A Framework for Software Interoperability in Brain Imaging Data Analysis

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Neuroimaging research would be nearly impossible without software for image processing and statistical analysis. Unfortunately, researchers are often constrained in their analysis of brain-imaging data because they rely upon tools whose operational particulars they cannot sufficiently control, or because they do not have an appropriate framework for developing tools that suit their particular needs. In order to address these problems, we have developed open-source software that allows a wide array of data-analysis procedures to be used. We have implemented a graphical user interface (GUI) that allows high degree of interoperability among existing and new procedures. We have also developed programming tools that simplify the development of novel methods. These tools have been developed with three groups of users in mind:

- Researchers who want to analyze their data, possibly combining a variety of methods used in the field, but do not have the time or desire to develop their own software and procedures for this purpose.
- Researchers who want to use existing tools but modify or augment them with other methods they aim to develop.
- Researchers seeking to develop novel methods of brain-imaging data analysis.

RumbaGUI is a tool that allows users to incorporate their own programs or software written by other parties in a modular fashion to allow interoperability of software tools. RumbaGUI also has several built-in modules that provide tools for loading, preprocessing, analyzing and displaying data.

The rumba C++ libraries are a collection of classes and methods for writing programs to analyze brain-imaging data. They allow programs to read data in many formats (ANALYZE 7.5, Siemens Vision ima format, Stimulate, MINC, AFNI brik, DICOM). They also provide a number of methods for performing mathematical operations on large space-time data sets. Additionally, they facilitate programming for the UNIX shell with routines that allow programmers to make use of shell-callable code without subjecting themselves to the rigors of C/C++ and UNIX protocols for argument handling and file-management. They are intended to facilitate the development of routines that can be readily incorporated into the rumbaGUI environment, or used as stand-alone methods for preprocessing, analysis, or visualization of neuroimaging data.

Several tools developed by other groups as well as by our own group have been adapted for use in rumbaGUI using a very simple procedure to create “modules”. Users can incorporate these modules into networks graphically, with minimal programming expertise. The rumbaGUI makes it easy to use these and other tools in a modular fashion as parts of a network of connected routines in a data-analysis stream. These tools can also be used without a graphical interface by writing shell scripts or interactively from a UNIX shell.