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Update on the NATIONAL WEATHER RADAR TESTBED (PHASED-ARRAY)

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1. INTRODUCTION

We have finished our second year of testing of a new research radar called the National Weather Radar Testbed (NWRRT). Located in Norman, OK, this 10-cm phased array radar is designed for use in studying and developing a multifunction radar with the capability to perform aircraft tracking, wind profiling and weather detection at the same time. As reported at several Interactive Information Processing Systems (IIPS) conferences, (Forsyth, 2002, 2003, 2005, 2006), the NWRRT was developed by a government/university/ industry team consisting of the National Oceanic and Atmospheric Administration's National Severe Storms Laboratory (NSSL), the Tri-Agencies' (Department of Commerce, Defense & Transportation) Radar Operations Center (ROC), the United States Navy's Office of Naval Research, Lockheed Martin Corporation, the University of Oklahoma's Electrical and Computer Engineering Department and School of Meteorology, the Oklahoma State Regents for Higher Education, the Federal Aviation Administration's William J. Hughes Technical Center and Basic Commerce and Industries, Inc.. The NWRRT became operational in September 2003, and the first data were collected in May 2004. Engineering tests were completed in 2005. Several data sets have been collected during the limited 2006 storm season. Current efforts are concentrated on improving the scanning speed through continued testing of beam-multiplexing (Yu, et.al., 2007, Curtis, 2007), manual adaptive scanning to obtain fast scan data of weather phenomena (Heinselmann, et.al., 2007), implementing dual weather and aircraft tracking capability (Yeary, et.al, 2007), and preparing the system for remote operations (Priegnitz and Forsyth, 2007). In this paper, we will describe the present status and research progress, and proposed structure of the NWRRT Facility Advisory Panel.

2. CURRENT STATUS

With the completion of the Engineering Phase in 2005, we have started some initial research using the NWRRT. This included obtaining and analyzing fast scan data. Subjective and objective comparisons to

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the WSR-88D continue to look good. The Environmental Processor (EP) was replaced with a Matrix PC system along with a new RAID system to handle recording of both moment and I&Q data. The remote operations capability was refined allowing the Testbed Control Center to be moved to the National Weather Center. Other support equipment was relocated to the WSR-88D facility.

3. DATA COLLECTION

Data collection with the NWRRT has been episodic. During 2006, we have collected data for engineering tests, weather observations and system checks. We have archived 32 hours of I&Q (raw) and 130 hours of moment (Universal Format (UF)) data. See Table 1. for a summary of our significant data collections in 2006. We had hoped to collect several tornadic cases, but the spring season in Oklahoma was again very quiet.

Date	Radar Status	# UF Vols	# Hrs	# IQ's	# Hrs	Weather / Comments
11/9/2005	Dr. Palmer collection	2				Ground clutter analysis
11/15/2005	Boon Leng collection	6				Clutter filtering analysis
12/7/2005	Data collection	30				
12/19/2005	Data collection	27				
1/22/2006	VCP12 & BMX12	15	1			For product comparisons
1/30/2006	Atlanta AMS operation	31				Remote operate with RCI
1/31/2006	Atlanta AMS operation	77				Remote operate with RCI
2/1/2006	Atlanta AMS operation	30				Remote operate with RCI
3/8/2006	Data collection	43	4			Product compare analysis
3/15/2006	Grass smoke collections	54	3			Fires South of OKC
3/20/2006	Data collection	81	3	10	3	Possible TVS
3/30/2006	Data collection	560	11	19	6	Hail, wall, & small TVS
4/1/2006	Multiplex data collection	181	6			Line of strong TSTMS
4/6/2006	VCP 12 collection	213	7			Dry line
4/24/2006	VCP 12 collection	400	13	17	6	Super cell development
5/2/2006	BMX 12 collection	300	10	4	2	Straight line winds
5/9/2006	Dsec (7 sec) collection	336	3	2	1	Small cell to the East
5/16/2006	Beam Pattern collection # 1	40	4	40	4	HW measurements testing

5/17/2006	Beam Pattern collection # 2	24	2	60	6	HW measurements testing
5/30/2006	Data collection	579	10	19	2	Super-cell & multi-cell development
5/31/2006	Data collection	183	2	18	2	Small intense TSTMS
6/1/2006	Data collection	397	4			Strong cells tracked
6/17/2006	Data collection	172	3			Cluster of cells
7/10/2006	Data collection	177	3			SVR TSTM warnings
7/11/2006	Data collection	345	8			w/Travis/hail core
7/12/2006	Data collection	410	9			Several weak cells
7/13/2006	Data collection	319	6			Storm development
8/3/2006	VCP 12 collection	140	2			Weak frontal boundary
8/15/2006	Data collection	661	7			3 body scatter spike hail
8/16/2006	Data collection	480	5			Multi cell development
8/17/2006	BMX 12 collection	170	2			Storm development
9/1/2006	Data collection	32	2			Weak cells
	Totals	6515	130	189	32	

Table 1. Summary of Data Collection for 2006. UF is Universal Format data files containing Moment data (Reflectivity, Mean Velocity, and Spectrum Width). I/Q data are raw data collected before moments are calculated. (TVS = Tornadic Vortex Signature, HW = Hardware, RCI = Radar Control Interface, TSTM = Thunderstorm, SVR = Severe, VCP = Volume Coverage Pattern, BMX = Beam Multiplexed)

4. RESEARCH PROGRESS and PLANS

Since we have resolved the initial data quality issues, we have proceeded with some initial research topics. One topic involves increasing the data collection speed by the use of beam multiplexing. The idea is described by Orescanin, et.al. (2005). Additional testing has occurred (Yu, et.al, 2007 and Curtis, 2007) pointing out some of the challenges of using beam multiplexing data including ground clutter cancellation. In addition, the remote operational capability (Priegnitz and Forsyth, 2006) has been refined (Priegnitz and Forsyth, 2007). This was needed not only to make the NWRT a truly national facility, but to allow NSSL to operate the NWRT from its new facility at the National Weather Center. The NSSL completed the move in July 2006.

With the change to the new Matrix PC system replacing the older Environmental Processor System, the capability to process the data radial by radial was implemented. The radial-by-radial processing allows more flexibility in displaying and processing the data with algorithms.

BCI, in support of the FAA, has installed and tested an aircraft tracking processor that runs independently from the NWRT using the same I/Q data stream

supplied to the Matrix PC. Tests have continued on the multi-function capabilities of the NWRT.

Other research projects being pursued with the NWRT include the detection of transverse winds (Zhang and Doviak, 2007), calculation of refractive index (B. L. Cheong, et. al., 2007), spectral signatures of tornadoes, clutter canceling, and adaptive scanning.

5. NWRT Facility Advisory Panel (N-FAP)

As of December 2006, the NWRT Facility Advisory Panel was established to prioritize and schedule proposals accepted for use on the NWRT. The establishment of the N-FAP, makes the NWRT a national/international facility and will ensure that a balance of proposals from the agencies and other sources are maintained. The panel includes two members from each of the original collaborative organizations, DOC, DOD, DOT, the University of Oklahoma, Lockheed Martin, and Basic Commerce Industries, and three at-large-members to be determined.

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