



DEVELOPMENTS IN REMOTE PARTICIPATION IN PLASMA PHYSICS EXPERIMENTS

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Recent growth in the size of plasma experiments and developments in network based software have contributed to a high level of interest in remote participation. Highlights of the recent conference¹ on this subject, and the ensuing "white paper" are presented, with demonstrations of various Data Server/Web/Java based remote access techniques. These not only allow AINSE/AFRG users convenient access to H-1NF data from their home laboratory, but are (or soon will be) available to and from many overseas laboratories with similar systems.

Many large plasma laboratories predict a large increase in remote access in the next two years. Several demonstrations of remote experiment control² have been performed over medium speed networks, and several new experiments are planning on remote access from the beginning. In this paper we consider data access rights and security, access to common documents, and access to processed and raw data.

Data Access Privileges

A spectrum of data access rules exists, from the 6 month data embargo of JET to the sentiment of many at the 1998 workshop to remove artificial barriers and delays to accessing data, replacing those with simple clear formal agreements about consultation *before publication* of data. There was also support for the principle that those given access to data might be expected to put something back into the database, assuming sensible restrictions on overwriting existing data.

Web Data Access

The simplest form of data access is through web "forms", which are submitted to a web server, and by means of a cgi script running a local program, produce a response in the form of numeric, tabulated data, or graphically in the form of an image (e.g. GIF) file. An example of this is the Gourdon/Heliac code puncture plot viewer.

Alternatively, (a reduced set of) "raw data" may be returned to the viewer, to be displayed by a program running on the viewer at the remote site, typically in Java code. This may take longer to transmit than a compressed image, but more interactive manipulation is possible, without returning to the data server. The Java language facilitates high level graphical display, and intuitive point and click controls with quite simple coding by virtue of the inheritance and defaulting features of object-oriented languages³.

The user does not need to program, install nor even update the code, as it is downloaded automatically at the beginning of the browsing session. Although interpreted, the Java code is efficient (thread and network classes are native, operations on whole arrays at once: v1.1), concise (no allocation, deallocation), secure, and platform independent. Plotting speeds of thousands of points per second are typical of Netscape 3 running on an Alpha workstation, even without native array classes. The resulting programming sophistication allows optimizations which may run faster than simpler compiled code.⁴ Another programming simplification is that the data access code (running on the server) requires very little modification: most changes affect only the Java code.

The ultimate extension of this is that the server becomes simply a raw data server. Stillerman⁵ has implemented a direct **TCP data server** with a simple access protocol which serves as a **common data interface** for different experiments on different continents running different

data systems. In this case, IDL was used as the viewer application, demonstrating how such a simple interface readily allows viewing software from one laboratory to access data from another. Although this data access method is independent of the web, it is readily integrated into it, and would benefit from access through a web page, which could make the details of addressing transparent to the user, and provide access to documentation, and machine readable dictionaries to translate diagnostic naming conventions from one data system to another. This level of interface is appropriate for analysis at any level, in contrast to Java access, which is more appropriate for viewing and simple analysis, such as smoothing, spectral analysis or downloading data into a spreadsheet.

X-Windows, VNC

X windows is the environment used internally in most large plasma research laboratories⁶, and therefore offers the widest range of access and analysis possibilities. Access requires local accounts and passwords, and may require firewall security exemptions when accessed remotely⁷. The “Virtual Network Computer” software⁸ overcomes most of these problems by running a server local to the data system, and viewing over the Web using standard Java-enabled browser technology. Native viewers for PCs and Macintoshes are also available, cut and paste more conveniently, and run faster in some cases. Two users, at separate web locations, can connect to their keyboards and mice to the same screen if a password is shared, in such a way that a new user can be guided when learning how to use the system. A local account is still needed for occasionally re-starting the desktop session, but only at telnet level. VNC is also useful when X-Windows applications, running at large distances (e.g. latencies of ~ 1 second) make frequent queries about display parameters, such as when displaying many small windows or buttons⁹.

Electronic Logbooks

In order to make sense of the raw data available, explanatory information must be provided. Basic information is readily supplied on Web pages (e.g. [H-1NF¹⁰](#)), but the need for access to detailed logs, and for collaborators to share information, leads to the concept of *Groupware*. Many options exist, both in the public domain and commercial. Several European Laboratories are considering the BSCW system (Basic Support for Cooperative Work), <http://bscw.gmd.de>. The MIT MDSPlus logbook is organised as a large number of separate text entries in an SQL server database, each with time and author stamps and subject keywords. This information is merged to appear as a continuous stream by an IDL widget program, which also allows the original author to correct and add to entries, and others to create new independent entries by simply placing the cursor on the merged text page. The MIT logbook shares the same database as the machine global data database, making the logbook accessible in the same way as any other machine data.

The H-1NF logbook is a operates under the emacs “info” hypertext subsystem, and provides multiple user access to a distributed set of text files which appear as one file, with context sensitive editing, outline levels, and other smart editing features. In addition to the running

<pre> ; date is automatic \title{Rogowski Run #4: Angular dependence part I} Note: New batteries in rog 33 integrator make all the difference = no lockup 27903,4,5 no rf to check IHel beginverbatim 6 rfdrive 00 - still some rf 7 rfdrive 05 7 rfdrive 10 8 rfdrive 10 </pre>	<p>[processed January 26, 1998]</p> <p>Rogowski Run #4: Angular dependence part I</p> <p>Note: New batteries in rog 33 integrator make all the difference = no lockup 27903,4,5 no rf to check IHel</p> <p>6 rfdrive 00 - still some rf 7 rfdrive 05 8 rfdrive 10</p>
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Fig 1a. H-1NF logbook entries, and draft quality printed output

```

; an IDL line ready to paste – automatically in
; verbatim mode, but here we explicitly set the mode
; anyway
beginverbatim
restore,'ecc$dir:rog797.stp'
stpl,27939,xr=[-10,80],/sav
endverbatim
; simple IDL line produces the graph, caption and
; reference
graph,[0,1,2],' Probe at 45 degrees to B field'
shotscan,dia='j_p',from=27939,to=27962,xdia='rog_0s_r',i
nt=.0615+[0,.014],ps=1,
text
Quite large currents, might be as big as at 0 degrees,
but we don't have results right near the helical

```

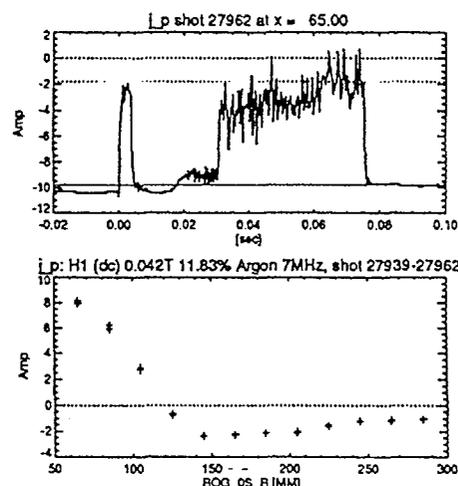


Figure 1: Probe at 45 degrees to B field

```

restore,'ecc$dir : rog797.stp' stpl, 27939, xr =
[-10, 80], /sav
see fig. 1 ( Probe at 45 de...)
Quite large currents, might be as big as at 0 degrees,
but we don't have results right near the helical.

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Fig 1b. H-1NF logbook entries, and graphical output from IDL lines.

commentary normally entered in a log book, many lines are cut and pasted “one-line” IDL commands which can re-create graphs displaying analysed data. These lines are executed by an IDL to LaTeX convertor which creates a draft quality output including the figures generated by those commands, complete with captions and context. The text database so generated is compact, portable, (Macs, PCs, unix) and is text searchable.

Security

Highly secure connections traditionally made via proprietary terminal emulators can be replaced by a *Virtual Private Network*, running on a wide area network with open access, using encrypted packets. However, for most purposes, the ‘*secure shell*’ (ssh) is more than sufficient, and the built-in compression may speed-up transmission to very remote sites. The simplest alternative, Web access, inherently protects the server site and data, and presents no administrative barriers to the collaborator. Data access can be controlled by password if desired, at a lower level of security, because even password holders are prevented at a very low level from writing to or breaking into the server.

Conclusion

Remote access to experimental data is becoming more desirable as experiments grow larger more expensive and fewer in number. Methods or access are developing very rapidly, and many of the software tools are available now. Most of the remote access tools are proving very useful for internal use, and are becoming the standard way of providing information for internal and external use.

Summary of Options for AINSE/AFRG Collaborators

As illustrations of the above, the viewers available on the H-1NF are listed in table 1, with varying cost, complexity level and type of communications used. Three are available now, those marked * under MDSPlus (full installation in February/March.1999).

Table 1: Data access methods for H-1NF

Data Viewing Access Method	advantages	Disadvantages
X-Windows (remote desktop)	Most powerful: access to all existing applications	need a local account, security barriers? (firewalls etc)
TCP/IP data servers *	Very fast local processing, common interface to multiple laboratories.	need remote IDL license, TCPIP stack interface --
VNC server (remote view of local desktop)	- As for X, but Netscape only needed - unrestricted remote access to local X windows - "Dual controls" – "learner/teacher" - faster than X at very distant sites?	Security: a little less secure than a local login account Startup requires local login access
World Wide Web: (applies to cgi/Java)	Very simple, secure, use any browser. No account needed Software is local, automatically updated	
Forms/cgi	Simple, familiar interface	Less interactive – need to re-submit to server to change view of data.
Java Viewers*	Any recent browser (e.g. Netscape 3,4) More powerful, very interactive Fast: only return to server when new data needed.	No advanced data <i>editors</i> yet such as <i>DataPlot</i> ¹¹ which can process data and write it back.

(For consistency, "local" refers to the vicinity of the experiment, "remote" the site accessing the experiment.)

(Note: the extended electronic version of this document: <http://rsphysse.anu.edu.au/~bdb112/h-1nf/remacc.html> is a convenient way to access the web pages in the text and footnotes below, and will contain a reference to the remote collaboration white paper when released.)

¹ Workshop on Remote Participation in Fusion Experiments held at the Czech Technical University in Prague, June 28-29, 1998 (referred to below as **Prague98**)

² T.A.Casper, B.Howard et al. Remote experimental environment: Building a collaboratory for fusion scientific research *Comp. in Phys.*, 12 220-226, (May 1998) <http://www.fusionscience.org/collab/REE/>

³ MIT single window Java Data Viewer (JAVAScope) http://www.pfc.mit.edu/mdsplus/scope/popup_scope.html (see also the code for graphics routines in JAVAScope: A huge file by Java standards, but fairly comprehensible to physicists) <http://www.pfc.mit.edu/mdsplus/classes/Source/Scope/WaveformCanvas.java>

⁴ G. Mandate : The JAVA Environment for Remote Control and Data Display in Nuclear Fusion Experiments (Prague98): also discusses CORBA: Common Object Request Broker Architecture for interfacing object oriented systems such as Java.

⁵ Uniform Data Access for Remote Participation: J. Stillerman, PSFC, MIT, Prague98

⁶ The main internal access method in the RFX lab in Padua is being changed from X-windows to Java/Web access.

⁷ For example, the demonstration of data access for the AINSE 97 plasma conference required a breach of the ANSTO firewall.

⁸ Olivetti Research Laboratories, <http://www.orl.co.uk/vnc/>

⁹ e.g VNC was more effective than a remote X-windows connection in running the MDSPlus Data Tree Traverser across the Pacific.

¹⁰ The H-1NF user information page: <http://rsphysse.anu.edu.au/~bdb112/h-1nf/usinfo.html>

¹¹ The DataPlot IDL Widget Application, an extensible data viewing and editing Point and Click application designed to view large quantities of data, optionally in subgroups. <mailto://John.Howard@anu.edu.au/>