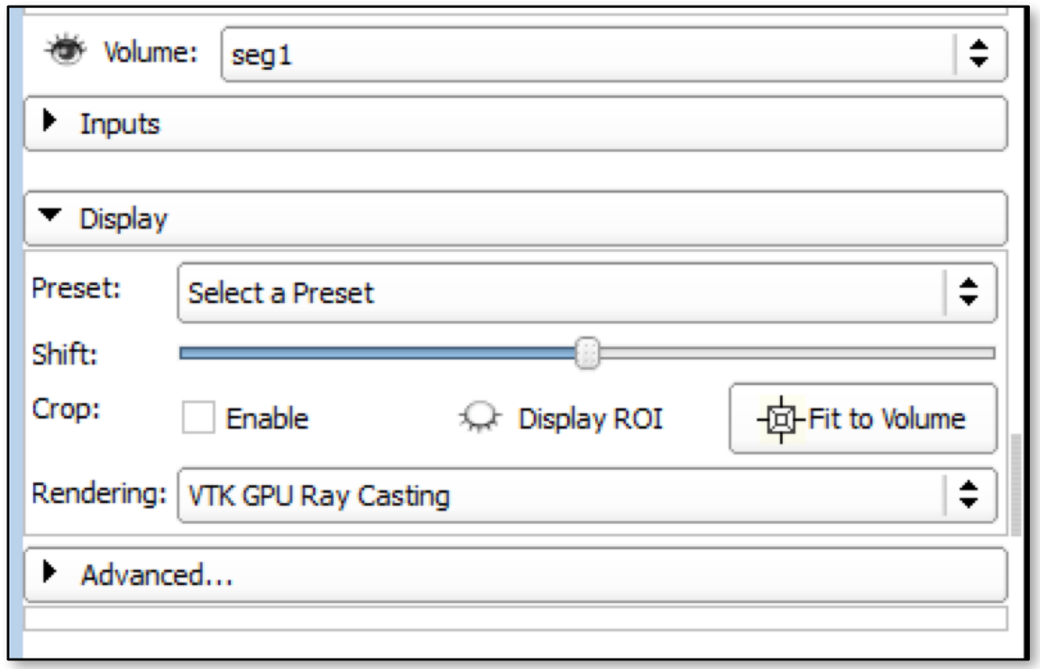
User-Friendly GUI

3.5

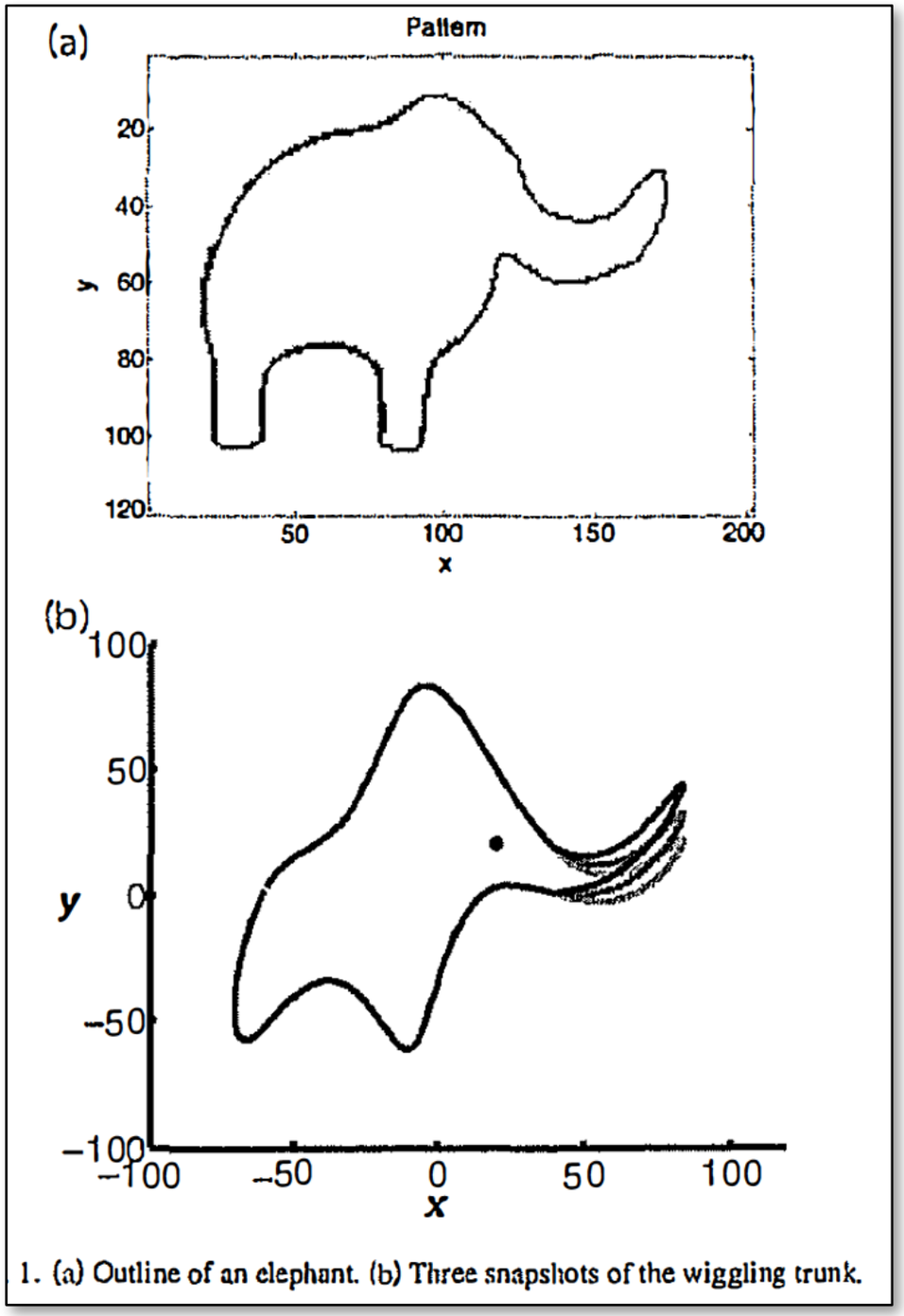


- First make everything work
- Then choose a use-case scenario
- Minimize the initial options and choices
- Put everything else behind an advanced tab, which is closed by default
- Example: Initial Presentation of the volume renderer in Slicer

4.0



No More Than One Simple Parameter



1. (a) Outline of an elephant. (b) Three snapshots of the wiggling trunk.

User-friendliness in the algorithm:

If I need more than 20 seconds to figure out how to set the parameter, I won't!

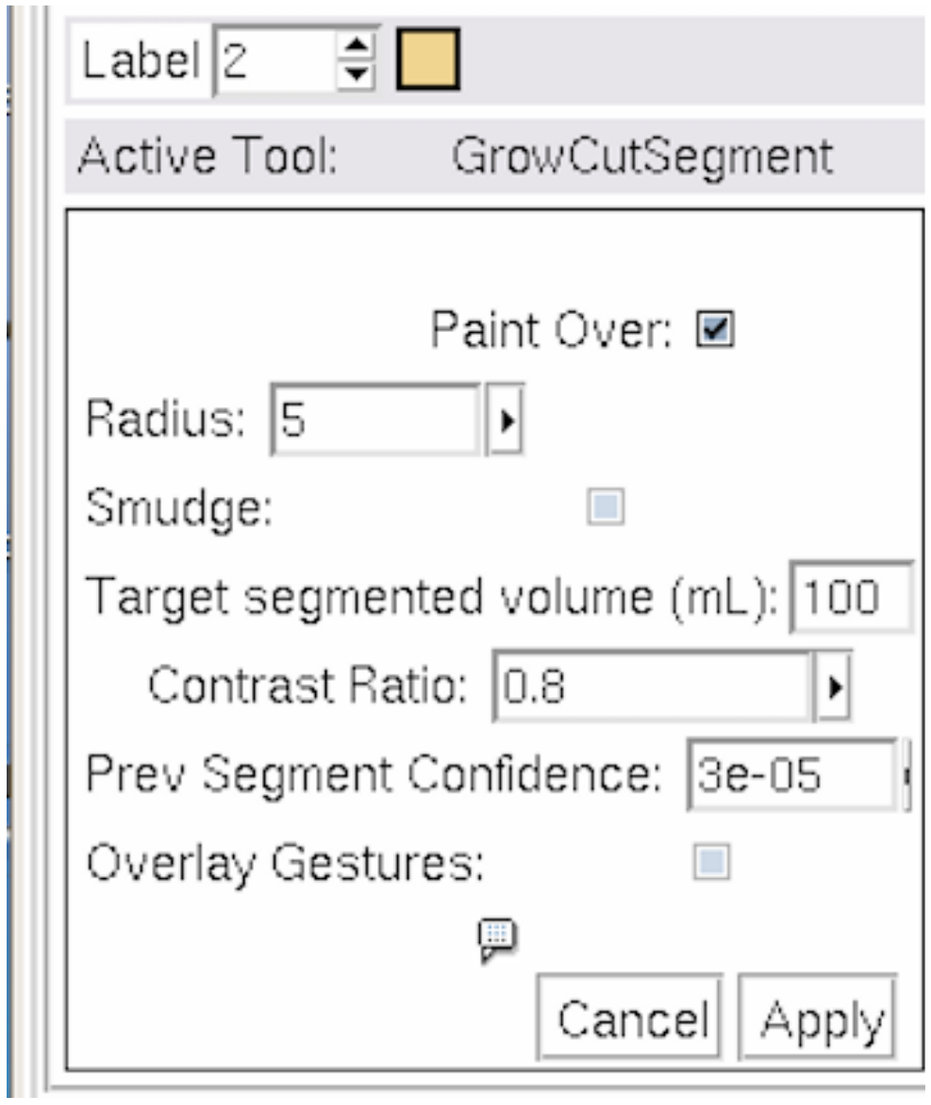
"With four parameters I can fit an elephant, and with five I can make him wiggle his trunk."

Attributed to von Neumann

(Am. J.Phys. 78(6), June 2010)

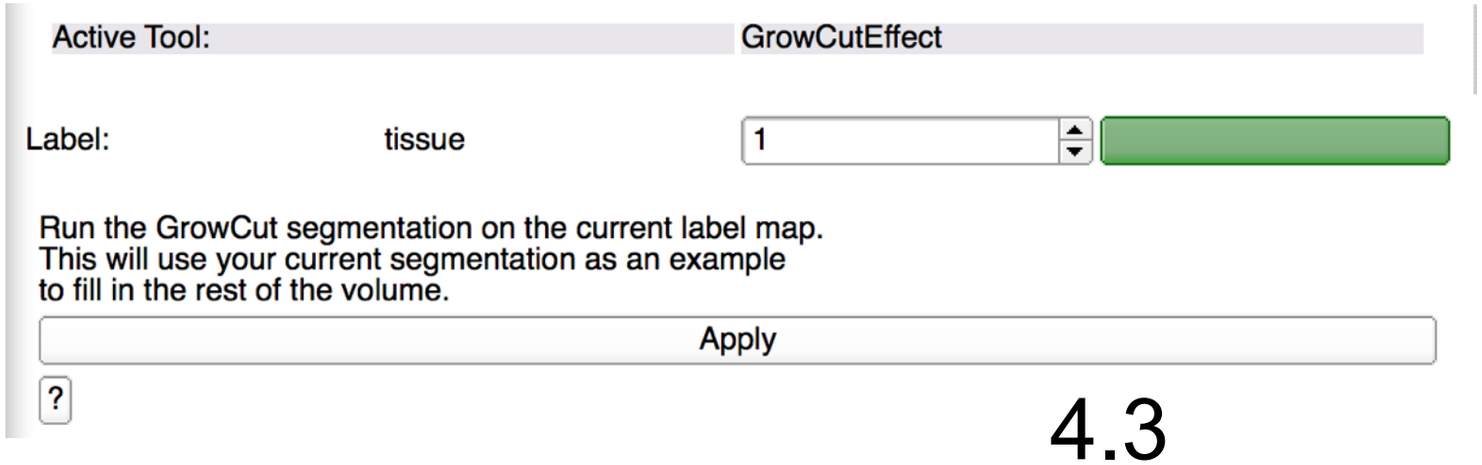
- How much time do I need to figure this out?

Hide Your Parameters



3.6

- Many parameters increase both capabilities and complexity
- Think hard whether they are REALLY needed
- Consider your use-case scenario
- Example: GrowCut effect in the Editor in Slicer



4.3

Make Your Algorithm Fast!

Mobile computing sets the tone:

74% of mobile web users will leave a site if it takes longer than 5 seconds to load. That means you have 5 seconds of someone's time to get them what they want, or they're gone. (http://bradfrostweb.com/blog/post/performance-as-design/)

- Instantaneous is what I really want
  - under a minute is acceptable

Algorithm Speed-Up

- Parallelization, GPU acceleration, ROI/ VOI selection are all generic ways to accelerate algorithms
- Proper initialization and selection of parameters can greatly contribute
- Alternate mathematical approaches
- Example: From GrowCut to FastGrowCut results in acceleration by more than one order of magnitude
  (see talk by Liangjia Zhu in Oral Session II)

What's In It For Me?

Impact, impact, impact

- The real validation of an algorithm is its use and usefulness
- Making an algorithm accessible helps to advance the field
- People who use your algorithm will quote your paper

How To Approach This

- Make sure you have a representative sample of data for development and testing
- First make it work
- Then make it work well
- Finally make the interface beautiful and efficient

Conclusions

- The neglect of “Use-IT” approaches in MIC is both a problem and an opportunity
- I have laid out a framework on how to address the issues and take advantage of these opportunities
- To the best of my knowledge, this workshop is the first of its kind in our field.

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