

8A.2 UPDATE TO THE NATIONAL WEATHER RADAR TESTBED RADAR CONTROL INTERFACE

David. L. Priegnitz⁽¹⁾ and Douglas E. Forsyth⁽²⁾

(1) Cooperative Institute for Mesoscale Meteorological Studies, The University of Oklahoma and NOAA.OAR National Severe Storms Laboratory, Norman Oklahoma

(2) National Severe Storms Laboratory (NSSL)

1. INTRODUCTION

Over the past year a number of improvements have been made to the National Weather Radar Testbed (NWRT) Phased Array Radar (PAR) to support research operations. Improvements have been to both the hardware and the software. This past summer, personnel at the National Severe Storms Laboratory (NSSL) moved to a new facility, the National Weather Center (NWC), located on the south end of the University of Oklahoma campus. Priegnitz and Forsyth (2006) reported on a new software package, the Radar Control Interface (RCI), which was developed to support remote radar operation. Since the physical radar hardware was not moved, the capability to operate the PAR remotely from the NWC was imperative. In this paper we describe the major changes to the RCI to support the aforementioned hardware changes and operations at the old and new facilities.

2. SYSTEM OVERVIEW

From a top level system perspective, the NWRT consists of three major components: a real-time controller, a moment data generator, and a radar control interface. The real-time controller component interfaces directly with the radar hardware controlling the transmitter, pedestal, and antenna. It accepts commands from the radar control interface and outputs time series data to the moment data generator. The moment generator component receives commands from the radar control interface and time series data from the real time controller component, processes the data into spectral moments and outputs them for display. Currently the moment data generator component is also responsible for archiving both the time series and spectral moment

data. The radar control interface acts as the control center for the NWRT. It dispatches commands from the user to other components, collects status and error messages and relays them back to the user. A more detailed description of the NWRT architecture can be found in a paper by Forsyth et al (2005).

A major upgrade was made to the moment data generator component this past year with the Moment data Processor (MP) replacing the Environmental Processor (EP). The MP is functionally similar to the EP but is more flexible and upgradeable. The EP was designed to run on proprietary hardware (UltraSPARC/Sky based system) and was limited in its ability to take on new processing tasks. When it was learned that the Sky hardware would no longer be supported the replacement of the EP became a necessity.

The MP currently runs on a Linux-based multiprocessor Matrix PC system. Its flexible design allows new processor nodes to be added, if needed. It connects to a RAID device capable of storing over 3.5 TB of time series and spectral moment data (replacing the 648 GB RAID on the EP) resulting in an increase in recording capacity to ~120 hours of time series data.

3. RCI

As described by Priegnitz and Forsyth (2006), the Radar Control Interface is a stand-alone multi-threaded Java-based application that directs all activity in the system. It is based on a client-server model with a single RCI server communicating with and controlling all system components, including one or more RCI clients. A single controlling RCI client sends system control commands to the RCI server which then dispatches them to the appropriate components. Other non-controlling RCI clients request status information from the RCI server for system monitoring. The RCI server and client software have been upgraded to reflect the

Corresponding author address: David L. Priegnitz, National Weather Center, Room 4433, 120 David. L. Boren Blvd., Norman, OK 73072
E-mail: David.Priegnitz@noaa.gov

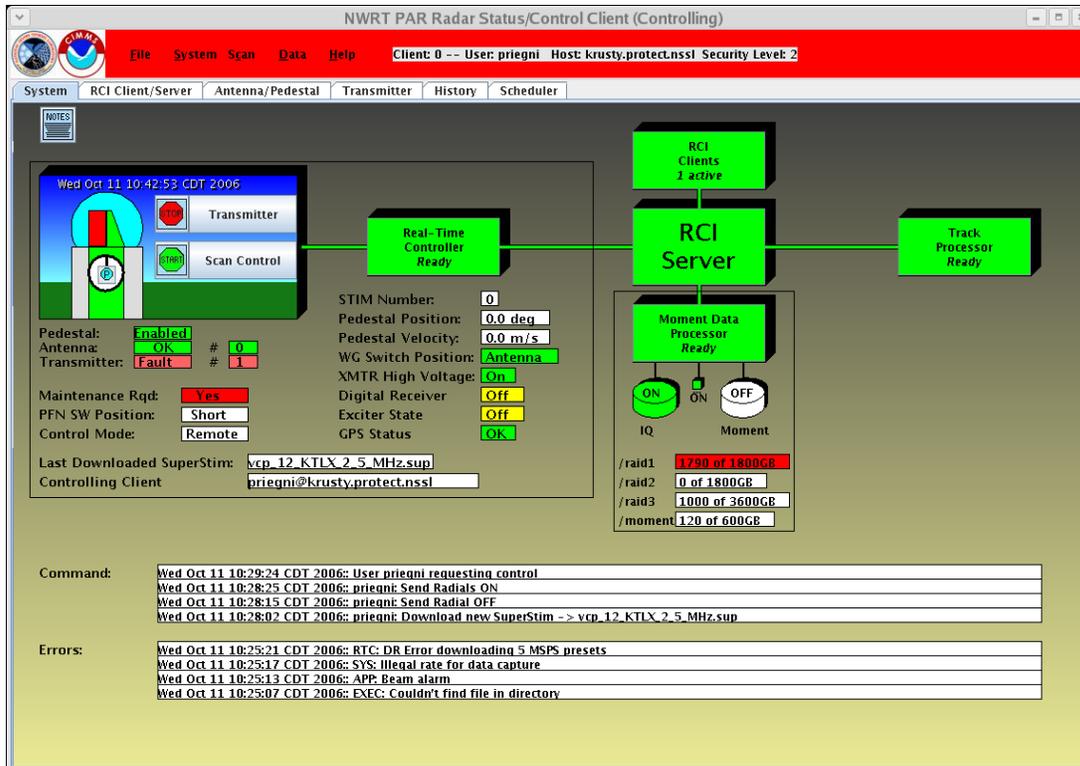


Figure 1. Updated RCI client system display window

new system configuration. An updated RCI client system display window is presented in Figure 1.

The new system display window contains more status information than its predecessor and a number of changes to the system control/status objects. A control/status object is defined as a graphical and/or text item which can be selected by the mouse to perform an action. When the cursor is moved over a control/status object a special text popup window, called a "tooltip" is displayed containing additional information about the function of the object. The system control/status objects can be found in the upper half of the window. Most notable are the selections associated with the antenna/pedestal graphic, the elimination of the IQ Record and EP control/status objects, and the addition of the Moment Data Processor (MP) and Track Processor control/status objects. The Track Processor is an application developed jointly by Basic Commerce & Industries, Inc and the Federal Aviation Administration to track aircraft using PAR time series data. Beneath the MP control/status object is information about whether archiving is active (both time series

and moment) and the status of configured RAID devices.

4. STIMULUS WIZARD

An important aspect in operating the PAR is the ability to develop and implement new scanning strategies. The PAR is controlled by a collection of commands, called "stimuli", which position the pedestal, transmit pulses, etc. Single stimuli define the pulse length (long or short), send a single pulse, send a group of pulses, etc. A sequence of stimuli, referred to as a "stimulus stack" are stored in files called "stimulus files". A special file, called a "super stimulus", contains references to one or more stimulus files, together defining one or more volume scans. The operator, through the RCI, directs predefined super stimulus files to be sent to the RTC. The RTC reads the contents of the stimulus files referenced in the super stimulus and builds a stimulus stack for execution. The RTC executes the stimulus stack upon receipt of a scan start command from the RCI server, currently initiated from the controlling RCI client. The operator has the option of setting a repeat count so multiple volumes can be collected without operator intervention.

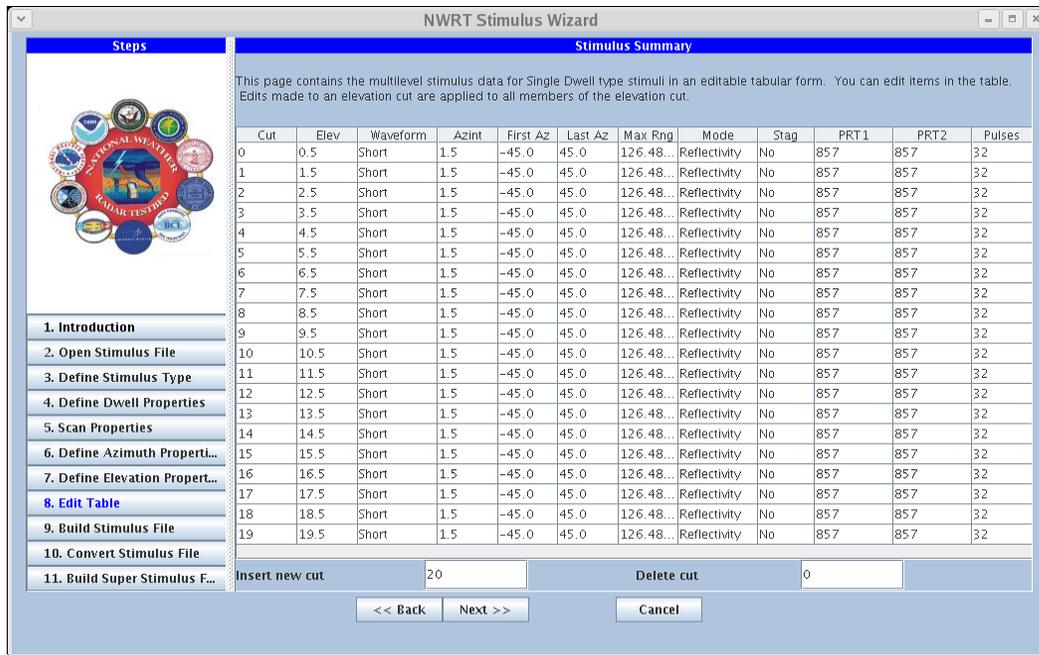


Figure 2. Sample Stimulus Wizard tabular display window

To compliment the RCI package, an application, called the “Stimulus Wizard”, has been developed to simplify the process of building stimulus files. It is a stand-alone Java-based application in which stimulus files can be quickly edited and integrated into the NWRT for execution. A sample NWRT Stimulus Wizard display window is presented in Figure 2.

The Stimulus Wizard is organized into a sequence of steps which reflect a typical stimulus file build process. Each step is defined by a list of menu selections on the left side of the window. When a menu selection is chosen, the region to the right of the list is updated, containing information pertinent to the selected step.

The first step in building a stimulus file is to select a stimulus file for editing. The “Open Stimulus File” menu selection provides choices for selecting an existing stimulus file and writing a brief description about the stimulus. If a stimulus file is not defined, defaults are provided for stimulus type, azimuth sector width, azimuth interval, elevation cuts, pulse repetition time (PRT), etc. In any case, the user should still provide a description about what the stimulus is designed to do.

The next 5 menu selections define general properties for the stimuli contained in the stimulus file. For instance, the “Define Dwell Properties” selection defines the PRT, pulse count, waveform, etc. These values will be used for all beams defined by the stimulus file. Any one of these menu selections can be skipped as long as the user is satisfied with preset defaults.

The “Edit Table” menu selection presents the stimulus file properties in a simple tabular format. Each table element can be edited. This is where the user can “fine tune” the properties of the stimuli. The exact content of the table is dependent on the stimulus type defined in the “Define Stimulus Type” step.

The final menu selections save the stimulus information to one or more file formats. These are: NWRT, LM ASCII, and LM binary. The NWRT file format is a high level text format generalizing, as much as possible, the properties of the stimuli. They are typically much smaller than the other file types. This format is expected by the Stimulus Wizard when selecting an existing stimulus file for editing. The LM ASCII and LM binary file formats explicitly define each stimuli contained in the stimulus stack and are created simultaneously with each being a reflection of the other. One file is in a readable text

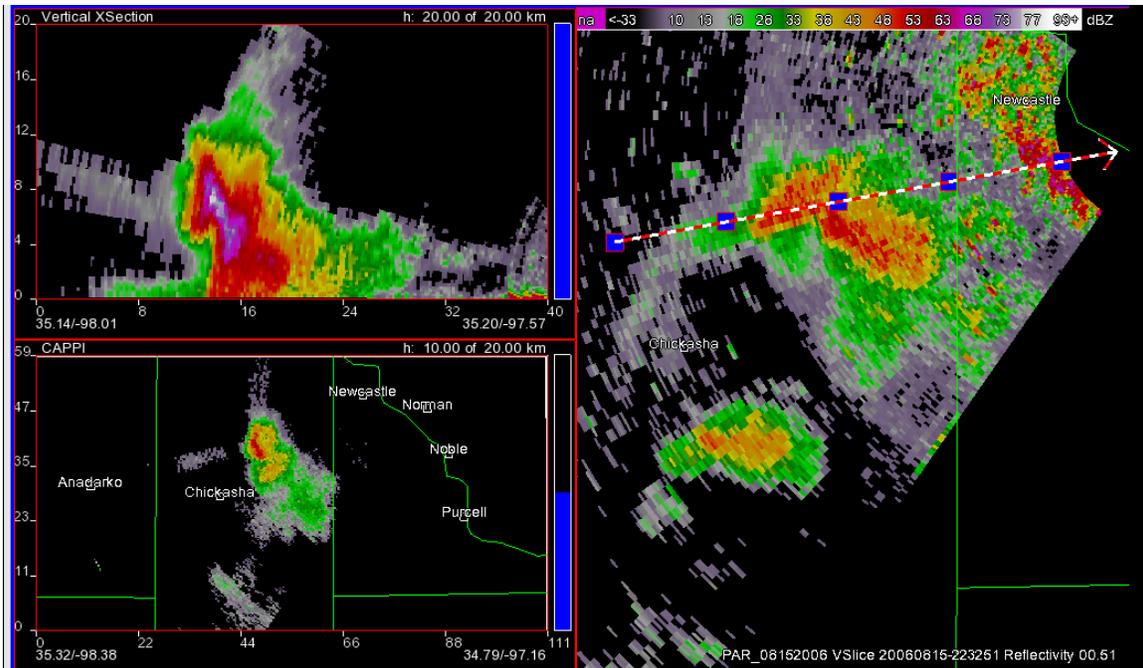


Figure 3. Multiple reflectivity views of a severe storm captured by the NWRT on August 15, 2006. The upper left view is a vertical cross section, the lower left view a 10 km CAPPI, and the right view a 0.5 degree PPI.

format (LM ASCII) and the other in a binary format (LM binary). The LM binary format file is read by the RTC for execution.

5. PAR OPERATIONS SUPPORT

The 2006 spring/summer season across central Oklahoma was atypical with the number of severe weather events well below average. However, a few severe weather events did occur within range of the NWRT which proved useful in testing the updated RCI and stimulus files created by the Stimulus Wizard. On one particular day, May 30th, a variety of severe weather events occurred that required modifications to the stimulus files that were chosen during operations in order to meet scanning objectives. A group of severe multicellular storms developed well north of the radar (> 150km) and merged together (see Heinselman, et al 2006). For comparisons with the Norman WSR-88D radar (KTLX), it was decided to use a VCP12 clone scanning strategy. In order to capture the storm merger process in a timely manner, it was determined that the volume scan time could be reduced from ~58 seconds to ~18 seconds by changing the sector width to 20 degrees. The Stimulus Wizard was used to modify the stimulus file with the editing process taking less than 5 minutes to complete.

Heinselman et al (2006) describe another severe storm that developed on August 15th which required a different scanning strategy (a sample cross section display of this storm is presented in Figure 3). An objective for this day was to keep volume scan times to less than 30 seconds. Since the storm developed relatively close to the radar (~40km), the time objective could not be met using the scanning strategy that was used on May 30th. Since the storm was located close to the PAR, the normal elevation angle limit of 19.5 degrees used by typical WSR-88D scan strategies would be inadequate in scanning the top of the storm. To achieve the spatial and temporal objectives, the Stimulus Wizard was used to add additional elevation cuts (up to 41 degrees) and reduce the PRT (831 μ s) and dwell pulse counts (12), resulting in a volume scan time of ~26 seconds.

These examples demonstrate a major advantage of phased array radar technology in being able to adaptively change scanning strategies based on conditions. In the aforementioned examples, changing the scanning strategy was done manually. In the future, an algorithm could be run that could determine the best scanning strategies and implement them much faster than a human operator.

6. SUMMARY

In this paper we describe some of the major improvements made to the NWRT over the past year. A number of different types of storm events have been captured using new scanning strategies, taking into consideration storm location and type. A new software application, the Stimulus Wizard, has been developed to simplify the work of developing new scanning strategies that are incorporated into the NWRT. It is expected to be integrated into the RCI to simplify the process of editing stimulus stacks during operations and integrating them into the system faster. The concepts incorporated into the Stimulus Wizard could be used by future algorithms needing to modify scanning strategies in real-time. This adaptive scanning capability should provide forecasters with improved information on severe storm detection and evolution, resulting in improved short-term forecasts.

7. ACKNOWLEDGEMENTS

This paper was prepared by David Priegnitz and Douglas Forsyth with funding provided by NOAA/Office of Oceanic and Atmospheric Research under NOAA-University of Oklahoma Cooperative Agreement #NA17RJ1227, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the authors and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce. We would also like to acknowledge the efforts of Chris Curtis and John Thompson in developing the Moment data Processor.

8. REFERENCES

Forsyth, D.E., J.F. Kimpel, D.S. Zrnic, R. Ferek, J.F. Heimer, T. McNellis, J.E. Crain, A.M. Shapiro, R.J. Vogt and W. Benner, 2005: The National Weather Radar Testbed (Phased Array). Preprints, 32nd Conf. Radar Meteor., Albuquerque, NM, Amer. Meteor. Soc., CD-ROM, 12R.3

Heinselman, P., D. Priegnitz, K. Manross and R. Adams, 2006: Comparison of Storm Evolution Characteristics: The NWRT and WSR-88D. Preprints, 23rd Conf. on Severe Local Storms, St.

Louis, MO, Amer. Meteor. Soc., CD-ROM, 14.1

Priegnitz, D. L. and D. E. Forsyth, 2006: The Radar Control Interface for the National Weather Radar Testbed. Preprints, 22nd Int. Conf. on Interactive Information and Processing Systems (IIPS), Atlanta, GA, Amer. Meteor. Soc., CD-ROM, 11.2