GIfTI: Geometry Data Format for Exchange of Surface-Based Brain Mapping Data

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GIfTI Motivation

- There are numerous surface-based brain mapping software applications.
- Each application has its own data format file format, making exchange of data difficult
- A similar problem with volume data is now largely resolved using the NIfTI volume file format

GIfTI History

- NIfTI - Neuroimaging Informatics Technology Initiative (2002-present)
- NIfTI developed NIfTI volume file format supported by 26 applications (http://www.cma.mgh.harvard.edu/iatr/display.php?spec=nifti-1)
- GIfTI - Geometry Subcommittee of the Neuroimaging Informatics Technology Initiative (2005-present)
- GIfTI - Developed file format for surface-based neuroimaging data
- YOU can start using GIfTI format now!

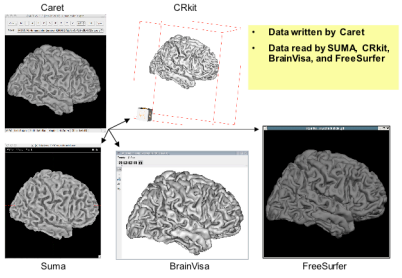
GIfTI File Format Creation

- Committee represented many surface-based applications .
- Examined existing file formats; none met needs .
- Developed format that can represent many types of surface-based data including surfaces, functional data, labels, statistical parameters, structural measurements, and time-series data .
- Data types are identified with NIfTI intent codes .
- Provisions for metadata included; "standard" metadata is defined.
- XML format allows use of many existing XML tools .
- Multiple encodings are supported, allowing tradeoffs between human-readability, speed of file reading, and overall file size .

It Works! Software Supporting GIfTI 1.0 Reading and Writing

- AFNI/SUMA (http://afni.nimh.nih.gov)
- BrainVisa (http://brainvisa.info/)
- Brain Voyager (http://www.brainvoyager.com/, currently write-only)
- Caret (http://brainmap.wustl.edu/resources/caretnew.html)
- CRkit (http://www.crl.med.harvard.edu/)
- Free Surfer (http://surfer.nmr.mgh.harvard.edu/)
- VisTrails (http://www.vistrails.org)

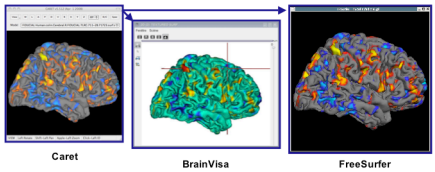
Successful Data Transfer - Geometry



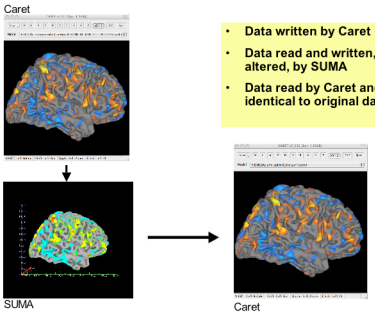
- Data written by Caret
- Data read by SUMA, CRkit, BrainVisa, and FreeSurfer

Successful Data Transfer - fMRI

- Data Written by Caret
- Data Read by BrainVisa and FreeSurfer

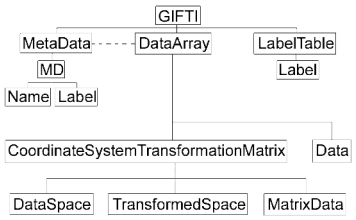


Bi-directional Data Transfer - fMRI



- Data written by Caret
- Data read and written, but not altered, by SUMA
- Data read by Caret and still identical to original data

GIfTI's Simple XML Tag Hierarchy



Example GIfTI File - Surface Geometry

GIfTI Performance

GIfTI files can be smaller and read faster than application-specific file formats

Surface File Format	Time to Read (seconds)	File Size (Megabtyes)
Caret Coord/Topo ASCII	1.26#	10.18
Free Surfer ASCII	0.86#	10.15
GIfTI ASCII	0.71#, 0.29*	13.44
GIfTI Base64	0.26#, 0.07*	6.57
GIfTI GZipBase64	0.24#, 0.09*	3.37
VTK ASCII	8.36#	17.10

- The surface consists of 143,479 nodes and 286,954 triangles
- Timings performed on an Apple Mac Pro with two 2.66 GHz Dual Core Xeon processors and 8GB RAM running Mac OS X 10.5.2
- Timing note: '#' indicates timed with Caret software and '*' indicates timed with the GIfTI C-API

Visit the GIfTI Website: http://www.nitrc.org/projects/gifti

- API's in C and Python
- API for Matlab in development
- Documentation of format
- Example data files
- Message board open to anyone interested

Next Steps for GIfTI Committee

- Continue to refine data specifications
- Use message board to discuss implementation problems
- Consider potential new data types (color tables for labels, color palettes for functional data, DTI tracts, tensor/vector data)
- Publish updates on GIfTI website
- Convene committee periodically to review issues

Conclusions

Reasons software developers should choose GIfTI (and NIfTI)

- Best format for users
- Maximize compatibility with other applications
- Resources (documentation, examples, message board, software API's).

Reasons users should choose GIfTI (and NIfTI)

- Eliminate format conversion when moving data between applications
- Supported by major neuroimaging applications

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