**14B.1** Progress Report on the NATIONAL WEATHER RADAR TESTBED (PHASED-ARRAY)

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## 1. INTRODUCTION

Since 2003, the National Weather Radar Testbed (NWRT) has provided a testbed for evaluating phased array technology for use as part of a national network of surveillance radars (Zrnic, 2007). Developed as a result of a partnership between the National Oceanic and Atmospheric Administration's National Severe Storms Laboratory, the United States Navy's Office of Naval Research, Lockheed Martin Corporation, the University of Oklahoma's Electrical and Computing Engineering Department and School of Meteorology, the Oklahoma State Regents for Higher Education, the Tri-Agencies' (Department of Commerce, Defense and Transportation) Radar Operations Center, the Federal Aviation Administration's Technical Center and Basic Commerce and Industries, Inc, the NWRT continues to test the concepts of a multi-function radar system and has become an educational component for the next generation of radar meteorologists and engineer.

With each passing storm season, we have continued to demonstrate the advantages of phased array radar (Forsyth, 2008 & Forsyth, 2009). In this paper, we will describe the present status and future plans for the NWRT and provide examples of the latest results of our testing of the phased array technology.

## 2. CURRENT STATUS

We have continued to improve the NWRT since coming into operations in 2003. In 2009, the Digital Signal Processor changes included adding spectral processing, staggered Pulse Repetition Time (PRT), automated ground clutter detection and removal, an interference filter (Torres, 2010) and capability to range oversample (Curtis, 2010). In addition, the first implementation of adaptive scanning of the NWRT was completed (Torres, 2010).

With these new improvements, a new set of experiments were executed for the spring 2009 that including Phased Array Radar Innovative Sensing Experiment (PARISE) and support to VORTEX-2. In addition, three high-temporal resolution scanning strategies were tested along with improved data resolution (Heinselman, 2010). We continued to improve our Radar User Interface (RUI) and were able to use NWRT for wind retrievals (Xu, 2007) and initialization of storm-scale models (Yussouf, 2008 and Thompson, 2009).

Work continued with Basic Commerce Industries on design criteria for a dual-polarized fractional sub-array.

The hardware for the Multi-Channel receiver suite obtained by a National Science Foundation (NSF) funded proposal to OU was integrated into the NWRT (Yeary, 2010) and is now being tested.

A new track-processor was completed and installed in May, 2009 by BCI and the FAA with funding from the Department of Homeland Security. The software was implemented on a new PC platform and the tracking was added to the detection software. An example of some of the aircraft tracks collected with the NWRT is shown in Figure 1. Additional work will include the addition of clutter mitigation and adding the mono-pulse tracking capability.

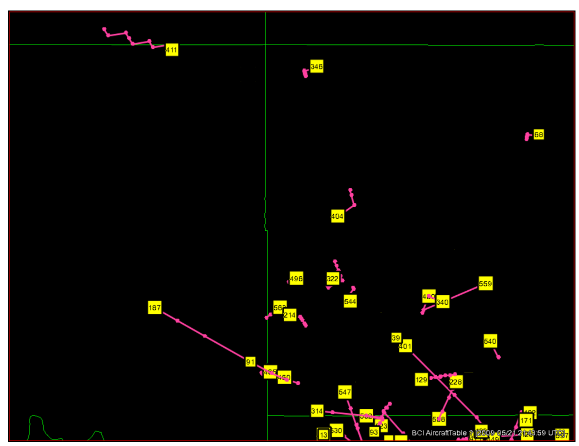

**Figure 1. Aircraft tracks (Magenta) and IDs (Yellow) as identified by the NWRT Phased Array Radar.**

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### 3. DATA COLLECTION (JAN 09 – DEC 09)

| Date | Collection Type | Moment Archived | IQ | Weather / Comments |
|---|---|---|---|---|
| 1/26/09 | Winter Storm | 3.9G | 192G | Melting layer |
| 1/27/09 | Ice Storm | 5.4G | 226G | |
| 2/09/09 | Light Storms | 1.1G | 46G | |
| 2/10/09 | Severe Thunderstorms | 3.5G | 133G | TVS |
| 3/09/09 | Thunderstorms | 9.0G | 192G | Hail |
| 3/23/09 | Thunderstorms | 3.5G | 158G | TVS |
| 3/26/09 | Storms | 590M | 17G | |
| 3/27/09 | Thunderstorms | 4.9G | 241G | |
| 3/28/09 | Snow Squalls | 1.8G | 83G | |
| 3/30/09 | Thunderstorms | 2.4G | 89G | Hail |
| 4/12/09 | Testing | 190M | 8.5G | |
| 4/13/09 | Thunderstorms | 964M | 37G | |
| 4/18/09 | Thunderstorms | 3.7G | 161G | Hail |
| 4/19/09 | Testing | 37M | | |
| 4/24/09 | Storms | 582M | 22G | |
| 4/25/09 | Thunderstorms | 6.9G | 277G | TVS, Hail |
| 4/26/09 | Thunderstorms | 3.4G | 136G | |
| 4/27/09 | Thunderstorms | 2.1G | 101G | |
| 4/29/09 | Squall Line | 955M | 46G | |
| 4/30/09 | Super Cell | 3.1G | 120G | |
| 5/01/09 | Thunderstorms | 2.3G | 186G | |
| 5/02/09 | Thunderstorms | 297M | 8.9G | |
| 5/05/09 | Thunderstorms | 3.8G | 151G | |
| 5/08/09 | Thunderstorms | 3.8G | 86G | |
| 5/13/09 | Thunderstorms | 3.5G | 170G | Hail |
| 5/14/09 | Thunderstorms | 164M | 8.7G | TVS, Hail |
| 5/15/09 | Thunderstorms | 2.4G | 114G | |
| 5/24/09 | Isolated Storms | 1.9G | 67G | |
| 5/26/09 | Cold Front | 827M | 35G | |
| 6/01/09 | Thunderstorms | 2.1G | 89G | |
| 6/02/09 | Thunderstorms | 2.9G | 120G | Hail |
| 6/09/09 | Thunderstorms | 1.8G | 74G | |
| 6/10/09 | Thunderstorms | 3.9G | 172G | TVS |
| 6/12/09 | Thunderstorms | 4.5G | 208G | Hail |
| 6/13/09 | Thunderstorms | 20M | 127M | |
| 6/16/09 | Thunderstorms | 818M | 31G | |
| 6/30/09 | Thunderstorms | 2.1G | 47G | |
| 7/01/09 | Thunderstorms | 162M | 6.2G | |
| 7/04/09 | Thunderstorms | 1.2G | 52G | |
| 7/08/09 | Thunderstorms | 687M | 27G | |
| 7/16/09 | Thunderstorms | 2.5G | 61G | Hail |
| 7/18/09 | Thunderstorms | 907M | 38G | |
| 7/21/09 | Thunderstorms | 5.3G | 259G | |
| 8/26/09 | Thunderstorms | 2.1G | 1.9G | |
| 9/07/09 | Thunderstorms | 681M | 31G | |
| 9/08/09 | Thunderstorms | 1.9G | 81G | |
| 9/10/09 | Thunderstorms | 1.9G | | |
| 9/21/09 | Thunderstorms | 3.8G | 174G | Hail |
| 10/01/09 | Cold Front | 2.0G | 76G | |
| 10/08/09 | Thunderstorms | 1.7G | 74G | |
| 12/01/09 | Testing | 2.4G | 8.5G | |

**Table 1.** Summary of Data Collection for 2009. Moment data (Reflectivity, Mean Velocity, and Spectrum Width). I/Q data are raw data collected before moments are calculated. (G = giga-bytes, M = Mega-bytes, TVS = Tornadic Vortex Signature)

### 4. RESEARCH PROGRESS and PLANS

Data Collection has continued on targets of opportunities and over 4.7 terabytes of I&Q data has been archived for research purposes. Some of the data has been used to compare the WSR-88D with the NWRT (Brown, 2009) as well as look at low-altitude circulations (Heinselman, 2009). Additional work for the 2010 spring program will include refining the scanning strategies to improve temporal sampling, testing and evaluation of the software upgrades and for a few cases, complete quantitative and qualitative assessment of the impact of temporal resolution on the warning decision making process.

Additional Digital Signal Processor (DSP) upgrades (Torres, 2010) are ongoing and include adaptive range over-sampling techniques and additional automated calibration routines that include an automatic noise measurement. ADAPTS (Adaptive DSP Algorithm for PAR Timely Scans) has been improved to allow for advanced scanning strategies such as elevation-prioritized scanning. A capability to manually schedule the scanning will allow the user to modify scanning strategies and acquisition parameters on the fly. In addition, the scanning control is being moved from the Real Time Controller (RTC) to the DSP in order to implement even more advanced scanning strategies.

In the area of data structures, we are planning to support the conversion of the time-series and moment data into standard formats (NetCDF). We are also continuing to improve the Graphical User Interface (GUI) to allow for more control and status monitoring.

### 5. ACKNOWLEDGMENTS

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