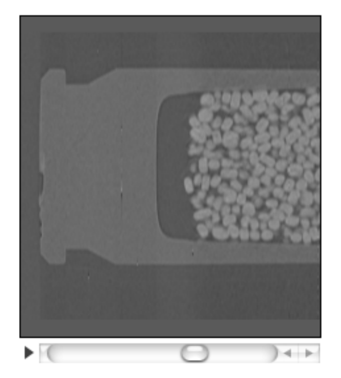
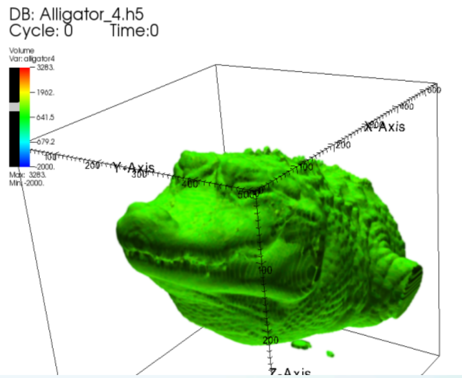
Implementing a Visualization Course into High School Curricula

By Christopher J. Hynes, Ph.D.

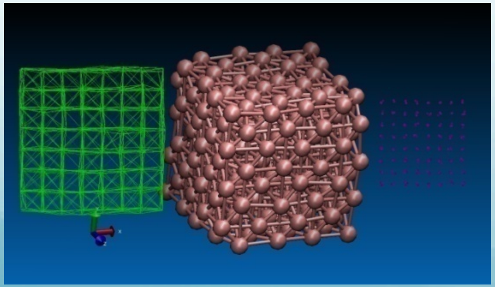


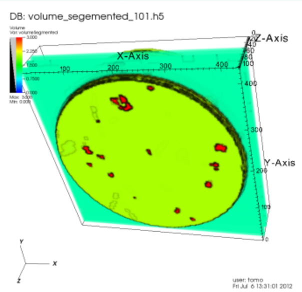


LA-SiGMA
Louisiana Alliance for Simulation-Guided Materials Applications

Keep pace with the times:

- Ph.D. in 1991, Analytical Chemistry, Oklahoma State University
- Teaching 20+ years at various colleges, universities, and Math & Science high schools
- Lots of changes:
  - Teaching methodologies (clickers, ebooks, applet demos)
  - Instrumentation (improved, smaller, cost, new varieties)
  - Sub-disciplines (Nano-technology, Computational Chemistry)
  - “Emerging” skill set: Visualization, HPC
- Our Science curricula is due for an update. Why not spice up traditional courses or add a new elective involving visualization?





Implementing Visualization into High School Curricula?

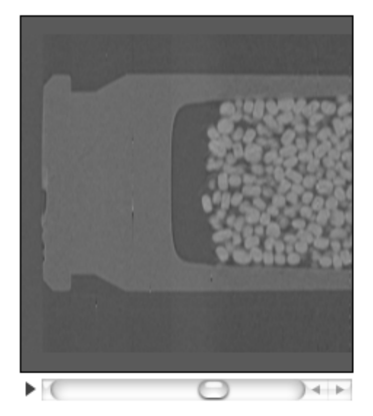
- LA-SiGMA summer 2011, molecular dynamics/visualization (LAAMPS[1], VMD[2])
- LA-SiGMA summer 2012, visualization software
- Unique opportunity to create a cross-disciplinary course bringing together Visual Art, Science, and Computer Science
- Louisiana School for Math, Science and the Arts[3] – high aptitude and motivated students, 25% (on average) accepted to Top 40 colleges[4]
- Accelerate through traditional course offerings, leaving them with opportunities to take specialized Electives in their academic interest:
  - Digital Media I & II, Molecular & Cellular Bio, Botany, Organic, Biochemistry, Astronomy, Quantum Mechanics, Python, JAVA, Mobile App Development
  - Time is right to add Intro to Visualization

Objectives:

- Create a 1 semester Visualization course, "Introduction to Visualization" using Dr. Butler's CHEM 4581 as a "starting point"
- Icing on the cake – use iBook authoring[5] and present it in an iBook format
- Truly amazing – allow the iBook to have access to a computer cluster on the back end
- Peer-peer instruction/collaboration

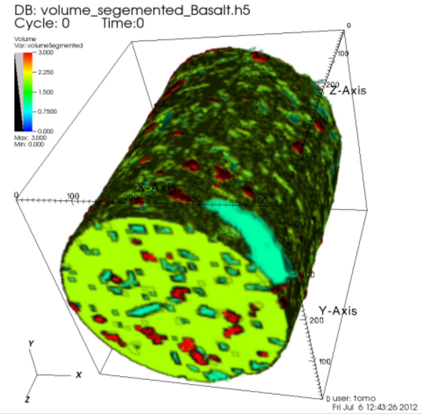
LASiGMA “research”:

- Learning as much as I can about visualization: software, files, rendition types
- What works, what doesn’t, advantages/ disadvantages, complementary
- Presenting it in a teachable format

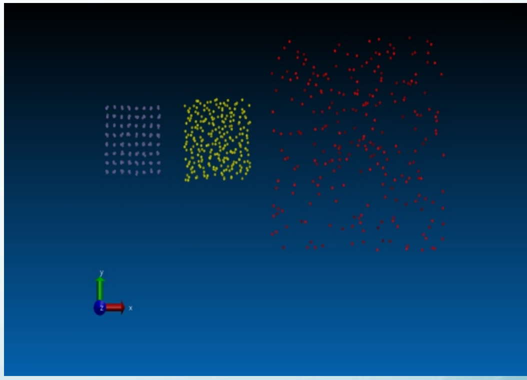


ImageJ[6]
(freeware)

Mathematica[7]
($$$)

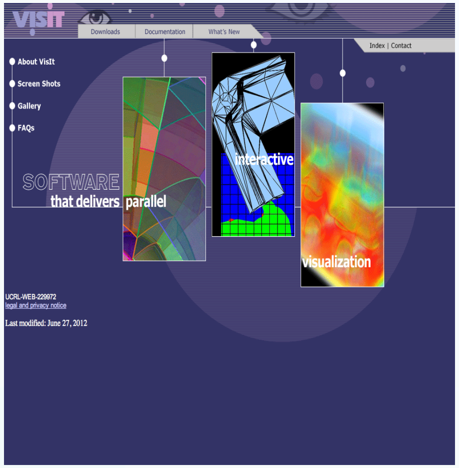


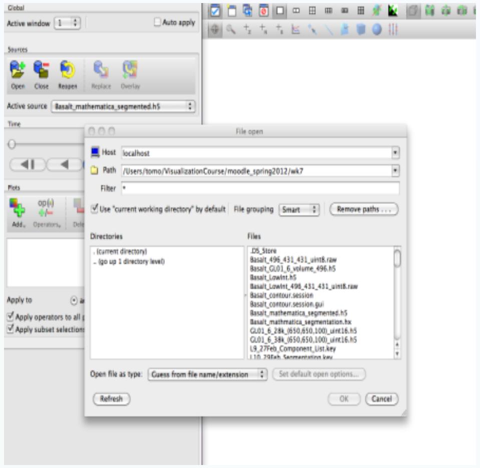
VisIt[8]
(freeware)



VMD[2]
(freeware)

Example of Instruction sequence for VisIt[8]:





Active source: Basalt_mathematica_segmented.h5

Host: localhost

Path: /Users/tomo/VisualizationCourse/moodle_spring2012/wk7

Filter: *

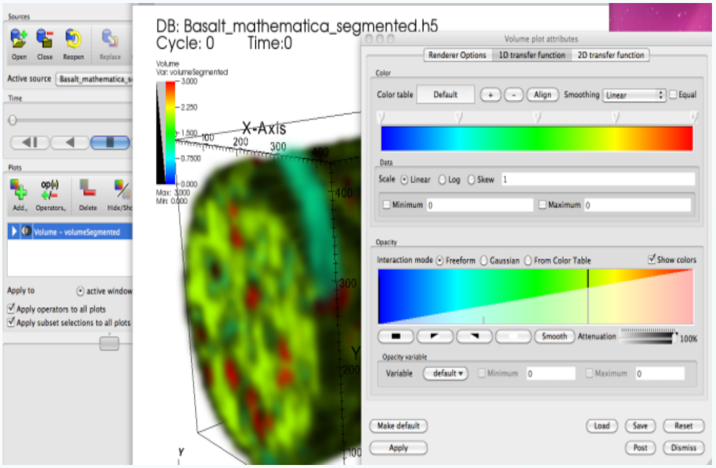
☑ Use "current working directory" by default

File grouping: Smart

Directories:
- . (current directory)
- .. (go up 1 directory level)

Files:
- .DS_Store
- Basalt_496_431_431_uint8.raw
- Basalt_GL01_6_volume_496.h5
- Basalt_LowInt.h5
- Basalt_LowInt_496_431_431_uint8.raw
- Basalt_contour.session
- Basalt_contour.session.gui
- Basalt_mathematica_segmented.h5
- Basalt_mathmatica_segmentation.hx
- GL01_6_28k_(650,650,100)_uint16.h5
- GL01_6_38k_(650,650,100)_uint16.h5
- L9_27Feb_Component_List.key

Open file as type: Guess from file name/extension



Active source: Basalt_mathematica_s

DB: Basalt_mathematica_segmented.h5
Cycle: 0 Time:0

Volume
Var: volumeSegmented
3.000
2.250
1.500
0.7500
0.000
Max: 3.000
Min: 0.000

Color table: Default; Smoothing: Linear; ☐ Equal

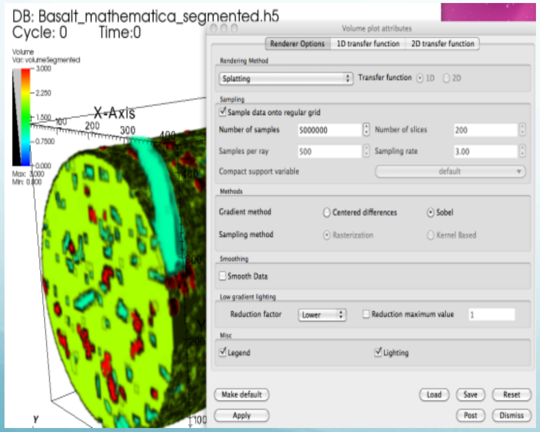
Scale: ● Linear ○ Log ○ Skew 1

☐ Minimum 0 ☐ Maximum 0

Interaction mode: ● Freeform ○ Gaussian ○ From Color Table ☑ Show colors

Attenuation 100%

Variable: default



DB: Basalt_mathematica_segmented.h5
Cycle: 0 Time:0

Splatting; Transfer function ○ 1D ○ 2D

☑ Sample data onto regular grid

Number of samples: 5000000; Number of slices: 200

Samples per ray: 500; Sampling rate: 3.00

Compact support variable: default

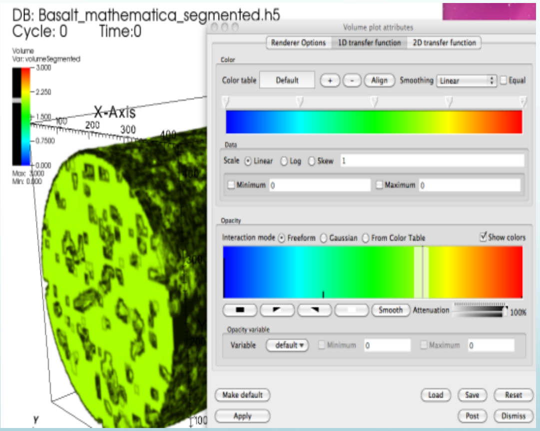
Gradient method: ○ Centered differences ● Sobel

Sampling method: ○ Rasterization ○ Kernel Based

☐ Smooth Data

Reduction factor: Lower; ☐ Reduction maximum value 1

☑ Legend ☑ Lighting



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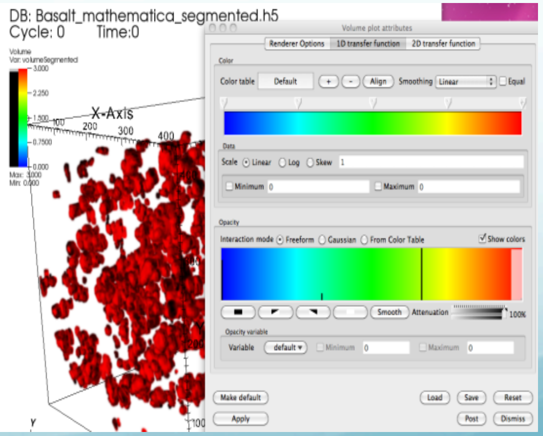
Variable: default



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Attenuation 100%

Variable: default

Future Work:

- Continue developing "detailed" teaching sequences
- Continue with i-book authoring
- Add more data files e.g. Astronomy, Anatomy, 4-D?
- Incorporate Blender[9] ? (freeware)
- Pursue I-Corps grant[10] ? NSF funded program to help bring an idea or process to commercialization. Uniqueness of visualization "course" via iBook with a HPC cluster on the back end?

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- Dr. Les Butler (mentor) - ideas, words of wisdom, patience
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- Louisiana State University
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References:

- 1) http://lammps.sandia.gov/
- 2) http://www.ks.uiuc.edu/Research/vmd/
- 3) http://www.lsmsa.edu
- 4) http://colleges.usnews.rankingsandreviews.com/best-colleges/rankings/national-universities/data
- 5) http://www.apple.com/ibooks-author/
- 6) http://rsbweb.nih.gov/ij/
- 7) http://www.wolfram.com/mathematica/
- 8) https://wci.llnl.gov/codes/visit/
- 9) http://www.blender.org/
- 10) http://www.nsf.gov/news/special_reports/i-corps/