JLABGEO : A NEW SURVEY AND ALIGNMENT DATA MANAGER*

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1. Abstract

The Survey and Alignment group at Thomas Jefferson National Accelerator Facility has relied upon the *MS-Dos* program *Geonet*[1] , originally developed at Stanford Linear Accelerator, as its central data manager. With the Lab decision to only use Microsoft Windows NT as the platform for PCs, limitations were reached in using *Geonet.* A program has been developed at Jefferson Lab, *JLabGeo* to mimic as many of the *Geonet* functions as possible, while also expanding and enhancing its capabilities. All of the adjustment programs, originally developed by Dr. Ingolf Burstedde, have been revised in order to work with arrays of any size, and operate as console applications in the NT environment. Integrating the use of a central fileserver as both the source of the executable programs and data files also ensures that all workstations are using the most recent data. Work continues on developing JLabGeo, notably the integration of all of our survey data types into a easily retrievable database, and the development of a central repository for beamline information and ideal coordinates.

2. Introduction

From the inception of the group in 1990, *Geonet* had been used for uploading of field information, reductions of data, adjustment of observations and coordinate storage. As hardware and software advanced *Geonet's* operations could be conducted in a *MS-Dos* window while running Windows for Workgroups or Windows 95. However, if any adjustments were to be done, one had to reboot and restart the computer in *MS-Dos*. This was a handicap as it did not allow for multitasking, or access to the lab's network server. Data was also being stored on individual machines. As more members of our group started data handling and processing, the need for a centralized data source was imperative.

In addition, due to increased security concerns throughout Jefferson Lab, a 1997 decision mandated that Windows NT would be the only lab supported operating system. At that time our group was linked via a local Windows 95 peer-to-peer network structure. Access to the lab's computer resources was achieved by a telnet client and backup of data was accomplished by tape on local machines. Data files would occasionally be stored incorrectly, and this would result in delays in both processing and managing.

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With the advent of Windows NT, it was discovered that none of the original adjustment programs that were part of the *Geonet* package would run even in a separate *MS-Dos* environment. In addition, the group had started using the Hewlett Packard HP200LX palmtop computers for data collectors for a majority of our field programs. The existing upload program supplied with Geonet would not connect to these units. The decision was made to create a new program that would mimic many of the original Geonet features while running in a Windows NT environment.

3. Software Goals

As with any software task, a strong set of specific goals help define the scope of the project. There were many desirable features and upgrades that were identified, however, a decision was made to incorporate as many easily modifiable programs as possible and keep the writing of new code to a minimum at this stage. Some of the original goals are outlined here.

- Mimic Geonet's existing adjustment, reduction and operational features
- Allow easy customization to any of the existing packages or add additional features
- Incorporate other software / calculations into the package
- Allow storage of all data and software across a network to ensure that the most recent copies of all are being used
- Allow data to be uploaded from multiple data collector systems.

4. Methodology

4.1 New Interface

As stated, a goal of JLabGeo was to mimic the original Geonet as much as possible, while creating a new graphical interface. The interface has been designed in the same fashion as the original, except that a mouse is used rather than entering a number to execute the functions.

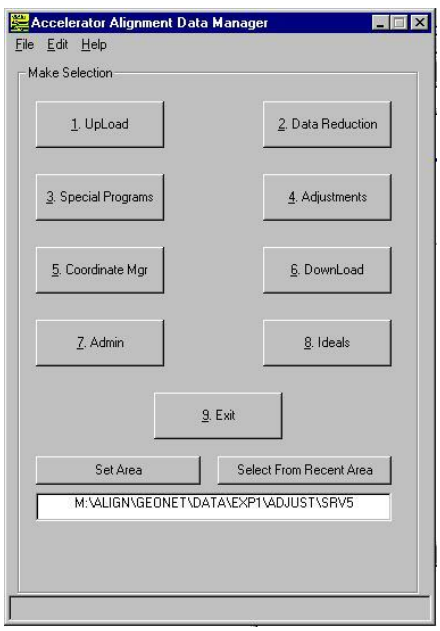

Figure 1 – JLabGeo Main Menu

One new feature of the program is that a work area must be declared for most of the functions. This can be selected from a list of recent files or the user can select a new area by a drill down series of menus. Additionally, non-standard directories can be chosen as an working option, providing that the directory tree structure remains the same. This allows offline work for simulations, development work or other situations. The work areas still use the same data structure as the original *Geonet* with a slight modification in that they do not start on the root directory. Another feature is removal of the limit of 16 maximum directories. A successful test which created 200 directories was performed to mimic our largest possible needs.

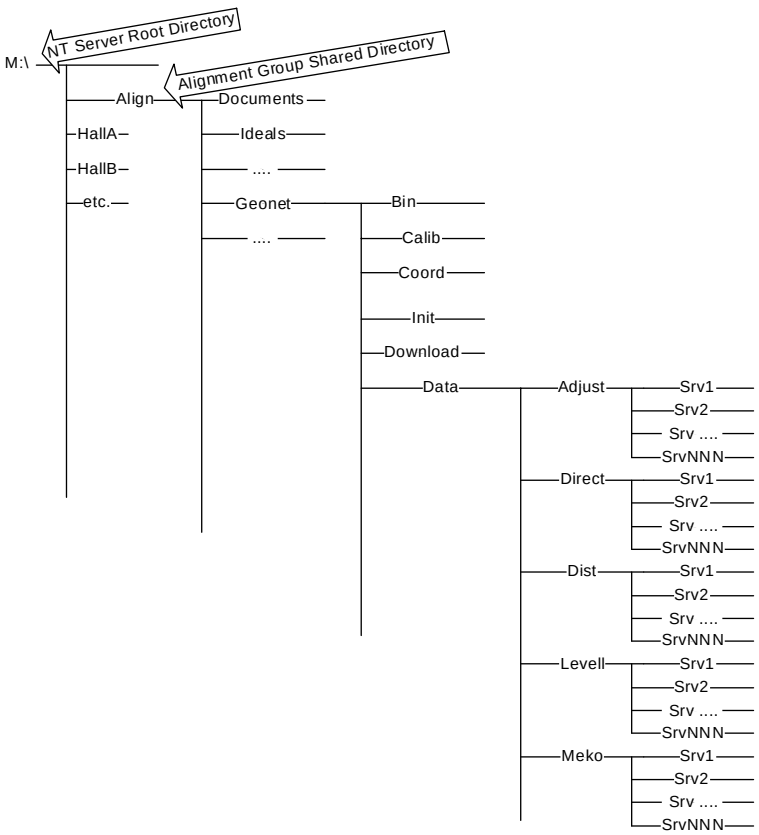

Figure 2 – JLabGeo Directory Structure

All of the various graphical interfaces have been built using Borland's C++ Builder Version 3[2], Microsoft's Visual Basic Version 6[3] and Microsoft's Visual C++ Version 5[3].

A initialization file must exist on every computer that is running the software package. This file, *JLabGeo.ini* is stored in the Windows main directory. It contains all information concerning what are the pertinent directories, reduction files, special optional programs, adjustment packages, and administration packages available. This is a highly customizable file, and options can be added or deleted as necessary. Most of the following options have a reserved space in the initialization file available for adding entries, which eliminates the need to modify the driver program.

4.2 Upload

The upload program is entirely new. It allows a HP-200LX to be connected to a NT server, select files for uploading, edit the files and save them to the appropriate work area. An option also allows for uploading from floppy or network drives.

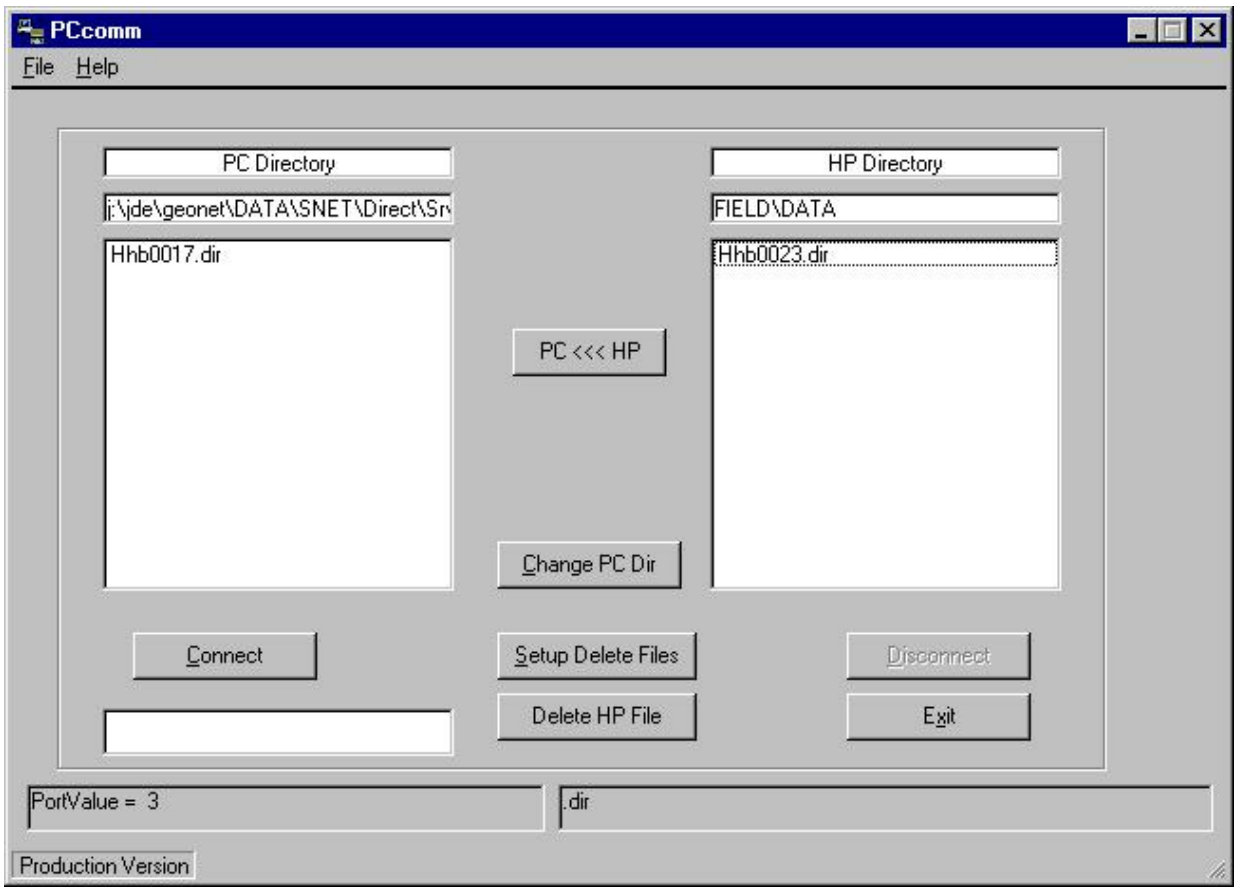

Figure 3 – Upload Main Menu

Unfortunately, as of this date, Hewlett Packard has decided to discontinue the HP200. The group is looking at using Windows CE Palmtop as a replacement and some preliminary work has been done on communications with our various surveying instruments.

4.3 Data Reduction

All of the original *Geonet* reduction programs were written and compiled using Microsoft C 6.0[3] or Microsoft FORTRAN 5.0[3]. The programs were operational in the Windows NT environment, but again had to be run as a *MS-Dos* program. This set of programs was slightly modified and recompiled to operate as 32 bit console applications, using Borland's C++ Version 5.02[2] and Microsoft's PowerStation FORTRAN 4.0[3] compilers. The majority of the modifications to these programs were to screen outputs.

One problem left to be resolved, is that one must wait for the completion of a console application prior to executing or continuing in another program. The method employed in this

version of the software is to force the user to answer a message box, indicating that the program has finished, then processing can continue in the driver program.

4.4 Special Programs

This section is a collection of miscellaneous programs. Currently, our group has 9 options and this list can be added to or removed, just by editing the *JLabGeo.INI* file.

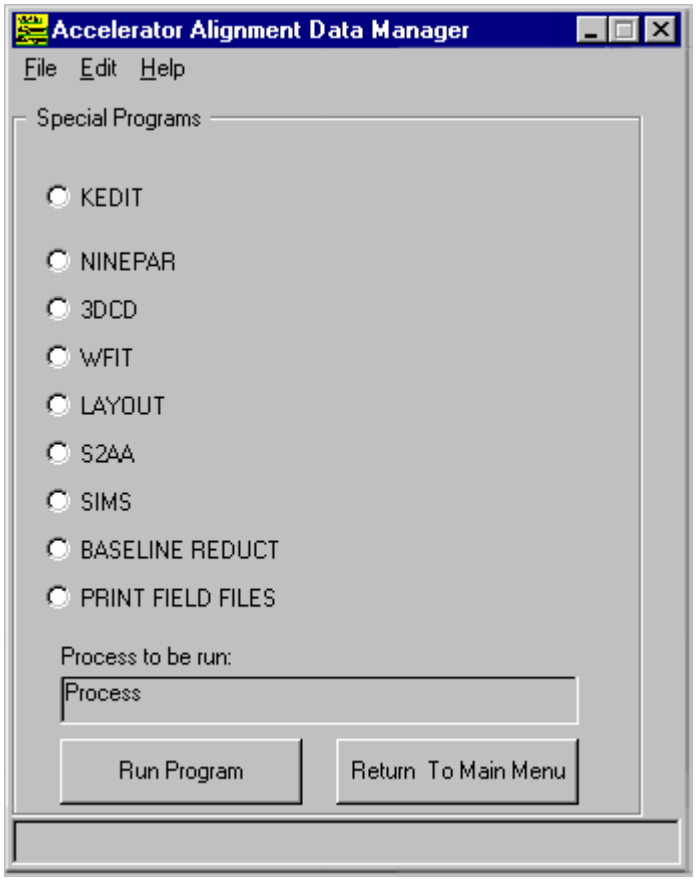

Figure 4 – Special Programs Main Options

The user can select any of the options shown in figure 4 and the main program then passes control to the called routine.

4.5 Adjustment Software

Dr. Ingolf Burstedde wrote the original adjustment software, in the 1980's. The various programs perform 1d and 2d adjustments, using either constrained conditions, free net conditions or error propagation. All adjustment programs were originally compiled using NDP FORTRAN[4] combined with Phar-Lap's[5] *dos* extender. The *dos* extender allowed memory above the 640 kilobyte limitation of *MS-Dos* to be accessed, which was required to perform adjustments of any size. As long as one was working in a complete *MS-Dos* environment, this would work. Windows NT uses a different memory model and would not work with this *dos* extender, hence the programs would not execute in our new environment.

A new version of the NDP compiler, NDP FORTRAN NT (Version 4.6.1)[4], was available which allowed compilations to take advantage of the Windows NT memory model. With a minimum of modifications, mostly to screen output of results, all of the libraries (181 subroutines) and each of the main programs were recompiled. At present, the programs are set up with fixed array limitations of 500 network points. The new compiler allows dynamic memory allocation and it is envisioned that eventually these programs will be compiled using this method of memory storage.

A program entitled *Merge32* was written using C++ which allows the creation of the adjustment input files. Options exist for the creation of files for all of the original *Geonet* programs (T2RA / T2RF / T1RA etc), as well as creating 1d, 2d, and 3d inputs for Stanford's *LEGO* adjustment program. An additional option is the ability to take a T2RA or T2RF style input file and use it to create a STAR*NET[5] input file.

4.6 Coordinate Manager

A new program has been created to allow the user to obtain the latest coordinate data from the database. It also manages the administration of database handling updates and point deletions. Printouts, file transfers and searches are also handled through this program.

4.7 Downloads

An existing 16 bit windows program is available from Hewlett Packard entitled Transfile Win200[5]. The program allows the user to connect to a HP200LX, via a serial cable, and allows the PC to act a master over the HP200LX. The HP200 must be running the included *FILER* program in order to communicate with Transfile.

4.8 Administrative Programs

At this time there are only 3 options under this heading, those being the creation of new directories, editing of passwords and editing of the survey directories history files. Additional options can be added by editing the *JLabGeo.Ini* file. These optional programs are created as stand alone routines, which allows the program to be customized as the situations arise, without modifying the original driver.

4.9 Ideal Coordinate Programs

Presently, users have the ability to connect to the network drive to obtain printouts of fiducial data, and geodetic coordinates for individual or groups of elements. This program will eventually be expanded so that historical as-found elements can be recalled, and mechanical and geodetic ideal beamline element locations can be generated. Figure 5 shows the current output from this program.

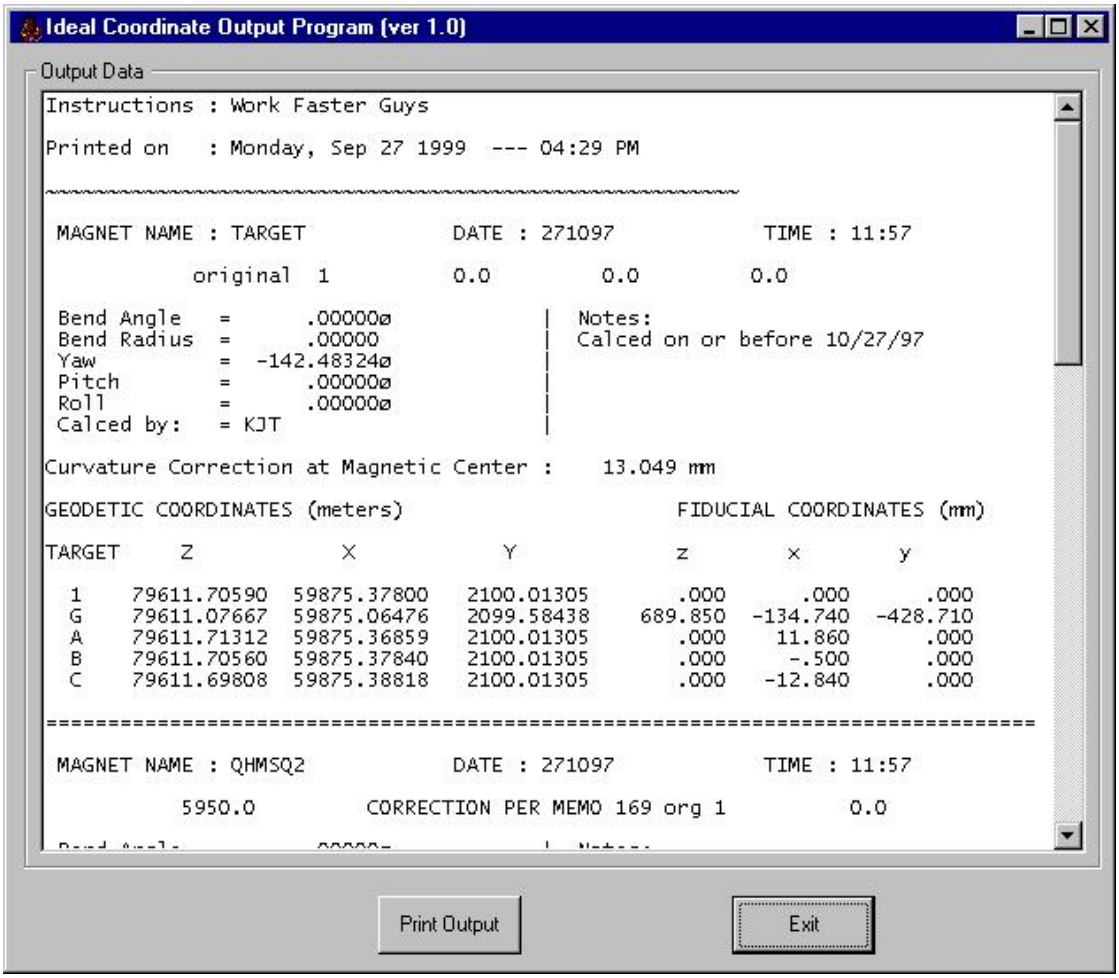

Figure 5 – Ideal Coordinate Output Screen

5. Future Direction

Current development plans include incorporating all of our data types into a retrievable database. Most of our historical records for beamline elements are stored in a structured electronic file system, plus a paper documented record. These files must be retrieved by hunting through to find the appropriate directory, then using a text editor to review the information. Additionally, different alignment techniques are used on specific elements. For example, some of our focusing quads must be aligned using optical tooling, due to poor geometry at that location, while neighbouring elements may be aligned using a separate technique. Therefore, the record data is not centralized due to using these different survey methods.

The goal of this new program will be to unify all of the data types into one system thereby ending some of the confusion that has occurred in the past. Additionally, we are incorporating new field techniques (Leica's AXYZ and a new Faro Portable CMM) into our alignment system which will further complicate the situation.

Plans to incorporate and upgrade our current ideal calculation program exist. The current program works acceptably in a *MS-Dos* environment but new features such as a historical record of element fiducials, and integrating the physics optics data into the program are desired. As shown above in figure 5, a initial field output portion of this program has been developed.

With Hewlett Packard's decision to stop production of the HP200LX palmtop, a decision has been reached that will involve transferring our current field collecting programs to the Windows CE palmtop platform. However, these programs are not in the scope of the JLabGeo program, which will cause some modifications to the upload / download programs at some point in the future.

Eventually, the adjustment programs will be altered to take advantage of dynamic memory allocation. This is a lower priority as our group rarely needs to make an adjustment over the current maximum capacity of 500 points. It is also a relatively simple task to increase the set array size, although the file size increases dramatically. For example, T2RA with declared maximum points set to 500 is approximately 4.1 mega-bytes, while declaring the array size at 1000 the file size becomes 16.3 mega-bytes. Further integration of other adjustment tools is also planned.

6. Conclusion

JLabGeo was originally created to move the program *Geonet* onto the Windows NT platform and take advantage of the labs new centralized server technology. Once development started, it was apparent that many other routines that our group uses in daily data handling could be added as well as new features with little effort. There are many benefits to this new program:

- data is stored on a labwide file server, which is backed up hourly
- all executables are guaranteed to be the current version as they run in a client / server method
- the program is highly customizable by adding options to the JLabGeo.ini file
- adjustment programs are now native 32 bit Windows NT with large array sizes
- productivity is increased by being able to edit input / output files immediately
- ideal data, coordinates and other output that our field crews require can be printed from many machines on site.

Development is continuing on JLabGeo to incorporate all of our survey data handling at the lab.

7. References

[1] Geonet Manual, Stanford Linear Accelerator Center publication SLAC-395, 1992, Stanford CA, USA
[2] Copyright Inprise Corporation, Scotts Valley, CA, USA
[3] Copyright Microsoft Corporation, Redmond, WA, USA
[4] Copyright Microway Inc., Kingston, MA, USA
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