Description of the Auto PRT enhancement to the NWRT PAR software

David Priegnitz

As part of the fall 2012 software release for the NWRT PAR a new algorithm has been added to minimize the amount of range folding in a specified region. The region can be as large as the entire 90 degree field of view or as small as the tracking box associated with the weather tracking algorithm. This document describes the algorithm and the user interface changes to support it.

AUTOPRT

The new algorithm, called "AUTOPRT", required enhancements to the EP, RCI server, RCI client, and RTC components. It was developed to support operational environments where weather tracking is active or inactive. In many situations, the short PRT in a split or batch cut is inadequate to resolve radial velocities for a specific weather feature. Precipitation at ranges beyond the range limit of the short PRT obscure the radial velocities inside the "first trip" region. In many situations, increasing the short PRT can allow the velocities for the weather feature to be resolved. Of course there are some trade-offs when increasing the PRT. Most importantly, the Nyquist velocity is decreased. So one needs to be cognizant of this when specifying an upper PRT limit. The algorithm follows the MatLab function "range_unfold.m" written by Chris Curtis.

Inputs and Outputs

AUTOPRT is run as a task on par4. It reads the linear power field "FPW" from the **censored moments** LB, *autoprt_control* messages from the **ep_comm** LB, and writes *autoprt_status* messages to the **rci_comm** LB.

Algorithm Description

When a start-of-volume flag is detected the following action is performed:

1) *Start saving radial power data.*

When the first new elevation cut is detected after the initial cut the following is performed:

1) *Starting with a PRT of 800 and stepping up in increments of 68 (10km) up to the user specified PRT limit*
   a) *build an overlaid map for each short PRT using power data from the long PRT*
   b) *extract the number of overlaid gates for each PRT*
2) B*uild a status message and write to the **rci_comm** LB*

The algorithm constantly checks the **ep_comm** LB for *autoprt_control* messages from the RCI server and processes them immediately. This is done before checking the **censored moments** LB for new power data.

Algorithm Control

Currently there are two commands that control algorithm processing: ON and OFF It is expected that when a control ON message is received, the desired windowing and thresholds are included in the message.

The *autoprt_control* message contains the following information:

1) Command (0 = OFF; 1 = ON)
2) PRT limit (800 <= PRT <= 3200)
3) Sector left azimuth (deg)
4) Sector right azimuth (deg)
5) Sector near range (km)
6) Sector far range (km)
7) Overlay threshold (dB)

Algorithm Status

An *autoprt_status* message is written to the **RCI_comm** LB after an *autoprt_control* message is received and after the obscuration data is computed in each new volume.

The *autoprt_status* message contains the following information:

1) Status (0 = OFF; 1 = ON)
2) PRT limit (800 <= PRT <= 3200): extracted from control message
3) Sector left azimuth (deg)
4) Sector right azimuth (deg)
5) Sector near range (km)
6) Sector far range (km)
7) Overlay threshold (dB)
8) Sector gates (total number of gates inside sector)
9) Number of PRTs (number of PRTs processed by algorithm)
10) PRT[0]; first PRT used in calculation
11) Gates[0]; number of obscured gates for PRT[0]
12) .....
13) PRT[N]; last PRT used in calculation, where N = Number of PRTs
14) Gates[N]; number of obscured gates for PRT[N]

When an *autoprt_status* message is received by the RCI server it immediately becomes available to any RCI clients that request it. In addition, an RTC scan control message, based on the information contained in the *autoprt_status* message, is built and sent to the RTC. If the algorithm status is ON, the PRT corresponding to the fewest obscured gates in the *autoprt_status* message is passed to

the RTC along with a command to enable AUTOPRT at the RTC.

Auto PRT at the RTC

When the RTC receives a *scan_control* message directing it to enable the auto PRT function it sets an internal control flag, extracts the PRT from the message, and computes the maximum range corresponding to the PRT. During stim processing, if the auto PRT flag is set, it does the following to packet dwell stims.

1) If the packet number is 2, check to see if the value for the algorithm PRT is smaller than the PRT value for packet number 1 (assume long PRT is packet number 1 and short PRT is packet number 2 in a split/batch cut)
2) If true, replace the stim PRT with the algorithm PRT.
3) Update the pulse count to preserve dwell time.
4) Update the channel 1 data collection stop range

After this is done, processing continues as before. If ADAPTS is enabled then it will function as it did before.
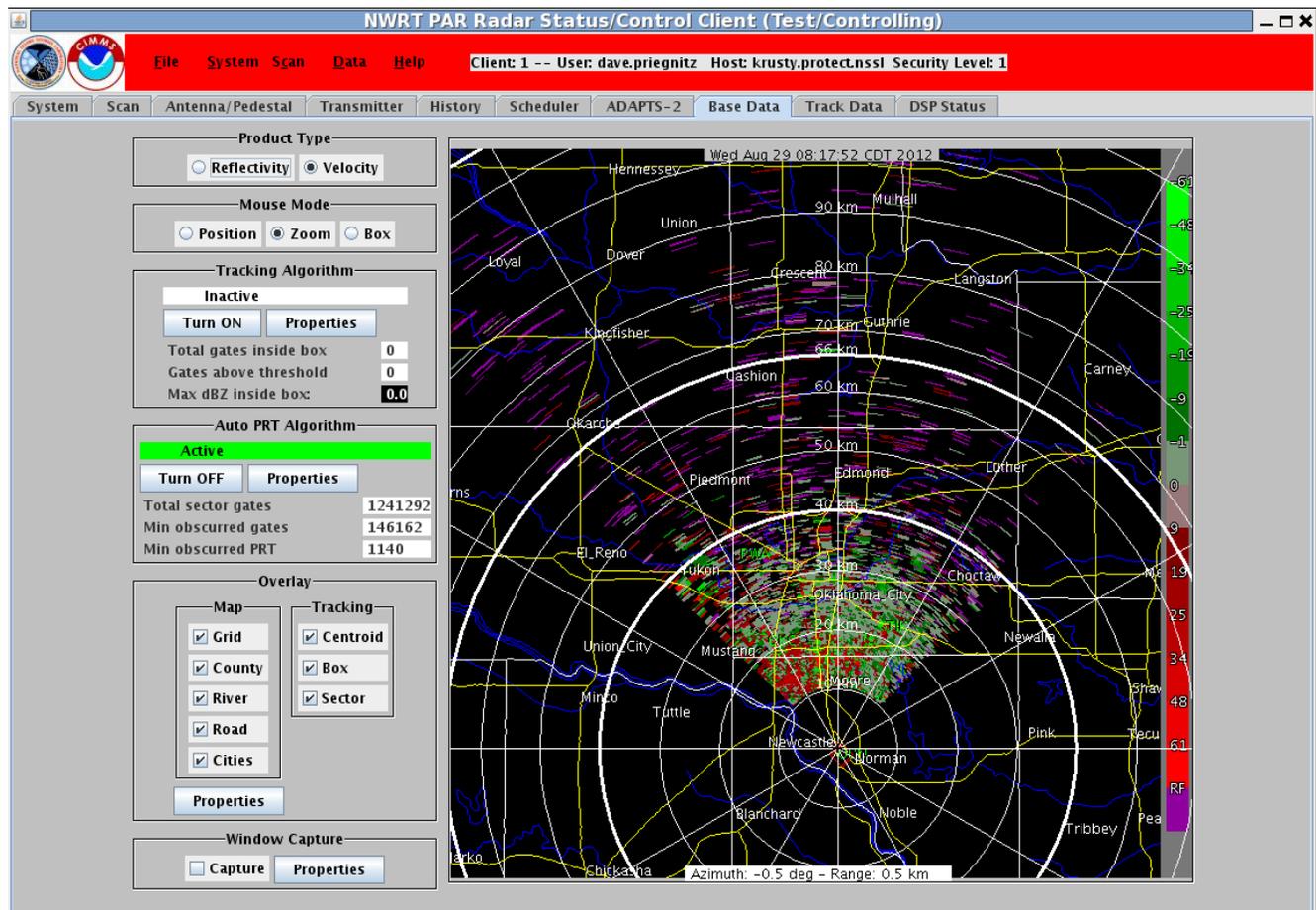
Figure 1: RCI Client Base Data window with Auto PRT Active (Wx Tracking Inactive)

Defining input parameters

The input parameters for AUTOPRT are defined at the controlling RCI client in the Base Data window (Fig 1).   In the left portion of the Base Data window are a group of objects that are associated with the "Auto PRT Algorithm". At the top is a text label that indicates whether the algorithm is "Active" or "Inactive". Below that are selections to turn on auto PRT processing and define algorithm control properties. Selecting the "Properties" button displays the Auto PRT Properties dialog (Fig 2). In the Auto PRT Properties dialog one can define a maximum PRT, minimum Nyquist, and dB threshold. The maximum PRT and minimum Nyquist parameters are tied together so changing one will change the other. The dB threshold defaults to 5 dB and in general one would most likely want to use the default. The "Accept" button applies any changes to the aforementioned parameters.
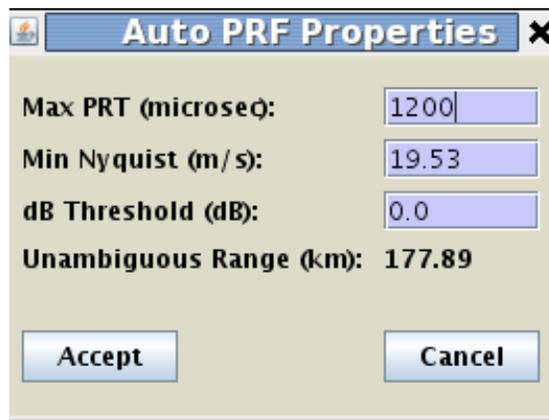
Figure 2: RCI Client Auto PRT Properties Dialog

If AUTOPRT is inactive the control button should be labeled "Turn ON".   When it is active the control button should be labeled "Turn OFF". To enable the AUTOPRT function select the control button when it is labeled "Turn ON". To disable the AUTOPRT function select the control button when it is labeled "Turn OFF".

If the tracking algorithm is active, the tracking box coordinates are passed in the _autoprt_control_ message when turning on AUTOPRT. AUTOPRT will only consider gates inside the tracking box. Whenever the RCI server receives new track box information from the tracking algorithm it passes them to AUTOPRT in a new control message.
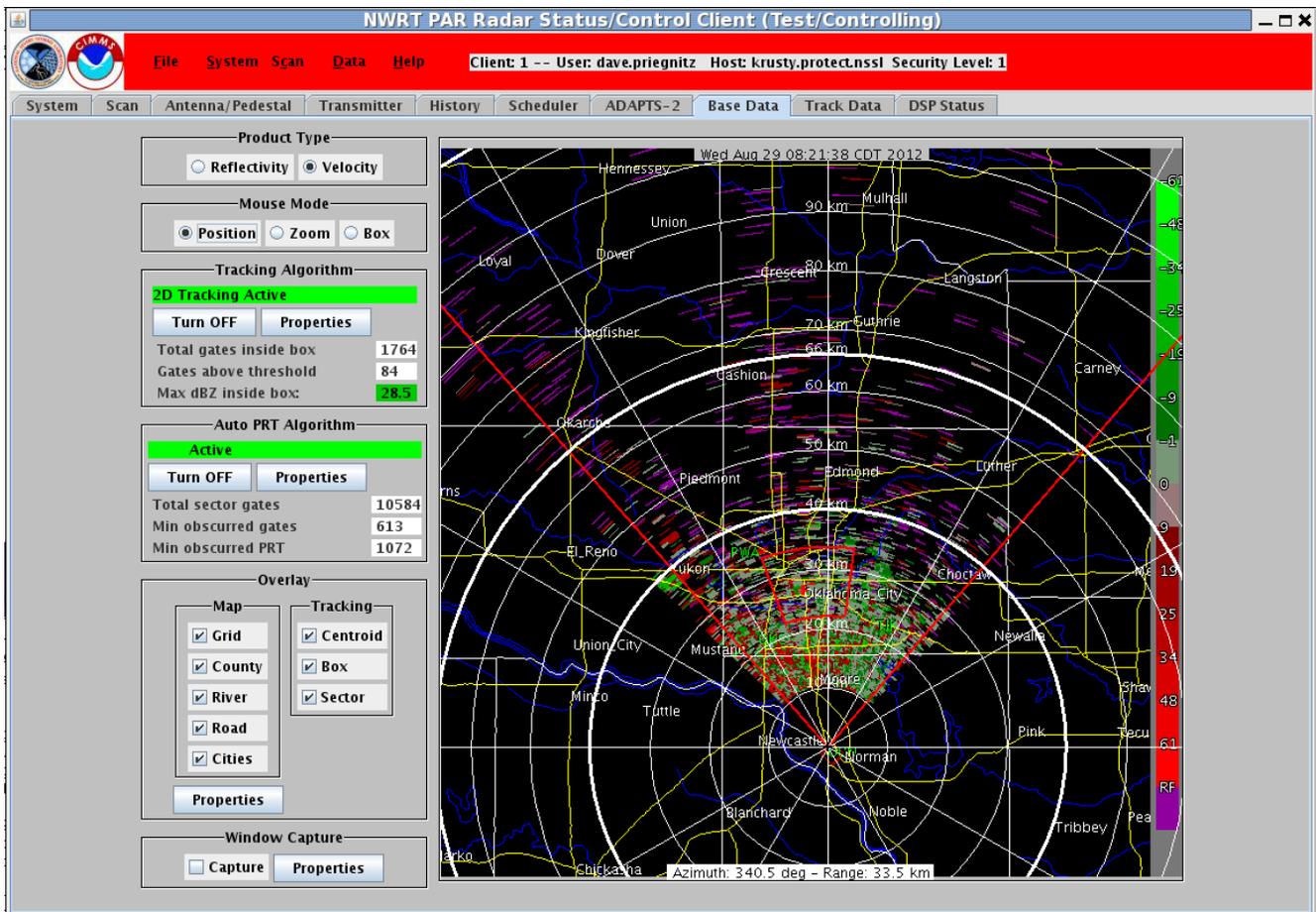
Figure 3: RCI Client Base Data window with Auto PRT Active (Wx Tracking Active)

If the tracking algorithm is inactive the sector coordinates are reset to the entire field of view and all gates are processed by AUTOPRT.

When AUTOPRT is active, the PRT Adjust function in the System window is disabled. The label field for "PRT Adjust" is replaced by "Auto PRT Alg" and status by "Enabled" (Fig 3).

One should note that the status information associated with the wx tracking algorithm has been reduced. It is intended to add another tab to the RCI client dealing with algorithm specific information. This will allow more detailed information for each algorithm to be presented without cluttering higher level displays (ie., Date Data window).
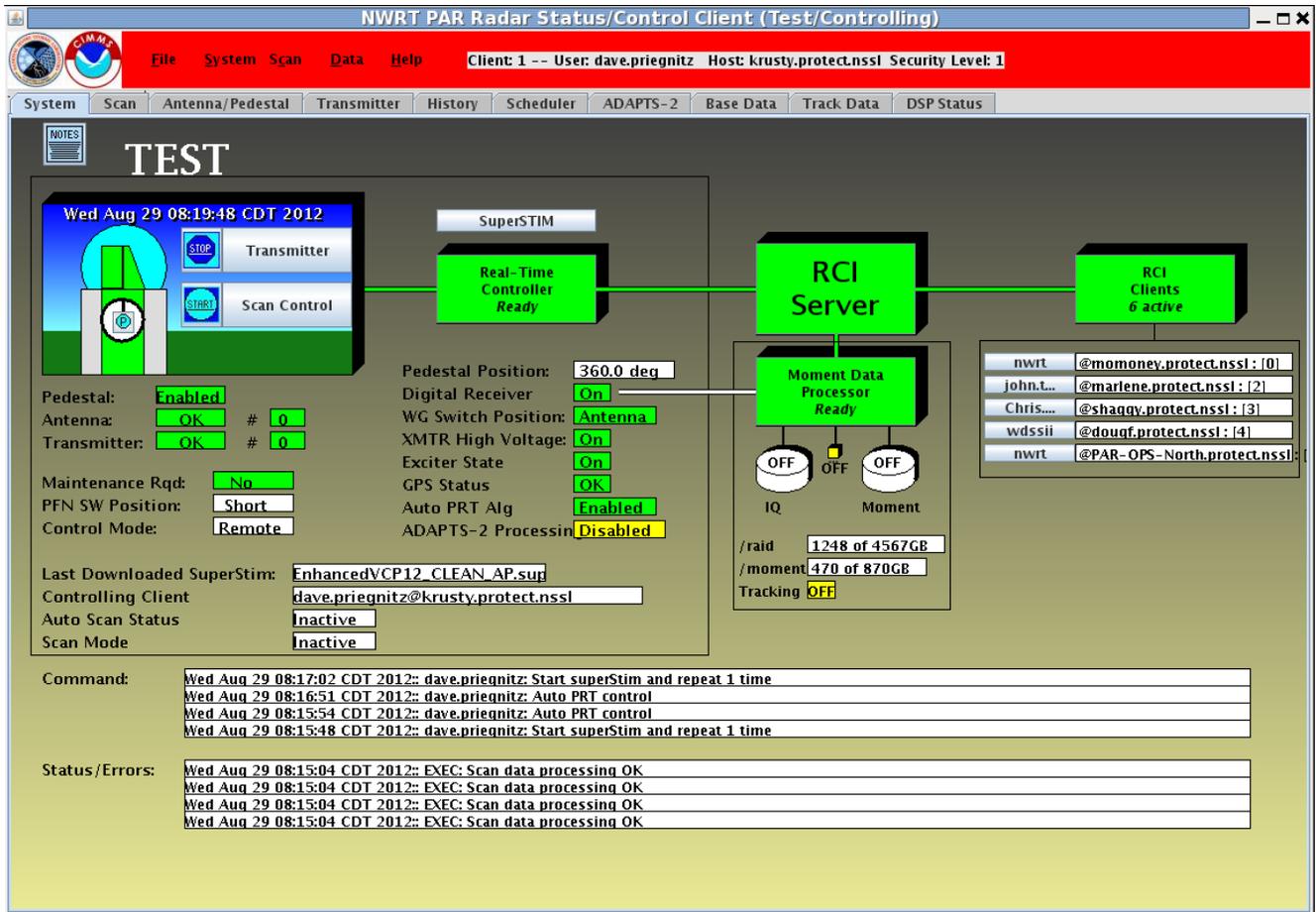
Figure 4: RCI Client System window (Auto PRT Active)

When AUTOPRT is inactive these field revert back to their previous state (Fig 4).

Figure 5: RCI Client System window with (Auto PRT Inactive)