

C-Y. Hsu¹, C-W. Ko¹, W-D. Lui¹, M. Buechert², and S-Y. Tsai³

¹Dept. of Computer Science and Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan, ²Department of Diagnostic Radiology, Section of Medical Physics, University Hospital Freiburg, Freiburg, Germany, ³Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University, Taipei, Taiwan

Introduction

As the usage of LCModel [1] has become more and more popular, the necessity of a user-friendly interface being able to access LCModel and display analyzed results is arising. McLean et al. [2] set up a system to process and display GE MRSI data within the GE SAGE/IDL package only. Previously we have developed a Graphic-User-Interface (GUI) tool for displaying the 2D/3D MR spectroscopic imaging (MRSI) results quantified by LCModel [3]

In this work we further implemented an user interface to be used via web browsers. Security and authorization issues were carefully maintained by firewall and SSH arrangement. Compared with other connection interfaces, web browser access is superior for its generality, which is more easily accessible and compatible with all kinds of operating systems. In addition, the popularity of the world wide web (WWW) benefits the clinical usage since more users are familiar with web browser. This allows easy access even within labs or hospitals with heterogeneous site setups. And since only a standard web browser is needed this will facilitate the usage of LCModel and the process of MRS/MRSI data set, which will benefit the clinical diagnosis and further studies.

Material and Methods

All scripts of the website were programmed in Expect, CSS, PHP, C++, JavaScript and HTML. The web server is running with Apache server on Linux system (Fedora Core 5). Two-layer security is constructed to ensure the authorization of internet connection. Firstly, this website is protected by firewall so that only authorized remote connectivity is allowed. Secondly, the authority to access LCModel is confirmed by Secure Shell (SSH) with Expect, a TCL-based automation tool for control with interactive responses. This website has been tested with Internet Explorer 6.0+ and FireFox 2.0+. MRS/MRSI data used for test were acquired by a GE 1.5T system using either quadrature or 8-channel phased array coil.

Results and Discussion

This web-based analysis tool can be accessed by conventional browsers, e.g. IE or Firefox. The account and password of LCModel are then required to login. Three main functions of “Explore”, “View” and “Control” are displayed at the top of the main page. The “Explore” function works as a file manager, which means MRS/MRSI data set (“Pfiles” for GE) can be uploaded by this function. The “Control” function, as shown in figure 1(a), displays the complete control parameter setting and can be easily either edited or modified. In the meanwhile, users can load the predefined control profiles and do some minor changes. The instructions of each control parameter will be displayed in the yellow block as the mouse moves to the parameter line. After the analysis by LCModel, the resultant spectra are displayed as shown in figure 1(b). Some basic functions, e.g. file selection, baseline subtraction, concentration table and file saving, are provided in the right column. Additionally, for GE MRSI data set, each spectrum can be viewed in another window by mouse clicking as shown in figure 1(c).

A user-friendly web-based interface for GE MRS/MRSI analysis with LCModel is developed. It not only provides users a convenient approach to access LCModel but also benefits the plug-in development due to the popularity of web scripts, e.g. PHP, Java, and HTML. In our case, for example, some additional scripts have been included to do eddy current correction for each phased array channel individually, rendering a better SNR of combined spectra. Moreover, the tool can be also easily modified for different data format, such as data from Siemens or Philips. Due to the convenience and expansion of this tool, we believe that it will be very helpful and valuable for MRS studies.

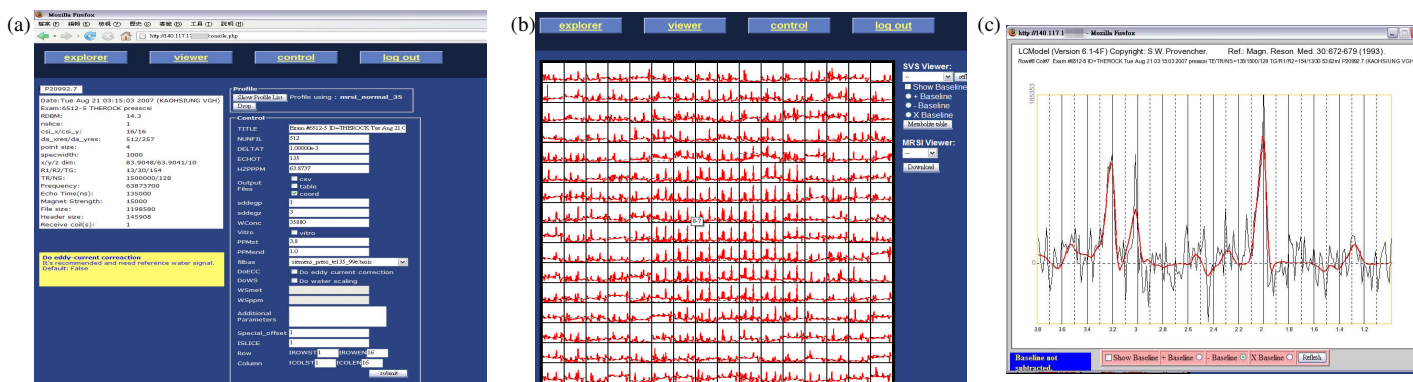


Figure 1. (a) the main window to input control parameters. Header information of Pfiles are displayed in the left column. Users can either reload the predefined control profile or input the setting in the right column. The detailed instruction of each parameter is displayed in the yellow block as the mouse moves. This setting is then submitted to LCModel for spectra analysis. (b) the resultant spectra (GE, 1.5T, 2D MRSI, phased array coil) are displayed either immediately after the analysis is finished or by clicking ‘Viewer’ button. To enlarge the spectra, users can click the voxel and then another window will pop up to show the analyzed result of the selected voxel (c). Some basic functions, e.g. baseline subtraction or concentration table are provided in the bottom.

Reference

[1] S.W. Provencher: Magn Reson Med 30, 672 (1993) [2] M.A. McLean et.al. Magn Reson Med 44, 401 (2000) [3] M.H. Yu et al., ISMRM, 2007.