MINC2.0 IO Support for ITK

History:

MINC is a software system for storing and manipulating medical images, originally developed in 1993 by Peter Neelin at the McConnell Brain Imaging Centre. The name MINC is an acronym for Medical Imaging NetCDF. The file format was originally defined as a specialization of the NetCDF (Network Common Data Form) file format created by the Unidata Program Center at UCAR (University Corporation for Atmospheric Research). The NetCDF format, libraries, and tools were created to store generic datasets of arbitrary dimensionality. NetCDF was chosen because it implements many of the functions that were envisioned for the MINC system.

Introduction:

MINC2.0 has been designed to address a few specific problems that had been identified in MINC1.0 (original MINC).

- Limited file size. The NetCDF file format used 32-bit pointers to address objects within the file. This effectively restricted files to a maximum size of 2 gigabytes. With the advent of very high resolution brain atlas data (from macrotome or other sources) and large fMRI datasets, it became clear that this restriction might become a serious problem.
- Restricted data types. The NetCDF format defines a small fixed set of data types - integers, floating point, and ASCII strings. Neither aggregate data (arrays or structures) nor labeled (enumerated) data are supported as fundamental data types in NetCDF.
- Limited storage options. NetCDF files store data in a contiguous array. This inhibits the addition of either block addressable data or internal data compression to the NetCDF format.

Since most of these problems were inherent in the MINC1.0 file format, it was clear that the design of MINC2.0 would require a major revision of the file format. The team developing MINC2.0 chose to replace NetCDF with the HDF5 library to form the basis of the MINC2.0 format. HDF5 provides a number of advanced features which are not available in NetCDF.

This paper describes simple and convenient IO (read/write) access of MINC2.0 files from within ITK framework.

Description:

The pluggable factory pattern of ITK is used (mainly to its simplicity of use) to register the "MINC2ImageIO" written specifically to place MINC2.0 function calls for reading and writing MINC2.0 Images. This IO retrieves all the image information (dimension size, spacing, direction cosines and etc) and transfers them to ITK and further makes a separate call "miget_real_value_hyperslab" to retrieve the actual data (i.e., hyperslab: an N-Dimensional

block of data) which is already scaled from within MINC2.0 (MINC uses the concept of slice scaling, i.e., there is a minimum and maximum values for each slice of data).

The same procedure in reverse order is followed to write a MINC2.0 image. All the image information is retrieved from ITK and written in the image header using the MINC2.0 function calls. The raw image buffer is then passed from ITK to one of the MINC2.0 hyperslab functions "miset_real_value_hyperslsab".

MINC2.0 is added to ITK as an "Advanced" option (default to off) mainly to ensure the smooth build of ITK regardless of the existence of the MINC2.0 libraries. Once this option is turned on, the location of NetCDF, HDF5 and MINC2.0 libraries and headers must be set.

A Test file is also provided which with the following:
- Create a MINC2.0 file from scratch with some random information (Optional).
- Read the MINC2.0 image using the MINC2.0 IO from ITK.
- Perform some basic resampling.
- Write resampled MINC2.0 file using the MINC2.0 IO from ITK.

Further Information:

MINC2.0: http://www.bic.mni.mcgill.ca/software/minc/
HDF5: http://hdf.ncsa.uiuc.edu/HDF5/
NetCDF: http://www.unidata.ucar.edu/software/netcdf/

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