Visualization TRD

[Image of various medical visualizations and diagrams related to anatomy and data analysis.]
DBPs: Winslow and Kardon

Visualization

MBytes

TBytes

1999

2015
Long-Term Goal: Visualize the variance in clinical outcomes (such as tremor arrest) that can be attributed to deep brain stimulation (DBS) lead location or stimulation location.
341 Sections
90nm thick sections
~32GB/Section
~1000 tiles/section
4096x4096 pixels/tile
2.18 nm/Pixel
16.5 TB after processing
Proposed Aims

Aim 1: Methods/infrastructure for large data
- LOD – Incorporate LOD for large data visualization
- Multi-channel visualization and analysis

Aim 2: Uncertainty visualization
- Visual analysis and tools to represent uncertainty in image analysis and simulation

Aim 3: Visual analysis of large volumetric datasets
- Data-driven feature selection
- Quantification of cell tracking
## Proposed Aims

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Visualization Software

Integrated Software Tools

Visualization

Image and Geometric Analysis

Simulation and Estimation

Image & Data Acquisition

Modeling, Simulation & Validation

Geometry Processing

Visualization

FluoRender

ImageVis3D

μView

Cleaver

ShapeWorks

SCIRun Toolkit

BrainStimulator Toolkit

Forward/Inverse Toolkit

BioMesh3D Toolkit
Visualization Software
Long-Term Goal: Visualize the variance in clinical outcomes (such as tremor arrest) that can be attributed to deep brain stimulation (DBS) lead location or stimulation location.

DBS Lead Locations for 60 Parkinson’s Disease Patients Among 8 Centers

νView DBS Visualization

Goal: Visualize the variance in clinical outcomes (such as tremor arrest) that can be attributed to deep brain stimulation (DBS) lead location or stimulation location

Development can be followed at https://github.com/behollis/DBSViewer/issues

New postdoc, Brad Hollister, will do a demo of nuView after lunch
νView Progress

- Completed PyQt framework for adding additional visualization functionality
- Utilizes earlier design work from muView (moved away from C++)
- Leverages VTK and other third-party Python modules for decreased development time of new features / code maintenance
- Provides volume rendering of Volume of Tissue Activated (VTA) for DBS patient results
- Allows users to set or use preset transfer functions based on a given statistic
- Allows users to select voxels in VTA for histogram report of patient data
- Allows users to manipulate clipping planes to probe interior of VTA
- Provides parallel coordinates of all loaded patient data sets
- Ability to select subgroups of patients from any data set
μView Visualization Framework
μView has a number of visualization approaches, many of which highlight the same features. Each visualization has its own advantages and disadvantages. Clustering has the advantage of highlighting multiple features simultaneously. However, it requires significant effort in visual search to wade through less important features. Using the isovalue visualization limits the number of features visible, making concentration easier, but requiring additional interaction. It is increasingly important to find visualizations that balance these modes of operation and identify which types of visualizations are most efficient from the perspectives of speed, accuracy, and cognitive load. Providing users with choice in visualization is valuable, but too much choice will overwhelm.

Our visual and cognitive channels can be overwhelmed with too much data.

User interfaces depend on the level of expertise of the user.

Optimizing visual interfaces in a challenging research question.
νView / μView Plans

- Provide electrode ensemble view
- Allow users to select multiple voxels
- Allow users to expand selected region of VTA (histogram reporting)
- Allow users to save new transfer functions
- Provide clustering from user defined feature vector
- Incorporate prior μView features into suite of visualization tools for both neurostimulation and cardiac simulation investigations
- All issues currently being resolved are available at https://github.com/behollis/DBSViewer/issues
FluoRender Citations

Adam Navis and Michel Bagnat "Loss of cfr function leads to pancreatic destruction in larval zebrafish." Developmental Biology, (2015)


Kazuhiko Takeyama, et al. "In-vivo imaging of the fracture healing in medaka revealed two types of osteoclasts before and after the callus formation by osteoblasts." Developmental biology, Elsevier, (2014)

FluoRender: Confocal Data Analysis and Vis

Multi-channel:

Mouse atlas:

Interactive Segmentation
FluoRender Progress
A density profile tool in FluoRender

Analyzing density profile within a cylindrical region
A tool to “drill through” data
A combination of existing functions in FluoRender

• Paint brush – click to create the cylinder
• Ruler tool – automatically created along the cylinder axis for density profiling
FluoRender Progress

Visualization

Density of Mitochondria
FluoRender Progress
A Versatile Tracking System

- Integration of segmentation, graph matching, and manual correction
- Iterative processing – progressive refinement
FluoRender Progress

Segmentation

- Based on the synthetic brainbows
- Computed on GPU using OpenCL
- Each time point of a 4D data set is processed independently
FluoRender Progress

Graph Matching

- Intra-frame graphs for neighborhood information in all time points
- Inter-frame graphs for neighborhood information between adjacent time points
- Can be modified dynamically
- Based on Boost Graph Library
FluoRender Progress
Manual Correction

- Based on existing interactive segmentation functions
- Select, separate, merge, link, and unlink operations
- Can be used with automatic functions or as a standalone tool
FluoRender Progress
Results
FluoRender Progress

Results
NVIDIA Center of Excellence Renewed

The NVIDIA Corporation, the worldwide leader in visual computing technologies has renewed the University of Utah's recognition as a CUDA Center of Excellence, a milestone that marks the continuing of a significant partnership, starting in 2008, between the two organizations.

NVIDIA® CUDA™ technology is an award-winning C-compiler and software development kit (SDK) for developing computing applications on GPUs. Its inclusion in the University of Utah's curriculum is a clear indicator of the ground-swell that parallel computing using a many-core architecture is having on the high-performance computing industry. One of twenty-two centers, the University of Utah was the second school to be recognized as a CUDA Center of Excellence along with the University of Illinois at Urbana-Champaign. Over 50 other schools and universities now include CUDA technology as part of their Computer Science curriculum or in their research.

The center, led by Professors Chris Johnson and Charles Hansen includes the work of several faculty members including:

Dr. Chris Johnson: Uncertainty Visualization
Dr. Chuck Hansen: Visualization

Collaborators

Dr. Martin Berzins: Scalable parallel computing and computational algorithms
Dr. Mike Kirby: Large-scale scientific computing and visualization
Dr. Mary Hall: Performance optimization
Dr. Ross Whitaker: Image Processing and Visualization
Dr. Valerio Pascucci: Extreme data management, analysis and visualization
Dr. Paul Rosen: Software Performance Visualization

FOR IMMEDIATE RELEASE:

NVIDIA RECOGNIZES UNIVERSITY OF UTAH AS A CUDA CENTER OF EXCELLENCE

University of Utah Latest in a Growing List of Exceptional Schools Demonstrating Pioneering Work in Parallel Computing

SANTA CLARA, CA & SALT LAKE CITY, UT — JULY 31, 2008 — NVIDIA Corporation, the worldwide leader in visual computing technologies, and the University of Utah today announced that the university has been recognized as a CUDA Center of Excellence, a milestone that marks the beginning of a significant partnership between the two organizations.