AN ADAPTIVE PEDESTAL CONTROL ALGORITHM FOR THE NATIONAL WEATHER RADAR TESTBED PHASED ARRAY RADAR

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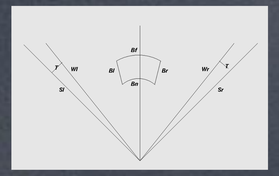
Description of Tracking Algorithm

The algorithm computes the weighted centroid position of the reflectivity field inside an operator defined polar box. The position of the centroid relative to the center of the box in the first scan is used as the anchor. A new centroid position is calculated in each successive scan and the box is adjusted to match the anchor position. The antenna is repositioned when the box reaches a scan window boundary. The formula for the centroid calculation is presented below.

$$a_c = \frac{\sum_{i=0}^{N} a_i w_i}{\sum_{i=0}^{N} w_i} \qquad r_c = \frac{\sum_{i=0}^{N} r_i w_i}{\sum_{i=0}^{N} w_i} \qquad w_i = (Z_i - Z_T)^2$$

w_i = weight at gate
Z_i = reflectivity at gate
Z_T = reflectivity threshold
a_c = centroid azimuth
r_c = centroid range
N = number of gates inside box at or above threshold

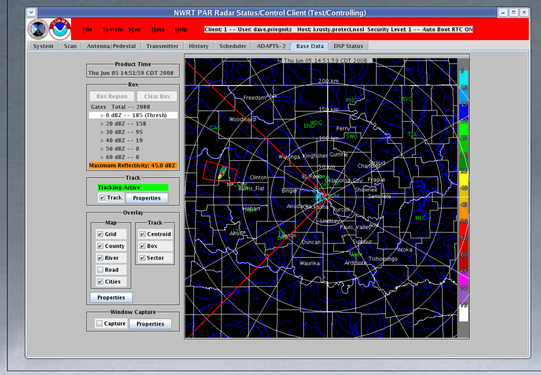
Tracking Box and Scan Sector



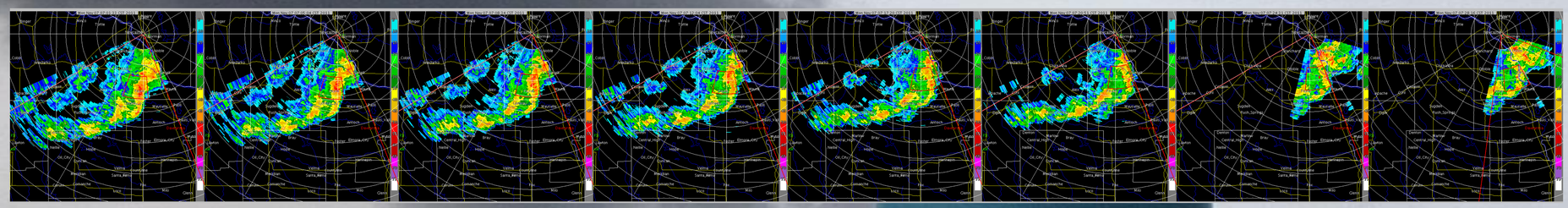
Sl - Field of view (left azimuth)
Sr - Field of view (right azimuth)
Wl - Scan window (left azimuth)
Wr - Scan window (right azimuth)
T - Azimuthal tolerance
Bl - Box left azimuth
Br - Box right azimuth
Bm - Box near range
Bf - Box far range

The National Weather Radar Testbed (NWRT) Phased Array Radar (PAR), located in Norman Oklahoma, consists of a single antenna array capable of electronically scanning a 90 degree azimuthal sector at any given moment. The antenna is mounted on a pedestal which can be commanded to move in any azimuthal direction allowing researchers to follow areas of interesting weather. Until now, when tracking a weather feature, an operator had to decide when and where to move the pedestal in order to keep the feature in the field of view, which imposed a significant operational burden. This paper describes an adaptive algorithm that uses reflectivity data to track an operator-defined weather feature and automatically adjusts the pedestal position to optimally keep it in the field of view.

Radar Control Interface (RCI) Tracking Control/Status Display

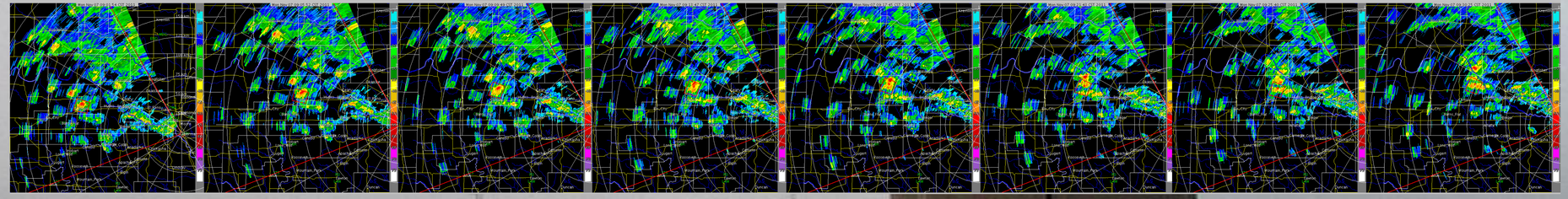


Test Case 1



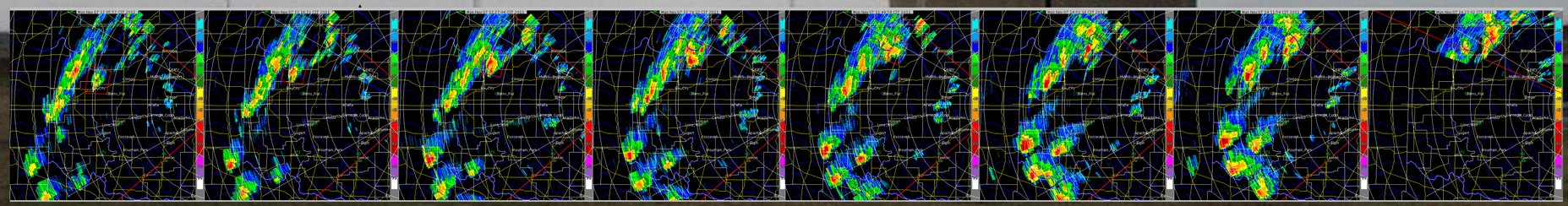
The algorithm did a good job tracking the boxed part of the squall line, repositioning the antenna when the left side of tracking box reached the left scan sector boundary.

Test Case 2



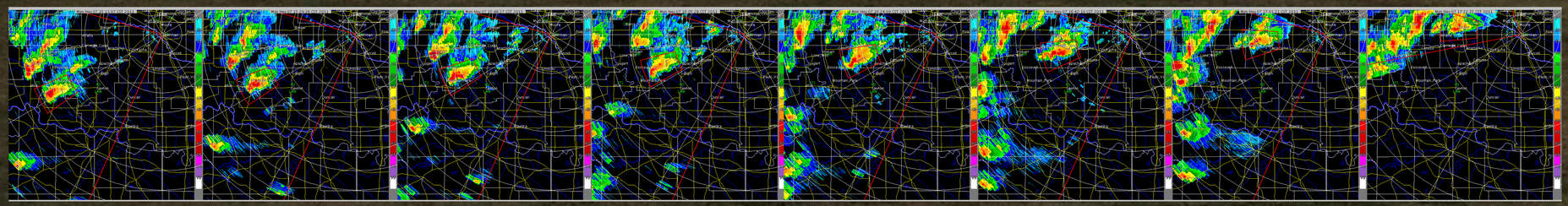
The algorithm did not perform well in this case. New cell development to the south of the initial storm kept the box from moving with the storm. Eventually the algorithm tracked the new cells.

Test Case 3



The algorithm did a good job tracking the storm as it moved to the north-northeast. The antenna was repositioned when the right side of tracking box reached the right scan sector boundary.

Test Case 4



The algorithm did a good job tracking the tornadic supercell as it moved to the north-northeast. The antenna was repositioned when the right side of tracking box reached the right scan sector boundary.