



Surgical Planning Laboratory  
Brigham and Women's Hospital  
Boston, Massachusetts USA

a teaching affiliate of  
Harvard Medical School



**Fraunhofer**  
MEVIS



Universität Bremen

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# Ron's Rules For Tools

## Ron Kikinis, M.D.

Robert Greenes Distinguished Director of Biomedical Informatics, Dept. of Radiology, BWH  
Professor of Radiology, Harvard Medical School  
Professor of Medical Image Computing, FB 3, Uni Bremen

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- Founding Director, Surgical Planning Laboratory, Brigham and Women's Hospital
  - Institutsleiter, Fraunhofer MEVIS
  - Principal Investigator, National Alliance for Medical Image Computing, and Neuroimage Analysis Center,
  - Research Director, National Center for Image Guided Therapy

# Acknowledgments

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**National Alliance for Medical Image  
Computing**

[www.na-mic.org](http://www.na-mic.org)

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



**Neuroimage Analysis Center**

[nac.spl.harvard.edu](http://nac.spl.harvard.edu)



**Surgical Planning Laboratory,  
Brigham and Women's Hospital**

[spl.harvard.edu](http://spl.harvard.edu)



**National Center For Image Guided Therapy**

[www.ncigt.org](http://www.ncigt.org)



# Medical Image Computing

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- 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

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- 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

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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

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- 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

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- 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

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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

**THE CANCER IMAGING ARCHIVE**

## Slicer and The Cancer Imaging Archive: Towards the shared goal of making the most of medical imaging resources

By providing open access to DICOM images, associated metadata and related resources, the **The Cancer Imaging Archive (TCIA)** opens the way to leveraging the use of medical imaging data in cancer research.

National Cancer Institute | National Institutes of Health | [www.cancer.gov](http://www.cancer.gov)

**THE CANCER IMAGING ARCHIVE** | [Log In](#) | [Register](#) | [Need Help?](#)

**LOG IN TO THE CANCER IMAGING ARCHIVE**

The Cancer Imaging Program (CIP) is working with investigators participating in TCGA to obtain images relating to the genomic, clinical, and pathological data in the TCGA Data Portal. [Learn more](#)

**ABOUT US** | **FOR RESEARCHERS** | **IMAGE SUBMISSIONS**

grand-challenge.org/site/comic/projects/

Home | Why Challenges? | All Challenges | Create your own project | Contributors

## COMIC

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### Projects

The following projects are registered at COMIC:

- CRASS** - CRASS stands for Chest Radiograph Anatomical Structure Segmentation. The challenge currently invites participants to send in results for clavicle segmentation algorithms.
- ANODE09** - ANODE09 is an initiative to compare systems that perform automatic detection of pulmonary nodules in chest CT scans on a single common database, with a single evaluation protocol.
- CAUSE07** - The goal of CAUSE07 is to compare different algorithms to segment the caudate nucleus from brain MRI scans.
- subsolidNodules** - We are presenting results of our segmentation of lung nodules.
- CADDementia** - We seek algorithms that perform multi-class segmentation of Alzheimer's disease (AD), patients with mild cognitive impairment (MCI), and cognitively normal controls (CN) using multi-center structural MRI data.
- MITOS-ATYPIA-14** - MITOS & ATYPIA 14 Contest, hosted by the Cancer Imaging Archive. Detection of mitosis and evaluation of nuclear atypia on histology images.

**XNAT**

Home | Tools

CENTRAL currently contains 377 projects, 3817 subjects, and 5190 imaging sessions.

Projects | Subjects | MR | PET | CT

ID:  Name:  Description:

Keywords:  Investigator: (SELECT)

**Projects**

- OASIS Longitudinal Studies**  
Project ID: CENTRAL\_OASIS\_LONG  
The Open Access Series of Imaging Studies (OASIS) is a series of MRI data sets that is publicly available for study and analysis. The present data set consists of 10 subjects. This is a public project.  
[Request write access to this project.](#)
- NCI Intra-operative MRT Glioma Resection**  
Project ID: IGT\_GLIOMA PI: Ferenc Jolesz  
This is a collection of 33 publicly available MR data sets containing brain tumors (gliomas). Each data set contains multiple MR acquisitions (T1, T2, or SP ...). This is a public project.  
[Request write access to this project.](#)
- Sample DICOM dataset**  
Project ID: Sample\_DICOM  
This is a public project.  
[Request write access to this project.](#)
- Resting-state anesthetic protocol comparison in mice**  
Project ID: fMRI\_ane\_mouse PI: Joanes Grandjean  
BOLD Resting-state fMRI in mice were acquired on a 9.4T Bruker magnet using a 2x2 phased-array cryogenic coil. Anesthesia protocols are compared: Isoflurane ... This is a public project.  
[Request write access to this project.](#)
- OASIS Cross-Sectional Studies**  
Project ID: CENTRAL\_OASIS\_CS PI: Dan Marcus  
See [www.oasis-brains.org](http://www.oasis-brains.org) for details. This is a public project.  
[Request write access to this project.](#)
- Decoding subjectively true "Yes/No" thoughts in the human brain using fMRI**  
Project ID: MVPA\_true PI: Zhi Yang  
Human fMRI data for the paper "Decoding subjectively true "Yes/No" thoughts in the human brain using fMRI". This is a public project.  
[Request write access to this project.](#)
- Functional Data for Neurosurgical Planning**

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

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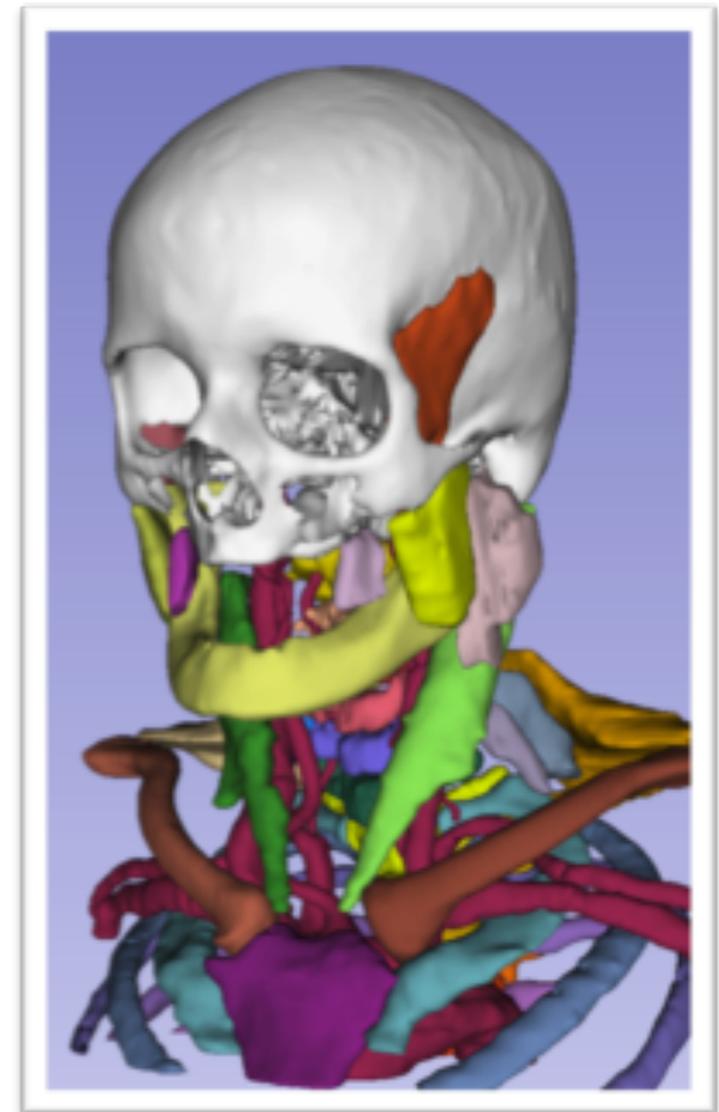
- Turning a prototype into a tool requires work but makes your algorithm accessible to others. This, in turn:
  - Increases the impact of your work
  - Is an important part of the scientific method:  
Experimental and theoretical results must be reproduced by others within the scientific community. ([http://en.wikipedia.org/wiki/Scientific\\_method](http://en.wikipedia.org/wiki/Scientific_method))

# Prototype versus Tool

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## 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

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User-friendliness in the interface:

Minimalist designs are a default in mobile computing.

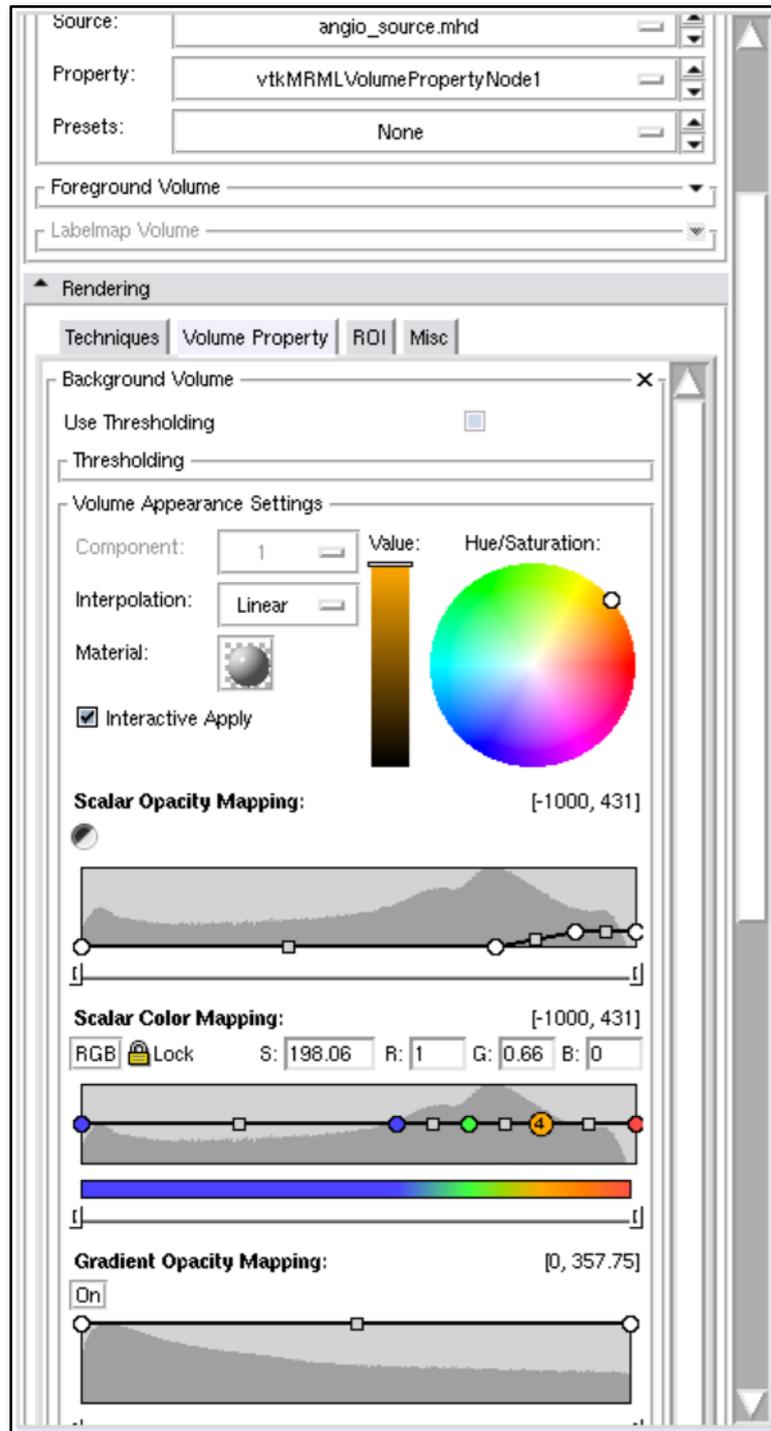
Users expect minimalist designs.

Recommendations:

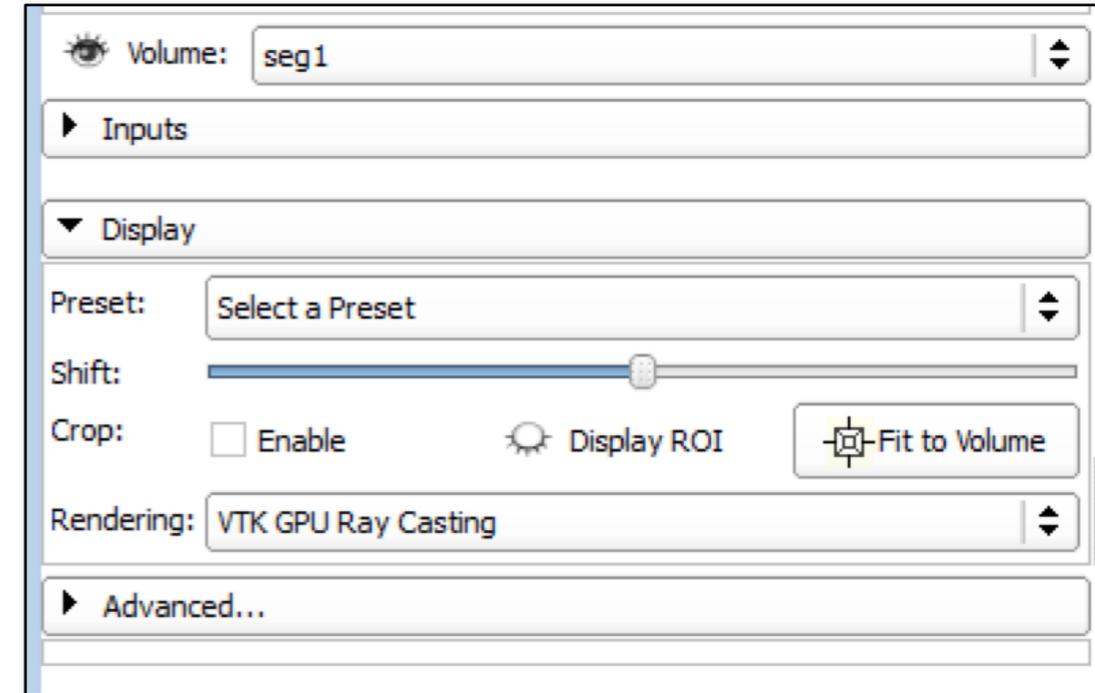
- Minimize the number of clicks
- Minimize the distance the pointer has to travel
- Have good default values

# User-Friendly GUI

3.5

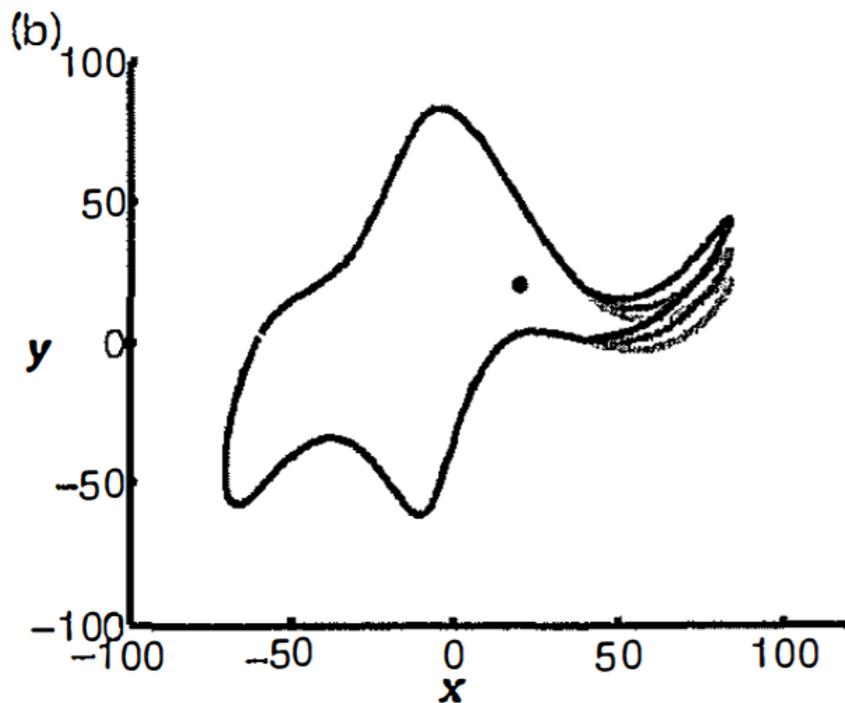
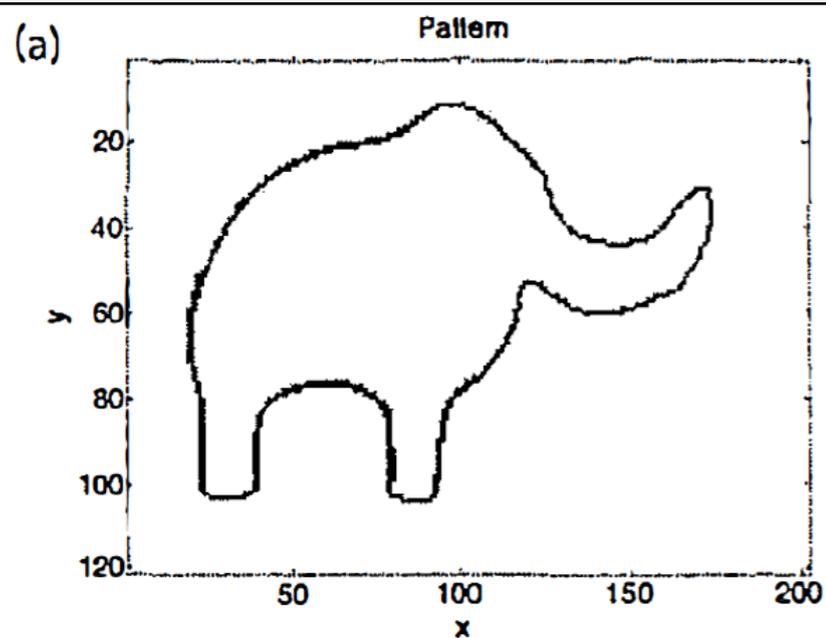


4.0



- 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

# 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!

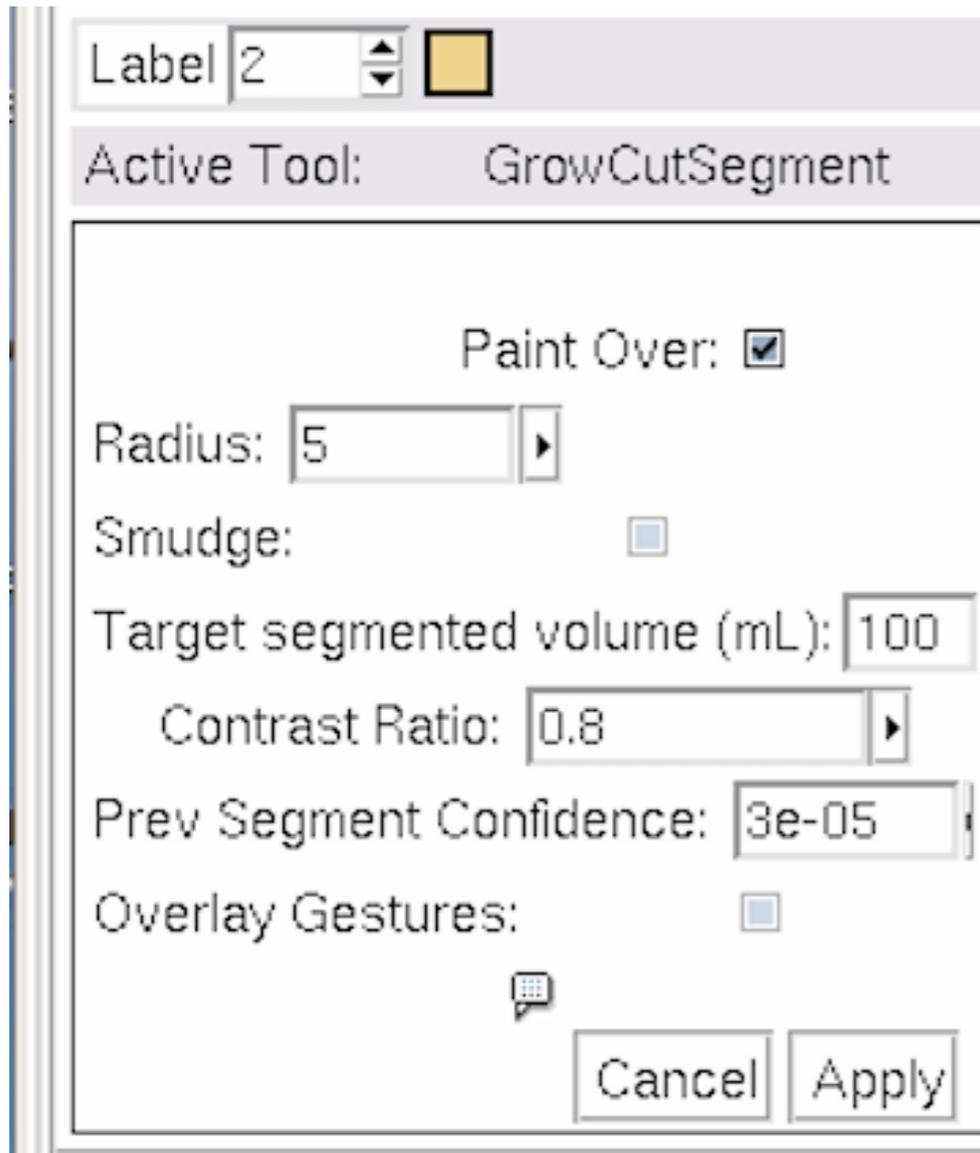
“With four parameters I can fit an elephant, and with five I can make him wiggle his trunk.”

Attributed to von Neumann

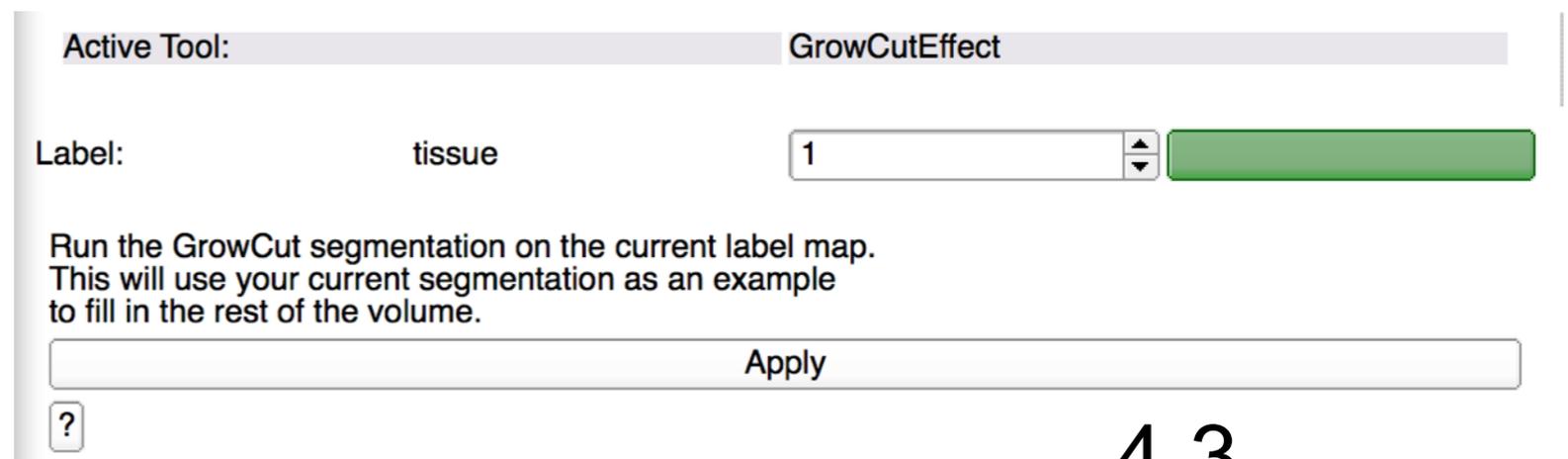
(Am. J.Phys. 78(6), June 2010)

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

# Hide Your Parameters



- 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



3.6

4.3

# Make Your Algorithm Fast!

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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

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- 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?

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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

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- 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

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- 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.

# Acknowledgments

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