P10.10 IMPROVEMENTS TO THE NATIONAL WEATHER RADAR TESTBED RADAR CONTROL INTERFACE

David L. Priegnitz[1], P.L. Heinselman[2], S. M. Torres[1], and R. Adams[1]
[1]Cooperative Institute for Mesoscale Meteorological Studies, The University of Oklahoma
[2]National Severe Storms Laboratory

1. INTRODUCTION

Since early 2004, numerous data sets have been collected using the National Weather Radar Testbed (NWRT) Phased Array Radar (PAR), located in Norman, Oklahoma Forsyth et al (2009). A major advantage of a phased array versus conventional mechanically scanned radar is the ability to quickly switch dwell locations. A major research goal has been to learn more about the temporal and spatial characteristics of weather phenomenon and how this information can be used to improve forecaster detection and warnings (Heinselman et al. 2008). The NWRT PAR is an ideal platform to support this research.

From a user perspective, all radar functions on the NWRT PAR are controlled and monitored by an application called the Radar Control Interface (RCI). The RCI is a Java based application which consists of a single server and one or more clients (Priegnitz et al. 2006, Priegnitz and Forsyth 2007). User commands are directed from the controlling RCI client and then validated and passed by the RCI server to the Real Time Controller (RTC), where they are executed. Output from the RTC (time series data) are sent to the Digital Signal Processor (DSP) where spectral moments are generated. Noise removal, clutter filtering, and other techniques are performed by the DSP.

This paper describes some of the current and planned improvements to the NWRT RCI and discusses the impacts of these in terms of increasing the usability of this unique radar system.

2. SCAN CONTROL AND MONITORING

The primary changes to the RCI since last reported by Priegnitz et al (2007) were in scan control. An important finding by Heinselman et al (2008) was that the spatial resolution and volumetric scan times used today by the WSR-88D are inadequate to capture small scale phenomenon such as microburst's and low-level circulations. The "one size fits all" approach to defining scan strategies has limitations which can hopefully be addressed using phased array radar technology.

2.1. Adaptive Scanning

This past spring, a simple proof-of-concept adaptive algorithm, called Adaptive DSP Algorithm for PAR Timely Scans (ADAPTS), was integrated into the NWRT PAR software. The purpose of this algorithm is to reduce scan time by skipping beam positions where no significant reflectivity is detected. The scan time reduction will be larger when little or no precipitation was occurring and smaller with widespread precipitation. A detailed description of the algorithm can be found Heinselman et al (2009). To summarize here, if the reflectivities along a beam meet certain criteria, the beam position is flagged as "SIGNIFICANT". Beam positions on either side (azimuth and elevation) are flagged as "ON" to allow growth. All other beam positions are flagged as "OFF". "SIGNIFICANT" and "ON" beam positions are considered "active" while "OFF" beam positions are considered "inactive". One requirement for the scanning strategies used by ADAPTS is that they scan in a traditional "PPI" manner. Once processing is completed for an elevation cut a message, containing the elevation angle along with active and inactive beam position flags, is sent to both the RTC and RCI server.

At the RTC, this message is integrated into an internal scan map which reflects all beam positions in the active scan. When a scan is run, the scan map is checked to determine if a particular beam position is active. If it is, then the pulses for that beam position are executed. To ensure the detection of new storm development in regions not adjacent to previously active weather, a periodic reset message is sent by the ADAPTS algorithm to

Corresponding Author address:
David L. Priegnitz
National Weather Center, Room 4433
120 David L. Boren Blvd., Norman, OK 73072
Email: David.Priegnitz@noaa.gov

the RTC turning all beams “ON”. The frequency of this message is determined by the operator. Typically, during recent spring operations, this value was set to 5 minutes.

To allow the operator to monitor the performance of the ADAPTS algorithm, a scan map is also maintained by the RCI server and made available to all clients. A graphical display of this scan map was added to a new RCI client window named “ADAPT”. A sample is presented in Fig. 1. The ADAPTS window can be broken up into two regions. The left quarter of the window contains RTC and ADAPTS status/control information. The rest of the window is used to display the ADAPTS state of each beam position in the scan. Each beam position is represented by a color-coded circle. If the circle is green, then that beam position is flagged as “active; based on significance”. If the circle is orange, the beam position is flagged as “active; based on neighborhood”. If the circle is white, the beam position is inactive. While the scan is running, the current beam position in the RTC command buffer is shown by a red circle.

2.2. Scan Parameters

One other useful feature that was added to the scan control process was the ability to adjust the unambiguous range in real time. This proved very useful to forecasters searching for low-level circulation features that would normally have been obscured by overlaid echoes. The RCI client presented the user with a menu containing range adjustments up to 40 km in increments of 10 km. The RTC applied this value to the long pulse repetition time (PRT) in all batch and split cuts in the scan. A sample velocity display is presented in Fig. 2 illustrating the impact of adjusting the PRT to move the unambiguous range outward 30 km (the adjustment was made during the scan and is clearly defined by the shift in the purple region just west of Lawton). As one can clearly see, using the default PRT would have resulted in the obscuration of the strong radial velocities south of Duncan. Oklahoma mesonet reports indicated surface winds in excess of 30 m s^{-1} at that time.

3. IMPROVED STATUS REPORTING

Torres et al (2009) reported on the signal processing upgrades made to the PAR over the past year. To better support the monitoring of the DSP software a new DSP Status window was created. A sample DSP Status display window is presented in Fig. 3.

There are four main groups of information contained in the DSP Status display: Switches, Devices, Alerts/Info, and Tasks. Each of these groups can be expanded dynamically as needed. The “Switches” group contains objects which are in one of two states: “ON” or “OFF”. The “Devices” group contains objects which represent physical devices such as disk drives. The “Alerts/Info” group contains objects which provide additional information and status about a process. The “Tasks” group contains a list of objects representing all of the main DSP processing tasks. Associated with each processing task are information about the node the task is running on and the tasks state. The state is color coded with green being normal and red indicating a failure.

If any of the items in “Alerts/Info” and “Tasks” groups have failed, the “DSP Status” label in the window tab is red. In this way, users can be alerted to a DSP problem without having to open the DSP Status window.

4. CURRENT PROJECTS

Priegnitz et al (2007) reported on adding table-based scan control to the RCI allowing users to dynamically build a set of scan strategies and modify them in real time. Although this feature wasn't available to users during subsequent data collection efforts, it is now being integrated into the baseline software package for testing this fall and winter, taking advantage of the knowledge learned the past two seasons. This new function will allow operators to change most scan properties in real-time. These will include: adding/removing elevation cuts, adjusting azimuthal spacing, changing PRT's and pulse counts. However, this in itself has limitations as managing multiple scan strategies simultaneously adds another layer of complexity to the user.

To reduce the complexity of scan control to the user, a new automated scan control process is being developed that will dynamically control scanning on the NWRT PAR. Scans will be built based not only on user input, but also algorithm input. Algorithms will be assigned a priority and embedded scans will be possible. Work is being done at the RCI client to provide a “snapshot” of the adaptable scan table.

5. ACKNOWLEDGEMENTS

Support for this paper and research has been 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'd also like to thank Eddie Forren, John Thompson, David Warde, Chris Curtis, and Igor Ivic for their contributions to the research, software design and implementation.

REFERENCES

Forsyth, D. E., J. F. Kimpel, D. S. Zrnic, R. Ferek, J. F. Heimmer, T. McNellis, J. E. Crain, A. M. Shapiro, R. J. Vogt and W. Benner, 2009: Progress Report on the National Weather Radar Testbed (Phased-Array), Preprints, 25th International Conf. on Interactive Information Processing Systems for Meteor., Oceanography, and Hydrology, Phoenix, AZ, Amer, Meteor. Soc., CD-ROM, 8B2

Heinselman, P. L., S. Torres, R. Adams, C. D. Curtis, E. Forren, I. R. Ivic, D. Priegnitz, J. Thompson, and D. A. Warde, 2009: Phased Array Radar Innovative Sensing Experiment, Preprints, 34th Conference on Radar Meteorology, Williamsburg, VA, Amer. Meteor. Soc., P6.5A

Heinselman, P., D. Priegnitz, K. Manross, T. Smith, and R. Adams, 2008: Rapid sampling of severe storms by the National Weather Radar Testbed Phased Array Radar, Wea. Forecasting, 23, 808-824.

Priegnitz, D. L and D. E. Forsyth, 2007: Update to the National Weather Radar Testbed Radar Control Interface, Preprints, 23rd International Conf. of Interactive Information Processing Systems for Meteor., Oceanography, and Hydrology, San Antonio, TX, Amer. Meteor. Soc., CD-ROM, 8A.2

Priegnitz, D. L., P. L. Heinselman and C. D. Curtis, 2007: Dynamic Scanning for the National Weather Radar Testbed, Preprints, 33rd Conference on Radar Meteorology, Cairns, Australia, Amer. Meteor. Soc., CD-ROM, 7.3

Torres, S. M., C. D. Curtis, I. R. Ivic, D. A. Warde, E. Forren, J. Thompson, D. Priegnitz, and R. Adams, 2009: Update on signal processing upgrades for the National Weather Radar Testbed, Preprints, 25th International Conf. on Interactive Information Processing Systems for Meteor., Oceanography, and Hydrology, Phoenix, AZ, Amer. Meteor. Soc., CD-ROM, 8B4

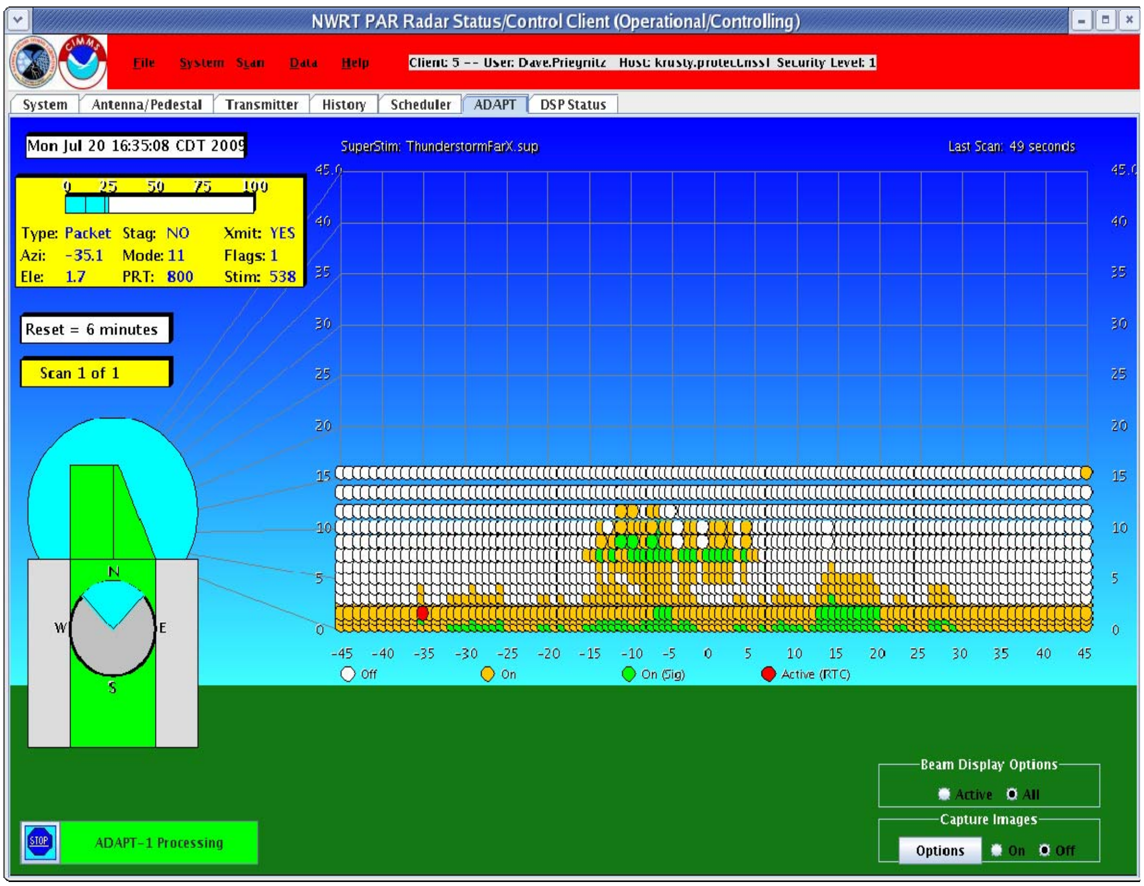

Figure 1: Sample ADAPTS Display

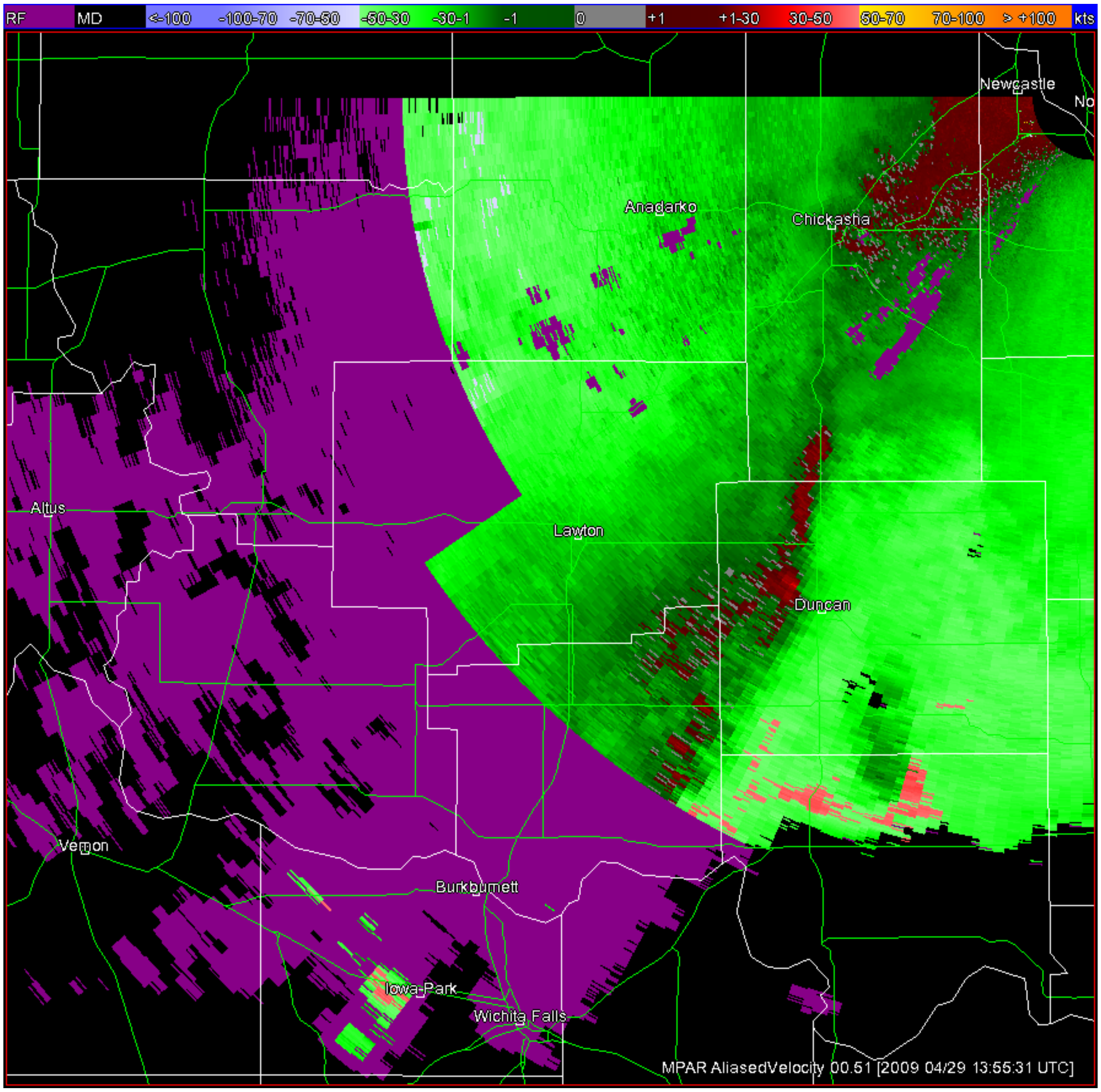

Figure 2: Sample Radial Velocity Display with PRT Adjustment

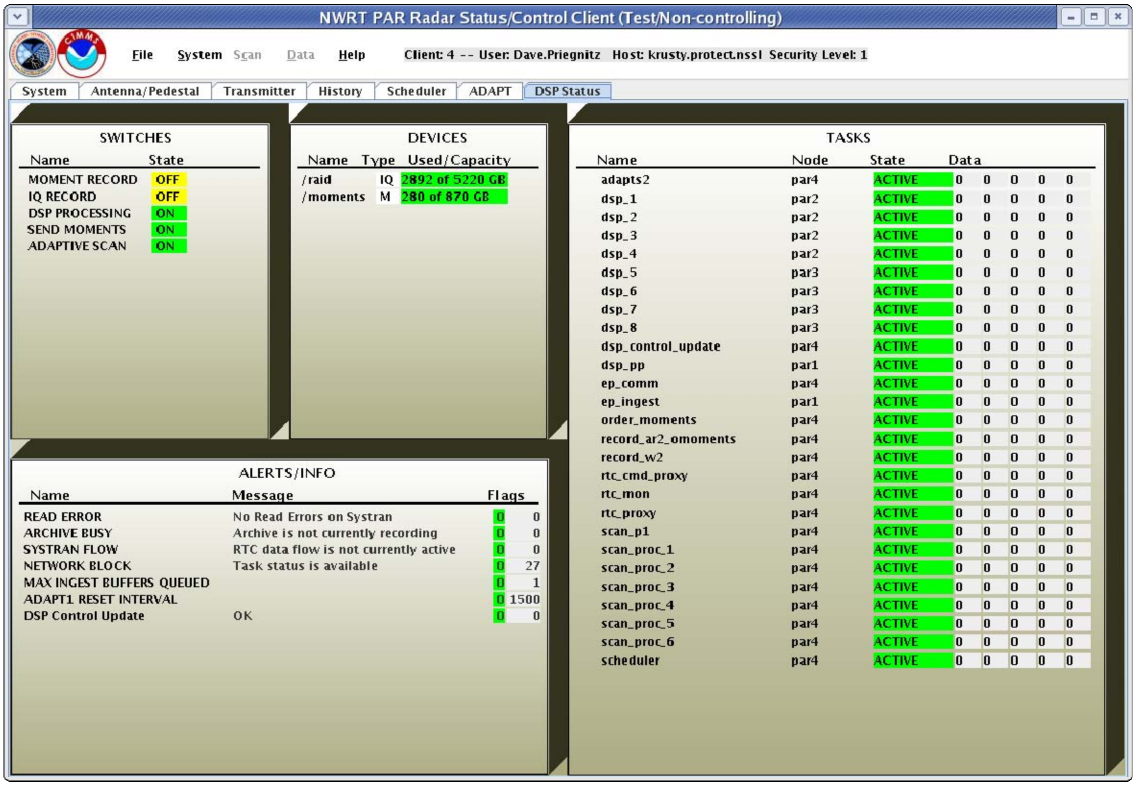

Figure 3: Sample DSP Status Display