Web-based, platform-independent dissemination of image reconstruction and RF pulse design algorithms using the Google Chrome Native Client

William A Grissom
Biomedical Engineering and Radiology, Vanderbilt University, Nashville, Tennessee, USA
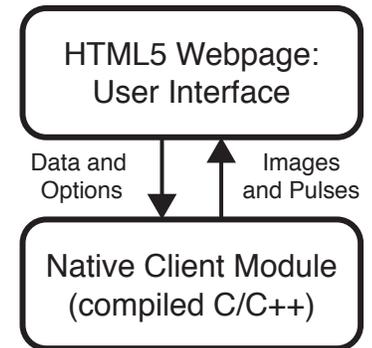
Motivation Dissemination of complex image reconstruction, image processing, and RF pulse design algorithms is complicated by differences between end-users' computers. For example, for MATLAB code the formatting of filesystem paths between Linux/Mac and Windows computers can pose a challenge for file input and output, and for finding functions and files in relative paths. In addition, even with the same operating system users may have conflicting MATLAB function names in their paths as those in disseminated code, or may have different compiler configurations that prevent them from easily compiling disseminated C code. Such difficulties discourage non-experts from using disseminated code, and discourage experts from making fair comparisons between contemporary algorithms.

Approach We introduce a web-based, platform-independent approach to algorithm dissemination based on the Google Chrome web browser's Native Client (NaCl) (Google Inc, Mountain View, CA, USA) [1]. NaCl is a sandbox for running untrusted x86 native code, which runs as a Google Chrome extension and gives web browser-based applications the performance of native applications. A compiled NaCl module is embedded in an HTML webpage and communicates with it using Javascript functions (Fig. 1). Since the module runs entirely inside the web browser, no downloading or installation of software is required, dramatically simplifying the use of disseminated algorithms. It is also possible to distribute an NaCl module and interfacing webpage as a Chrome Web App that can be used offline.

Figure 1: *Shematic view of the interaction between the compiled code in the Native Client module and the user interface, implemented as an HTML webpage.*

We used the NaCl C compiler provided by Google to implement two classic algorithms in image reconstruction and RF pulse design: a gridding reconstruction algorithm (Fig. 2a), and the Shinnar-Le Roux RF pulse design algorithm [2] (Fig. 2b). The gridding reconstructor `http://www.vuiis.vanderbilt.edu/~grissowa/nacl_gridrecon/` reconstructs and displays compiled-in data with a user-specified matrix size. The real and imaginary reconstructed pixel values are returned in text boxes. A future update will enable loading of external data using binary, .csv, or .mat files, as well as downloading of reconstructed images in multiple formats. The SLR pulse designer `http://www.vuiis.vanderbilt.edu/~grissowa/nacl_slr/` allows the user to specify the number of time points in the pulse, the time-bandwidth of the pulse, the pass- and stop-band ripples, the pulse type, and the filter design method. The designed pulse is then plotted for the user, as well as the excitation profile. The real and imaginary pulse samples are returned in two text fields from which the user can cut and paste them into other applications.

Discussion The development of the presented examples required no modifications to the C code of the algorithms themselves; we only had to develop message-passing functions in C to communicate settings and results from and to the webpage. Future work will include the online release of template HTML and C files to enable image reconstruction and RF pulse design algorithm developers to rapidly produce their own webpages with NaCl implementations of their algorithms.

References [1] B Yee et al. In *30th IEEE Symp Sec and Priv*, pages 79–93, 2009. [2] J M Pauly et al. *IEEE TMI*, 10:53–65, 1991.
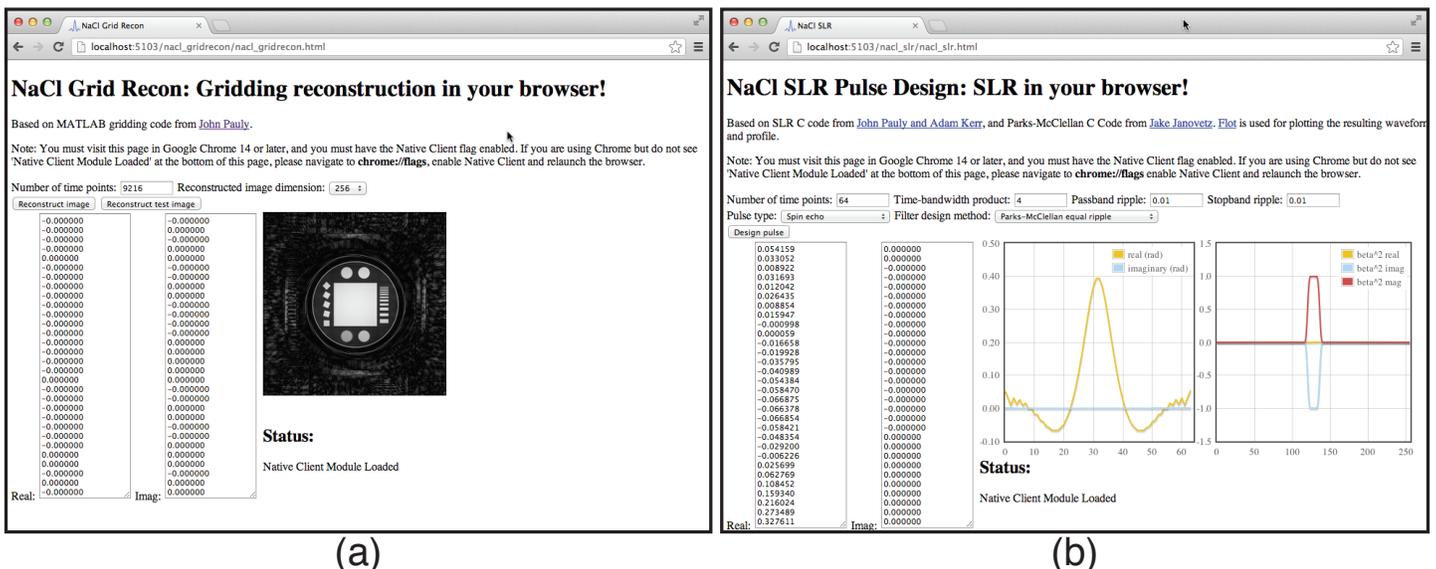
Figure 2: *User interface webpages for (a) image reconstruction and (b) SLR pulse design. The pages can include text fields and dropdown menus to control algorithm parameters, text fields or 'load file' dialogs for loading data. For export of the resulting pulses and images, the pages can include text fields for cut-and-paste, 'save file' dialogs, and plots and images of the results.*