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RAF COMPUTING - OVERVIEW AND STATUS

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DATA PROCESSING.

The RAF Computing Group is currently involved in a project to upgrade the quality of the DAP "quick look" processor to full production quality. The processor's derivation algorithms will be obtained from the same directory of subroutines as the on-board WINDS display system drastically reducing maintenance overhead and quality control problems. Additionally, the user set-up interface will be improved and expanded to allow for easy user configuration for a processing run. The GENPRO will be replaced by the upgraded DAP for production and quick look processing -- they will be the same.

The GENPRO processor will continue to be used for turbulence and low-rate processing until the new DAP is ready to be used for low rate processing. Use of the GENPRO is contingent upon having adequate staff at the RAF to perform maintenance and configuration for processing runs. The pre-mature departure of Celia Chen from the RAF has left the GENPRO in need of modifications and clean-up work before it can be used for processing of up-coming projects such as CAPE and Emmanuel. The work that needs to be performed is inclusion of the new header in the INPUT module; new algorithms for the Honeywell SM IRS; organization of the software in directories and files; improvements to existing UNIX scripts for set-up and running. In this area it is recommended that RAF request that Ron Ruth be reassigned from RDP for a period of six-months.

High rate turbulence processing presents a unique set of problems because of the multitude of phasing errors than can creep into the processing from sources such as asynchronous data streams, analog filters, sampling jitter, clock drift, etc. These errors can become a significant part of the sampling interval at the high rate and therefore can contribute to significant errors in the phenomena we are trying to measure. The phasing errors become less significant when data are averaged to a lower rate. These errors have been significantly reduced in GENPRO processing. To re-write and check-out the software for a new processor will be a time consuming task. We are looking at ways to incorporate the GENPRO modules in the DAP data stream for high rate processing without a total rewrite of the code. Much of this processing could be put in the on-board ADS system greatly simplifying the post processing but it would require a very large engineering effort and is probably not justifiable at this time.

IRS INTEGRATION.

The new Honeywell SM IRS's have a completely different data bus and sampling structure and different internal software and data outputs. At the one-second rate we can take advantage of the internally computed parameters such as vertical aircraft velocity to simplify processing. However at the high rate we still have to evaluate the systems to determine what the new timing structures are, latency of data, and how are algorithms must be changed to accommodate the new systems. This evaluation effort has been delayed because required modifications to GENPRO and DAP in order to analyze the data have not been accomplished due staff shortages and higher priorities (KOFSE, DAP conversion, etc.). We are expecting to find that higher resolutions, better data handling and higher sampling rates on some parameters will result in cleaner processing at the high and low rates. The vertical high rate channel will require more sophisticated code than the LTN-51, but will give higher resolution.

AIRCRAFT SYSTEMS.

The WINDS display system is on two of the RAF aircraft and will be installed on the Sabreliner this fall. This will complete the phase-out of the HP computers at the RAF. There is still a long list of enhancements that scientists, project managers and technical support persons have requested. The concept of connecting special purpose computers to the aircraft network which would then have access to the data block to perform special analysis in flight has not been explored. This would allow scientists to bring their software (and compatible computers) to a project and do analysis and/or review of data in flight. After the DAP low rate processor is ready, there is the potential for using this software in flight and returning with a processed data tape ready for review. The RAF must decide how much effort and what priorities should go into this area.

NETWORKING AND SYSTEM MAINTENANCE.

Network and computer system management and support have grown to become a formidable task at Jeffco. Obviously the fewer the number of incompatible computers at Jeffco, the more manageable the task is. The Jeffco network is an Ethernet that extends throughout the offices and labs and can be connected to the aircraft on-board systems while they are in the hangar. There are also a large number of serial connections throughout the building that are hooked to a Sequel data switch in the computer room. A high-speed T-1 communications link to the Mesa Lab provides voice and data communications and serves as RAF's gateway to the Internet, Cray YMP, NCAR mass storage, and other networks. The Jeffco network has grown haphazardly around the Masscomp computer and has several dozen p.c.'s, workstations, and

field computers connected to it. Maintaining this computing and communications network requires about .75 to 1.0 FTE and is the responsibility of the Computing Group. In order to improve maintainability and provide adequate on-line disk storage for current and future demands as we move away from computing on the Cray, the Masscomp will need to be replaced with a Unix file and compute server. The current disk storage is inadequate and the Masscomp is difficult to configure as a file server. To take advantage of the power of a modern network with file sharing, the Masscomp should be replaced with a Sun-type file server in FY92.

LIDAR PROCESSING.

Lidar processing remains a concern. The NAILS has only been flown on one project and this was in a up/down looking backscatter mode. The data were analyzed in house using some quickly written color display programs. The data were not disseminated outside of the RAF for further analysis by project scientists. In anticipation of doppler lidar data being collected in HaRP, a collaborative effort with RDP was begun to write software for formatting the raw I and Q components in universal radar format to take advantage of existing radar display software and for distribution. This project progressed to the point of needing some real data to continue moving ahead and was suspended when none was forthcoming. Since this time formats have changed and it is not clear what effort would be required to continue on for either backscatter or doppler mode. The RAF and RDP need to review the status of the Lidar data and decide what the requirements are for distribution and analysis software.

NEW DAP FUNCTIONAL CONCEPT AND DESCRIPTION

The goal of the newDAP project is to provide an alternative to and eventually a replacement for the GENPRO data processor. The new processor will use concepts from DAP and GENPRO that have proven to be effective and incorporate new software from the newly designed aircraft WINDS such as the display formats, the library of algorithms, and a similar user interface. The first use of the processor will be for one second averaged data with quality equivalent to that of GENPRO. This software will become our primary processor and there will be no distinction between "quick look" data and "archivable" data as far as the functional software is concerned. In the case of a field project, the project manager will have to decide whether the data are of sufficient quality (i.e., transducer calibrations, transducer performance, etc.) to hand off to the investigators in the field or needs more work at Jeffco.

Future high-rate data processing will be handled by GENPRO

until it can be accommodated in the newDAP. The newDAP will use a GENPRO front end that will perform the filtering, phasing, and interpolation, and then pass the data through to the newDAP derivation algorithms. Separation of the two data streams through the processor will allow the high rate data to be scaled down in two dimensions: fewer variables calculated at the high rate, and a shorter time frame. This will preserve the unique features of GENPRO and eliminate the time consuming and cumbersome changes to the calibration section of GENPRO which will no longer be used.

The overall design philosophy is to implement the newDAP on Unix-based workstations. The programming language will be C. There are other emerging languages with desirable features (e.g. C++) but portability issues and the fact that the project is already well under way with C will probably forbid their use in the near term future. The displays and user interface software will be oriented toward the X window system to the greatest extent possible. Portability versus performance may be an issue in some instances and it may make it necessary to circumvent X in some areas. This is consistent with developments throughout ATD, SCD, and Unidata and is the foundation of the aircraft computation and display system (WINDS). The user will configure the system with a graphical user interface (GUI) similar to the WINDS interface when run from an X terminal or workstation (or PC with an X environment). When running from a non-X environment the user interface will be similar to the old DAP.

Other design considerations are ease of use and flexibility. Ease of use means that the package can be used by non-programmers and derive maximum benefit without the use of extensive off-line training or documentation. Flexibility is the ability to provide a wide range of useful functions and to be able to add new algorithms without extensive changes to the code. Maintainability of a software system this large and diverse is best achieved by tight and efficient control of the code through limited access and a check-in check-out updating and archiving system for the software files. The purpose of this project is not to provide software to a user base so that they can rewrite it for their own specific requirements.

Signal conditioning routines (ie., averaging, interpolation, digital filtering, time shifting, etc.) will be modules accessed by the input routine. Data configuration tables will be used to specify the operations performed on each variable and these can be established by the user via the GUI. Since many (most?) of these operations will not change from project to project, they will be heavily defaulted and not have to be dealt with on every set-up.

The computational section of the input routine will access the AMLIB directory where all of the standard and user algorithms reside. This library of routines is shared between all of the aircraft and ground systems and its integrity will be maintained through tight software control. Dependency tables will be used to establish which input variables are used to derive a given output variable and in what order the calculations must be made to assure always having the most current values. These will be specified by user interaction via the GUI. The AMLIB will be divided into essentially two directories, one for standard RAF maintained algorithms, and one for unverified user algorithms.

Data output will be in internal format on disk for subsequent operations, and an option for GENPRO or netCDF format for distribution. GENPRO format will maintain continuity for previous recipients of RAF data and netCDF will provide a documented and supported (by Unidata) format for user access. Translators to ASCII format can be used for small amounts of data, but this is an extremely inefficient format for distribution of large data and should not be encouraged. Final archivable data sets will be staged to the NCAR mass storage system and entered in a user accessible catalog. RDP will continue to distribute the data sets.

Existing display programs (QLDAP, SCDAP, LSQDAP, etc.) will be retained but with an improved GUI and a new interface to accept the new formats. The WINDS display software will be configured to read processed data in a non-real time mode and used for an interactive data perusal and analysis package. Many, if not all, of the displays created for the on board system will be highly useful for post processing and analysis tasks. The flexibility of the WINDS display should be able to supplant the use of microfilm for quality control and instrumentation trouble shooting. If bulk hardcopy output is still a requirement, graphics metafiles can be generated by QLDAP, the GENPRO plotter, or other specially designed packages and sent to the microfilm device.

The project can be divided into six categories:

1. Basic data processing code
2. Displays for perusal and analysis - postprocessing
3. User interfaces (GUI's, etc.)
4. Data interfaces and formats - internal and external
5. High rate processing interface
6. Definition and implementation of hardware and software environment for use and maintainability.
7. Data mgmt — RDP influences (eg., Empress)
   ↳ includes file mgmt
8. AMLIB verification

transition to WINDS → abuse of X terminals