7.5 UPDATE ON THE HUMAN COMPUTER INTERFACE FOR THE WSR-88D (NEXRAD) OPEN SYSTEMS RADAR PRODUCT GENERATOR (ORPG)

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1. INTRODUCTION

Over the past several years, as part of the Next Generation Weather Radar (NEXRAD) Product Improvement (NPI), a great deal of work has been accomplished rehosting the WSR-88D functionality to an open systems environment (Saffle and Johnson, 1998). The initial phase of the NPI is to replace the current Radar Product Generator (RPG) component with a more portable and expandable version that is open systems compliant (ORPG). Considerable work has already been done in rehosting the RPG (Jain, 1998). This paper focuses on the development of the ORPG Human-Computer Interface (HCI) that will be replacing the existing Unit Control Position (UCP).

The current UCP is a text-based user interface with a well defined command structure. However, from a user perspective, the UCP is difficult to use; especially for the infrequent and untrained user. Priegnitz, et al. (1997) described some of the problems and examples of several solutions. However, at that time, the HCI was in an early stage of development and no formal testing and review of the interface had been conducted.

This past spring, the NEXRAD Operational Support Facility (OSF) began allocating additional resources to the ORPG development effort. Most importantly, OSF personnel began developing test procedures for the HCI components that were in a mature state of development. After a set of test procedures were developed, a small group of users representing the NWS and AWS were brought to Norman to review the procedures and provide feedback regarding the overall HCI design and usability.

This paper describes several of the HCI components which were tested and reviewed along with some of the results and ongoing activities.

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2. IDENTIFYING REQUIREMENTS

Efforts during the early stages of the HCI development were directed at gathering knowledge of the UCP and system requirements. Personnel at the OSF were an important source of information. Considerable knowledge has been amassed by personnel at the OSF regarding all aspects of the UCP and RPG. A GUI UCP design team, comprised mostly of OSF personnel, was formed with each member having a specific area of expertise. These areas included: algorithms and adaptable parameters, user support (hotline), training, RPG system, testing, and human factors. The purpose of the team was to guide the software developers by identifying problem areas in the current UCP and recommend solutions. Discussions of specific problem areas resulted in software prototypes being developed and demonstrated to the GUI team.

An important consideration was to identify which tasks were most important to the user. Several questionnaires were sent out to the NEXRAD user community to gather information on what the most important UCP areas were and what the user's would like to see in the HCI. The results of these questionnaires were mixed and the response weak. Most of the comments concerned what they didn't like about the UCP. Also, it became apparent there was more than one class of UCP user. So the next step was to identify who the users were and what were their needs.

The UCP users can be broken into three primary classes: meteorologists, hydro meteorological technicians, and electronics technicians. In addition, two secondary classes can be added: experienced and unexperienced. It is beyond the scope of this paper to provide any specific details about any one class. However, we will address a few of the most troublesome areas of the UCP and describe our efforts in designing a GUI solution, keeping in mind who the users are.

The following UCP functions were identified as being ideal candidates or the new HCI: Clutter Suppression Regions, PRF Selection, Environmental Winds, Status, and Product Generation/Distribution. Prototypes for all of these have been developed. The prototypes for the first three are more mature and have been reviewed. They will be discussed in more detail in this paper.

3. CLUTTER SUPPRESSION REGIONS

Clutter from non-meteorological targets can be a significant operational problem. It can affect the precipitation detection algorithm and contribute to over- estimates of radar estimated rainfall. There is an RPG requirement to allow the operator to define up to 15 sectors in which different clutter filtering properties can be applied.

In the UCP, the user defines boundaries of each sector by supplying two azimuth angles and two ranges. In addition, the user identifies an "elevation cut" and filter properties for each sector by entering coded information. There are several problems with this interface. One, the user must determine the sector boundary definitions using information from a different interface (i.e., Principle User Processor (PUP)). Second, one must translate a desired filter property into a code. It is very easy to type in an incorrect value. If many sectors are defined, it is very easy to lose track of what the resultant filtering will be. A sample UCP Clutter Suppression Edit screen is presented in Figure 1.

CLUTTER SUPPRESSION REGIONS PAGE 1 OF 2
COMMAND: AD,WXMAN1,CL,C,11,
FEEDBACK: OPER A/R 21
(M)odify, {LINE#} (DE)lete, {LINE#} (DO)wnload
(E)nd (C)ancel

Region	Start Range	Stop Range	Start Azimuth	Stop Azimuth	Elev Seg Number	Operator Sel Code	Channel D	Width S
1	2	510	0	360	1	1	3	2
2	2	510	0	360	2	1	3	2
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Figure 1. Sample UCP Clutter Suppression Regions Edit Screen.

The approach in the HCI is to eliminate the need for the user to have to enter information manually at the keyboard. Inputs are through well-defined menu selections minimizing the need to validate user input. A new approach has been developed in which the user uses a GUI to interactively define sectors over a display of base data by dragging the mouse. This allows the user to visually associate a sector with actual data. In addition, the user doesn't have to know what the sector azimuth and range boundary values are and potentially type in incorrect values at the keyboard. A sample HCI Clutter Suppression Regions sector edit window is presented in Figure 2.

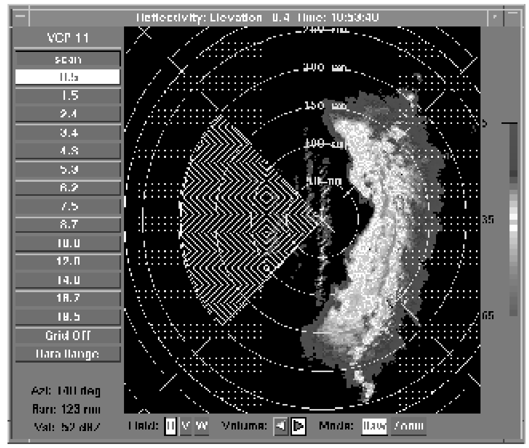

Figure 2. Sample HCI Clutter Suppression Regions sector edit window.

Another feature the HCI provides is a composite display of all defined sectors and filter properties. This allows users to determine which filter property will be used in the event of overlapping sector boundaries. An example is presented in Figure 3.

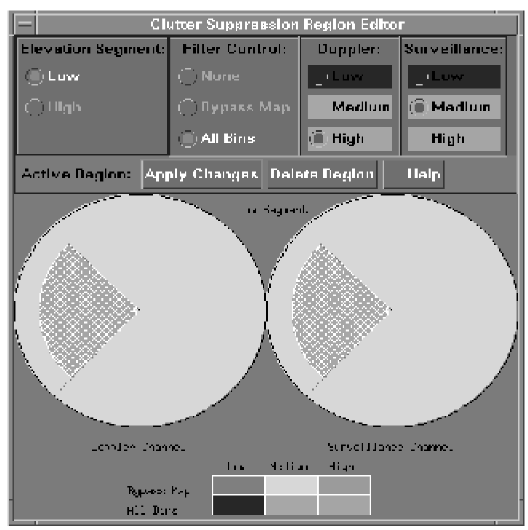

Figure 3. Sample HCI Clutter Suppression Regions clutter map display.

As a whole, the results of the user review of the prototype were favorable. The reviewers liked the idea of using a GUI to interactively define clutter regions over a background display of base data. They liked the simplicity of defining new sectors using the mouse. However, a number of problem areas were uncovered. The primary problem dealt with window management. The prototype used three separate windows for data display and control. Having to switch between different windows was confusing. Work is currently under way to consolidate all clutter suppression regions windows into a single window and remove redundant features.

4. PRF SELECTION

The Auto PRF algorithm uses reflectivity data from the lowest elevation scan to determine a Doppler Pulse Repetition Frequency (PRF) which minimizes the amount of range folded data in velocity and spectrum width products. However, a major problem with this scheme is that it minimizes obscuration for the "whole" scan instead of what may be best for a particular storm. The end result may determine whether a mesocyclone may or may not be detected, for example.

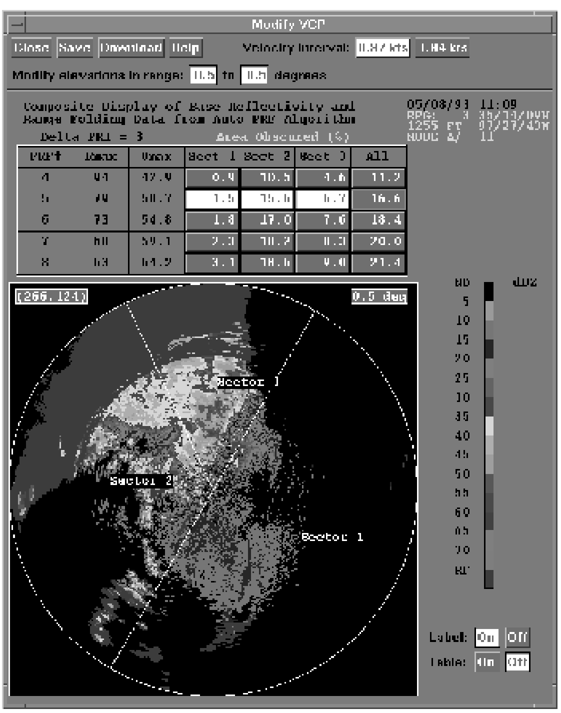

Figure 4. Sample HCI PRF Select window with all sectors set to PRF number 5.

The capability exists in the current system to define a unique PRF for up to three different sectors in any elevation scan. However, this capability is rarely, if ever, performed operationally due to the complexity of the interface and lack of range obscuration information at the different PRFs available to the user.

This problem has been addressed in the HCI. The Auto PRF function now provides the HCI a product containing a composite of base reflectivity and range obscuration data for each PRF. The user can use this information to determine whether an elevation scan should be sectored in order to minimize range obscuration for a particular storm.

Figure 4 shows an example of a range obscuration data product for the PRF chosen by the Auto PRF algorithm to minimize obscuration for the entire elevation scan. Figure 5 shows data for the same scan using a different PRF for a sector bounding a large storm west of the radar. As one can see, important information would have been lost in subsequent velocity products if sectoring was not performed.

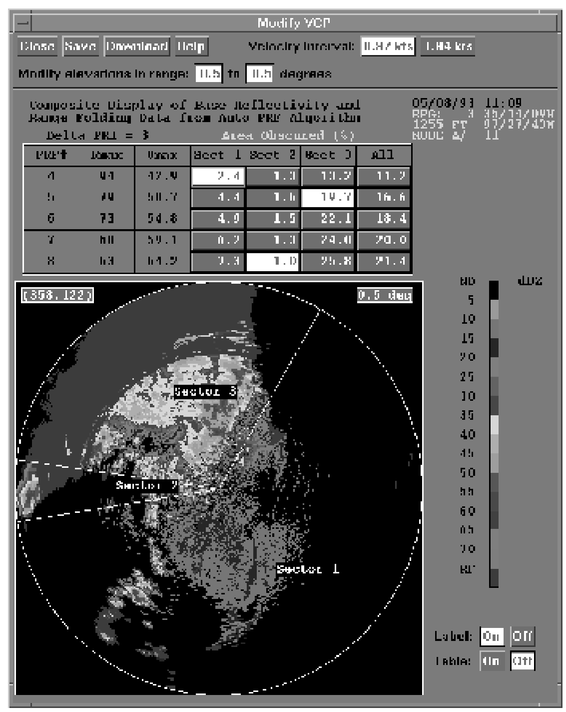

Figure 5. Sample HCI PRF Select window with sector 2 set to a different PRF number.

The reviewers reacted favorably to the PRF selection prototype. Being able to see the obscuration patterns at the different PRFs made it very simple to decide which PRF to use;

something which they cannot do with the UCP. Also, the quickness in which one can define PRF sectors was very important. They no longer have to guess as to what effect changing the PRF will have on the Doppler data. However, most reviewers found the obscuration table to be misleading and unnecessary. The primary reason being, users are more concerned with minimizing obscuration for meteorological phenomenon than geographic sectors. Work is underway to remove this table from the main display and provide this information only on request.

5. ENVIRONMENTAL WINDS

An important source of information to the velocity dealiasing algorithm is the environmental winds table. The environmental winds table contains a vertical profile of wind direction and speed at one thousand foot intervals. Improper wind data in this table could result in improperly unfolded radial winds in radar velocity based products.

The UCP provides a tabular display of the 70 level wind data. Usually, the user must first translate a coded wind message into wind direction, speed, and height. To modify the data at a level or range of levels, the user enters a height and both a wind direction and speed at the keyboard. An example of a UCP environmental winds edit screen is presented in Figure 6.

ENVIRONMENTAL WINDS EDIT SCREEN PAGE 1 OF 5
COMMAND: E,
FEEDBACK:COMMAND EXECUTED - E,A OPER A/R 21
(M)edify, {N} (E)Nd (C)angel (A)to V.D. Update
(U)nits Toggle {m/s vs k's} (I)knotholes Table,(Start level, End level) *
N HOT(kit M.S.L.) MEAN DIR (deg) MEAN S.D.(k's) Auto Update: ON

N	HOT	MEAN DIR	MEAN S.D.	N	HOT	MEAN DIR	MEAN S.D.
1	1.3	270.0	12.0	8	8.3	323.0	63.8
2	2.3	294.8	17.4	9	9.3	324.1	71.9
3	3.3	306.7	24.4	10	10.3	325.0	80.0
4	4.3	313.2	31.9	11	11.3	32767.0	32767.0
5	5.3	317.1	39.8	12	12.3	32767.0	32767.0
6	6.3	319.7	47.7	13	13.3	32767.0	32767.0
7	7.3	321.6	55.7	14	14.3	32767.0	32767.0

NOTE: Start level must be less than or equal to End level. Only integer values are allowed for this command.

Figure 6. Sample UCP Environmental Winds edit screen.

The HCI provides a graphical solution to displaying and editing the environmental winds table. A sample HCI environmental winds edit window is presented in Figure 7. The wind data are displayed in two ways. First, a vertical wind barb profile is displayed in the center of the window. Second, individual graphs of wind direction and speed are displayed on either side of the wind barb profile. Editing the winds at a particular level or range of levels involves modifying the profiles of both wind component profiles. To edit a profile the user moves the cursor over the graph and changes its value by dragging the mouse while the

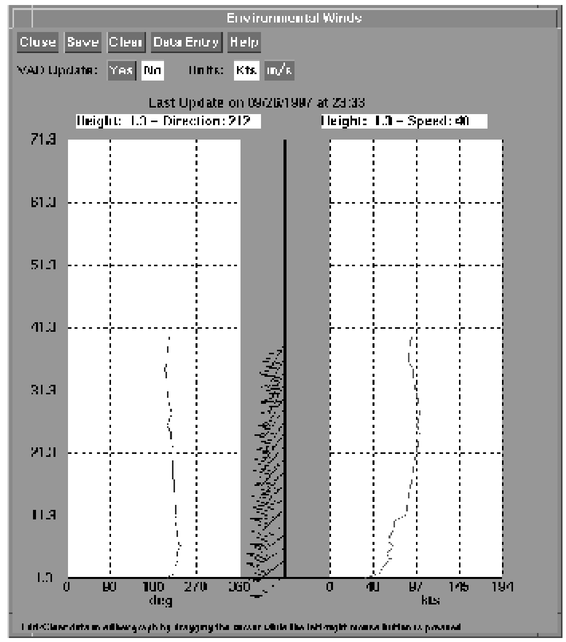

Figure 7. Sample HCI Environmental Winds edit window.

left mouse button is pressed.

A tabular data interface is also supported in which the user can manually enter wind data directly or in a standard significant wind level data format.

Reviewer comments for the environmental winds editor prototype were again favorable. Being able to view the wind data graphically instead of in a table was one of the biggest advantages. Most of the comments were directed at more cosmetic changes to the data display. These included better separation between graphical elements (remove overlap) and changing cursor shape when in edit mode.

6. SUMMARY

Work on the Human Computer Interface (HCI) for the open systems RPG is well under way. As the HCI development has matured, the level of formal testing and user review has increased. It is anticipated that this parallel effort will reduce the number of coding defects and design problems when the software development is completed. Having frequent user reviews during this process will help in ensuring that the HCI will meet user requirements.

7. ACKNOWLEDGEMENTS

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