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Ron's Rules For Tools

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Acknowledgments



**National Alliance for Medical Image
Computing**

www.na-mic.org

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



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



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

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

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-center structural MRI data with 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 Research and Biomedical Informatics Center at the University of Michigan. Detection of mitosis and evaluation of nuclear atypia on images.

XNAT

Home | Tools

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

XNAT

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.](#)
- NCIGT 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 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](#)

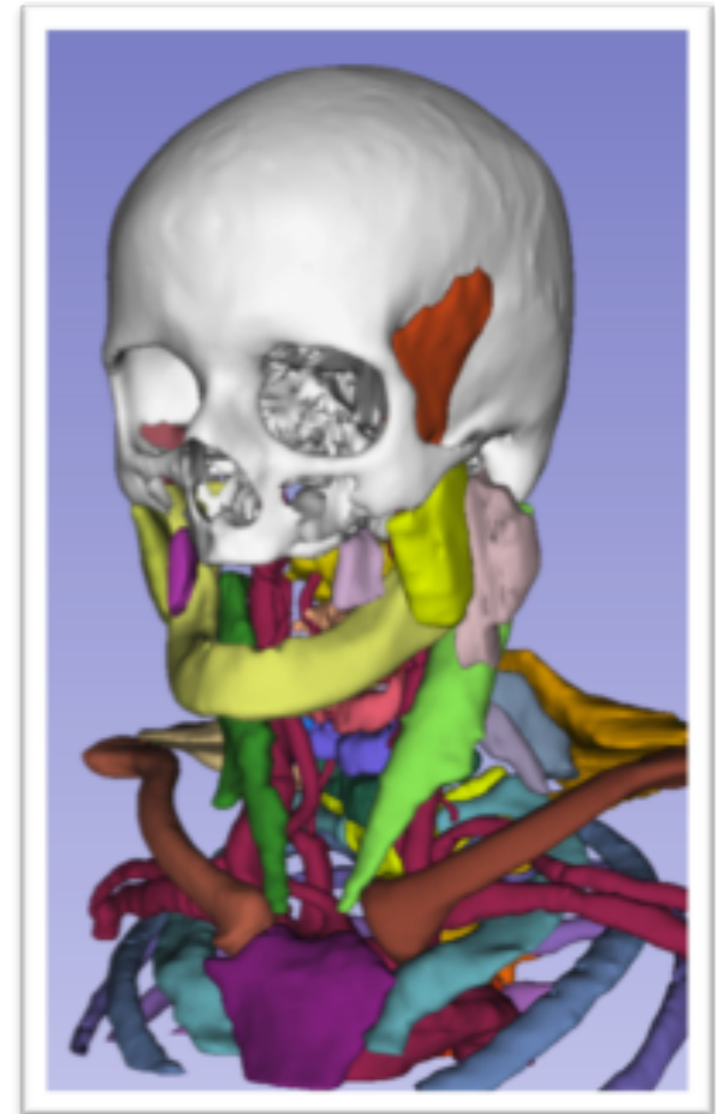
Your tool does not exist, until it works on my laptop with my data.

- 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.

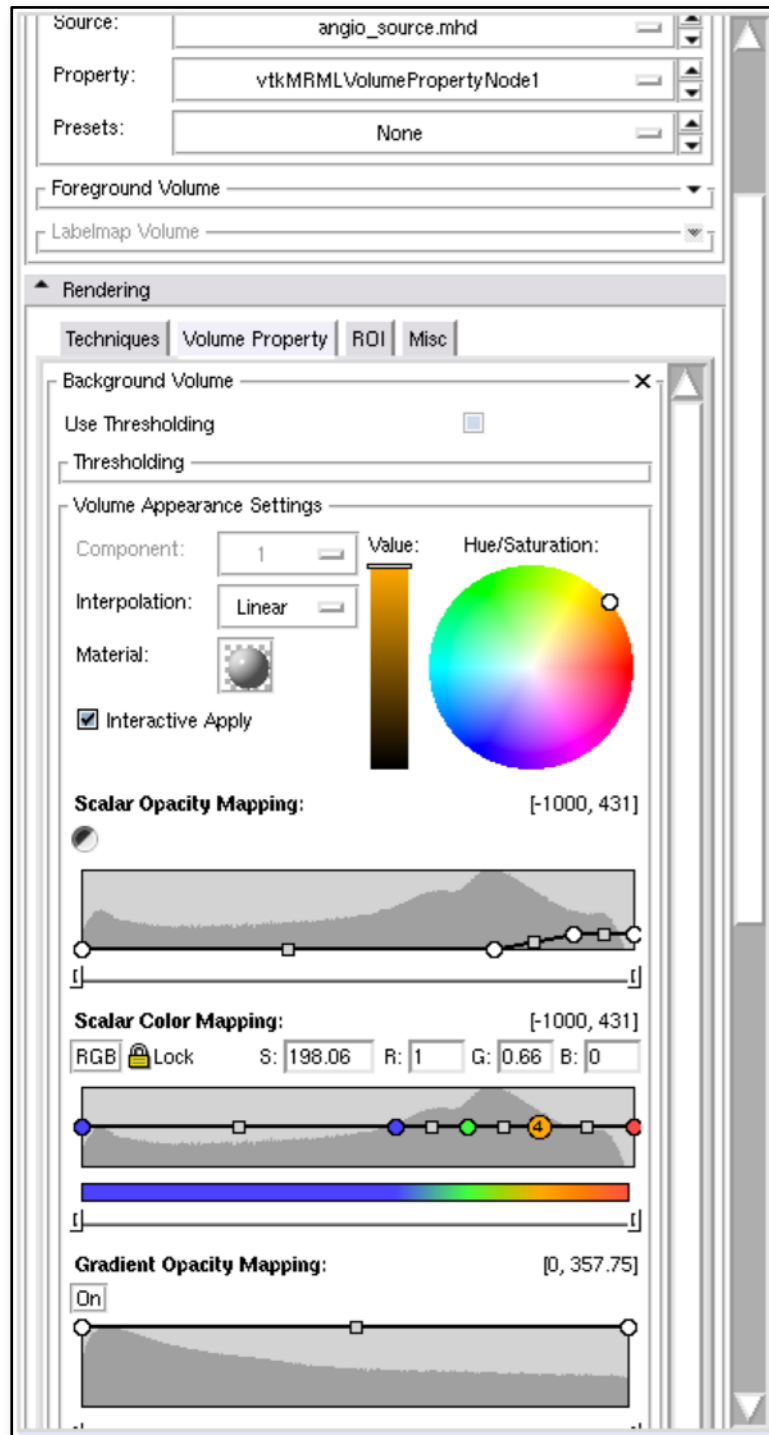
Users expect minimalist designs.

Recommendations:

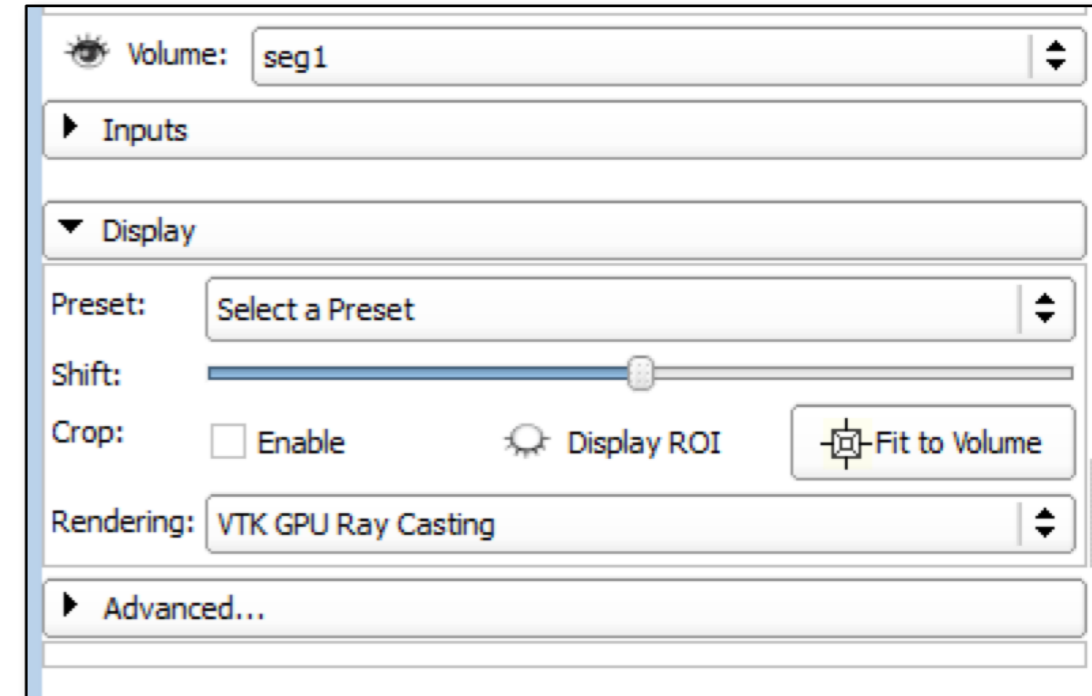
- Minimize the number of clicks
- Minimize the distance the pointer has to travel
- Have good default values

User-Friendly GUI

3.5

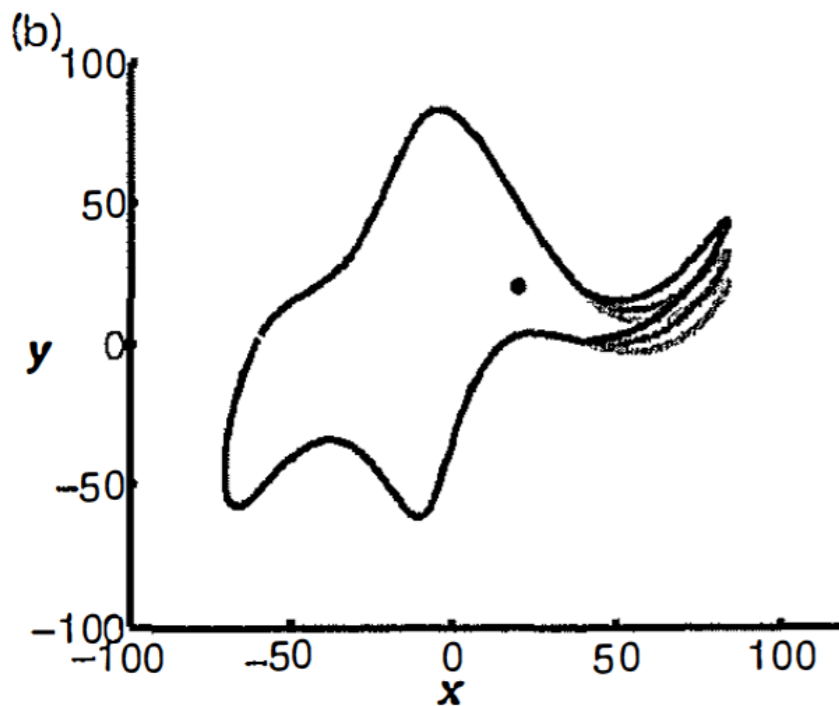
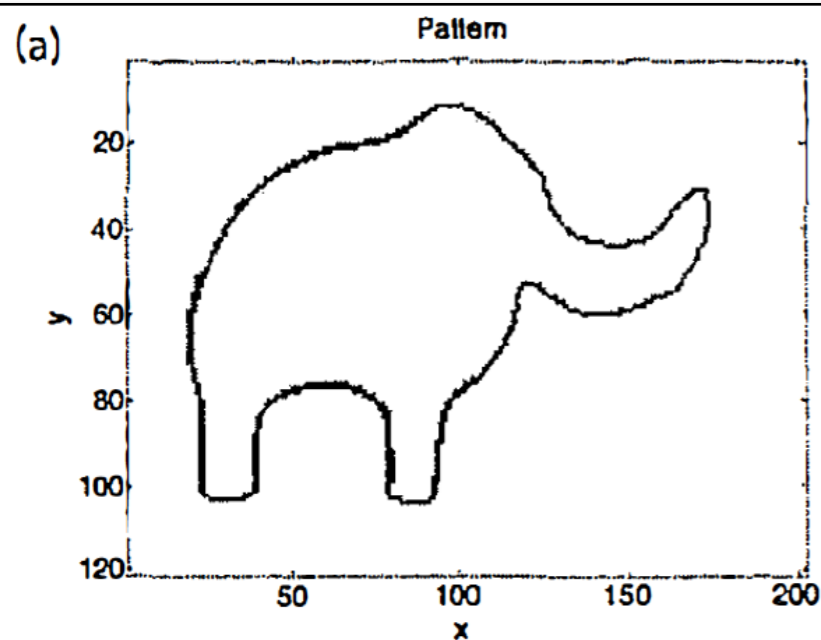


4.0



- 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!

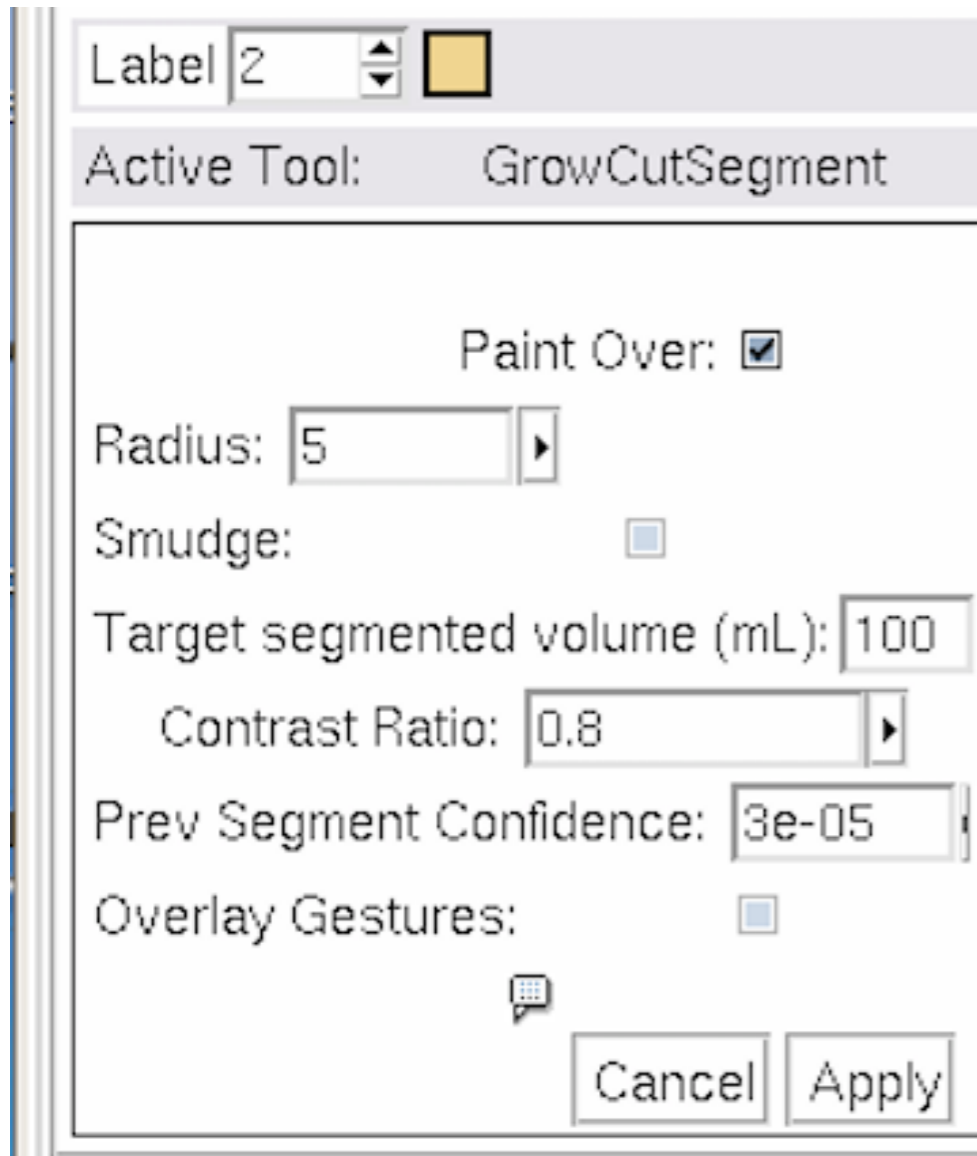
“With four parameters I can fit an elephant, and with five I can make him wiggle his trunk.”

Attributed to von Neumann

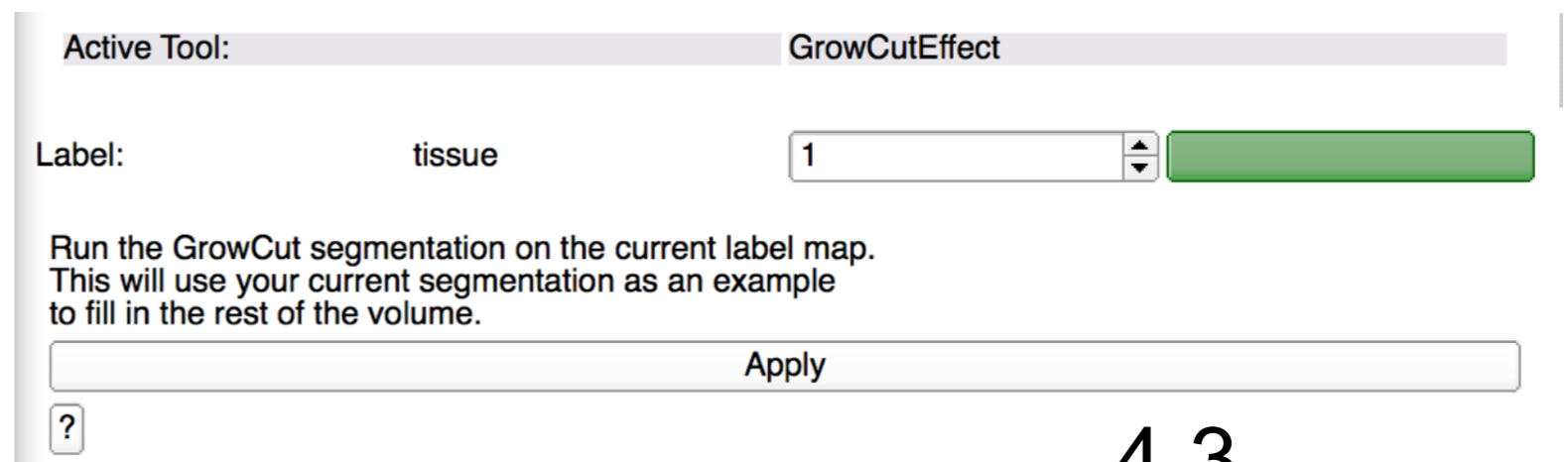
(Am. J.Phys. 78(6), June 2010)

- 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!

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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