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THE DIMENSIONS OF TURBULENCE THROUGH THE ADP (ATMOSPHERIC DATA PROCESSOR) SOFTWARE TECHNIQUE USING THE INDIAN MST RADAR

Rajendra Prasad Rao[1]*, R. S. Yadav[1]

[1]Department of Electronics & Communication, University of Allahabad, Prayagraj, India
rajendra.rao434@gmail.com, rsyadav_au@rediffmail.com

***Corresponding Author Email:** rajendra.rao434@gmail.com

Abstract: The Indian MST radar at Gadanki India was used for a brief experiment starting on April 21, 2014. The method used by the ADP (Atmospheric Data Processor) to calculate the kinetic energy of turbulence at Gadanki, the ADP can only be changed on one polarisation at a time for analysis. In areas with light winds, the ADP method and the conventional method for calculating TKE are very similar. The traditional method frequently produces TKE in areas with stronger winds because the beam-broadening correction is greater than the observed spectral width. It is suggested that the uncertainty in the radar beam's effective width is the cause of some of the issues with the conventional approach. The modified ADP method provides total kinetic energy on the beam parallel to the predominant wind in every region. The spectral widths that have been observed and this are probably well-known. In the afternoons of both April and May, the values of total kinetic energy from the ADP method are constant with height before dropping quickly to about 9 km. The diurnal range of total kinetic energy at some point in this period is found to be approximately 5 dB below 12 km and from about 15 to 19 km, near the troposphere, with maximum values through local afternoon. The data from May cover an entire diurnal period.

Keywords: Turbulence;MST radar;Yagi antennas;NARL

1. INTRODUCTION

The coherent mono-static pulse-coded Doppler radar at Gadanki operates at a very high frequency of 53 MHz and has a tirade phase group transmitter. The common power aperture product of MST radar is 7×10^8 Wm^2. A special system for studying the Earth's atmosphere is the MST radar. The Mesosphere (50-100 km), Stratosphere (17-50 km), and Troposphere are the height regions covered by the MST radar (17 km). The Mesospheric Statospheric Tropospheric radar studies go up to a height of 100 km, or the mesosphere of the earth [1-7].

The phased array very high frequency (MST) radar subsystems have 32 triode-based transmitters and 1024 antenna elements. The MST radar has a 2.5 MW generating capacity. The single channel receiver in the control and instrumentation room has a sensitivity of -165dB. A controller for automatic experiment is the Mesospheric Statospheric Tropospheric radar [8-

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14]. The MST radar's main function is to act as a sizable computer for signal and data processing. Table 1 displays the key attributes of the MST radar.

Since its installation in 1987–1993, the Mesospheric Statospheric Tropospheric radar has been effective operation for an normal of 2500 hours annually. Numerous review articles on research in atmospheric science were produced by them.The phase calibrations, upgrades to the radar's electronic subsystems, and continuous test maintenance activities. Maintaining the calibre of the scientific data product is the radar challenge. In this paper, we detail the radar subsystems for a 25-year period in order to ensure their continue doing well operation [15-28].

The MST radar working frequency is 53 MHz. About 20,000 square metres are distributed among the radar control and instrumentation room, transmitter rooms, and antenna array. A 1024 element group of Yagi-Uda antennas makes up the MST radar. Antennas are arranged in a square grids with 32 ×32 matrixs. Antenna components for the Yagi-Uda include a dipole, director, and reflector. The dimension is approximately 3 metres long with a 4 metre inter-element distance [29-35]. The exciter, radar controller, powerful computer, back-end receiver, signal processor, and offline data processing system are all parts of the manage and instruments room. Four aerial room contain a total of 32 transmitters. The north and south sides of the array each have two rooms for the MST radar transmitter. Eight transmitters, a network for distributing signals, and a local processor computer make up the transmitter room. Aerial phase shift loading and aerial ray navigation are done in a transmitter room.

The details of the calibration, upkeep, and upgrade activities are presented in the following sections. the effectiveness of using the output data from the radar for high-quality scientific research. the development of high power system in transmitter room, as well as the testing and maintenance of the antenna and feeder network. In order to get around the digital modules, numerous system upgrades have been made [36-38].

2. MST RADAR

For 25 years, the radar supported 50 satellite start on campare with flawless assistance and 100% success. Up to 20 km in height, the MST radar provides dynamic wind estimate for begin vehicles. The Indian MST radar's performance in measuring winds vector for new open application and academic research. Recent measurements of antenna design pointing accuracy using radio sources and actives moon probes revealed that the accuracy was within 1%. Due to the MST radar's adaptation to technological advancements, it has been operationally successful. The beam steering capability of the MST radar has been increased from a 5 beam mode to an automated 82 beam mode of experiments with a resolution of 1 degree. The majority of turbulence issues have been resolved thanks to crystal oscillators in microprocessor systems. The MST radar is capable of measuring winds up to the tropopause height.

The creation of the software known as Atmospheric Data Processor (ADP), which is used to process wind measurement data. The offline records process system used a UNIX programme as its foundation. The digital data is stored on a attractive tape data store system.The updates the records archival system continuously from tape drives to disk discs and compact disk-based. The 8086 microprocessor was the initial component of the indian MST radar control and instruments room. A 16-bit microprocessor is the 8086. The radar consists of a best heterodyne receiver, a local oscillators, a four detectors, and an exciter and coder system. Based on an 8086 microprocessor for analogue to digital conversion, the two channel signal processor processes time domain signals from the in-phase and quadrature-phase channels. In order to keep pace with the rapid advancements in technology, the radar system has undergone numerous upgrades. Two channels of 14-bit ADCs were used in the development of a PCI-bus based data acquisition card (Analog to digital conversion). To perform the decoding operation for coded transmission, the output of each ADC is fed.

Four local processor rooms serve as the link between the transmitter rooms and the radar control and instruments room. The 8085 microprocessor loads the MST radar's phase shift data into a digital phase shift using an RS-232 serial link. An 8-bit microprocessor is the 8085. An upgraded fibre optic Ethernet connection to the radar controller replaces the RS-232 connectivity. To address the issues during lightning strikes, the coaxial cable-based timing signals network is replaced by an instrumentation network based on optical fibre. Every year, proper power levels are also tested for in the radio frequency subsystems. In order to solve the connectivity issues during testing and maintenance procedures, all of the external radio frequency cables between the modules in radar were replaced. For each scientific experiment, the transmitters are kept at an availability of between 85 and 95 percent. When the system is in operation, frequent power outages are blamed for the failures of transmitter amplifier triodes and duplexer pin diodes. The 141 MOSFET-based amplifier has upgraded the solid state amplifier module. When operating in class A or class AB, a radar can output 100 W with the input signal of 0 dBm and a bandwidth of about 8 MHz. The failure of the RF coupling capacitors on the triode output is the main issue with the transmitter high power modules.

Installing an continuous power supply for transmitters solves the problem of active component failure, such as triode and pin diode. The failures of the high voltage capacitor caused by air conditioning in the transmitter room. High power triode-based transmitters and pin diode based solid state reasonable duplexer required daily attention. Upgrades and replacements of the lump element branch line duplexer was made.

Renovating high voltage and RF cavities is how transmitter annual maintenance tasks are carried out. the checking of electrical connections, testing, and fine-tuning of triode anode, cathode, and filament power supplies to with 5% patience level. To maintain the transmitters RF output power, transmitters radios frequency cavity are fine-tuned for the necessary gains and bandwidths requirements. With a team of about 10 technicians, this task used to take almost a month. Tuning of the RF tank circuits is done every three months. Complete radar preventive maintenance was carried out in December and January for about a month. Each subsystem is tested yearly, and any problems are fixed right away. Every two weeks, RF pulse shape and power level are checked. Radar performance and data quality are constantly being watched over.

Phase calibration refers to the phase equalisation processes carried out on the Yagi-Uda antenna array. They are carried out on a monthly schedule. Regular checks are made of the antenna voltage standing wave ratio (VSWR) in the transmitters' front panel metres. A minimal number of spares are kept on hand to maintain the array's three-element Yagi-Uda antennas that are exposed to the elements of weather. Applying RTV sealants yearly to prevent water entry into electronic modules prevents the radio frequency feeder network connectivity problems. The newest technological developments are being extended by the active array system using the MST radar antenna array. Half the rated power is used to obtain wind profiles up to 20 km, eliminating RF power loss in the 100 m long cables. The antenna elements are placed close to the Transmit/Receive modules. The installation of dissident electrical, RF, and optical fibre cables, as well as the extensive development work on the antenna figures for transmitter receiver modules, are all being carried out in parallel with the operation of the Mesospheric Statospheric Tropospheric radar for all technical operation. The interferometer technique for processing radar signals is being tested. Astronomy, meteorology, and atmospheric studies can all be conducted using the indian Mesospheric Statospheric Tropospheric radar [39-41].

Table 1: Specification of MST radar

SN	Aspect	Specification
1.	The locality of MST radar	Gadanki
2.	Frequency of MST radar	53 MHz
3.	Common power aperture product of MST radar	$7 \times 10^8 Wm^2$
4.	Peak power of MST radar	2.5MW
5.	Maximum duty ratio of MST radar	2.5%
6.	Number of Yagi antennas in MST radar	1024
7.	Beam width of MST radar	3º
8.	Pulse width of MST radar	1-32µs
9.	Pulse repetition frequency of MST radar	8kHz
10.	Maximum number of range bins of MST radar	256
11.	Radar Controller	Workstation with radar controller software (ADP)
12.	Data in MST radar	Two channel PCI-card based data system with 14 bit ADCs

3. ADP Software Method

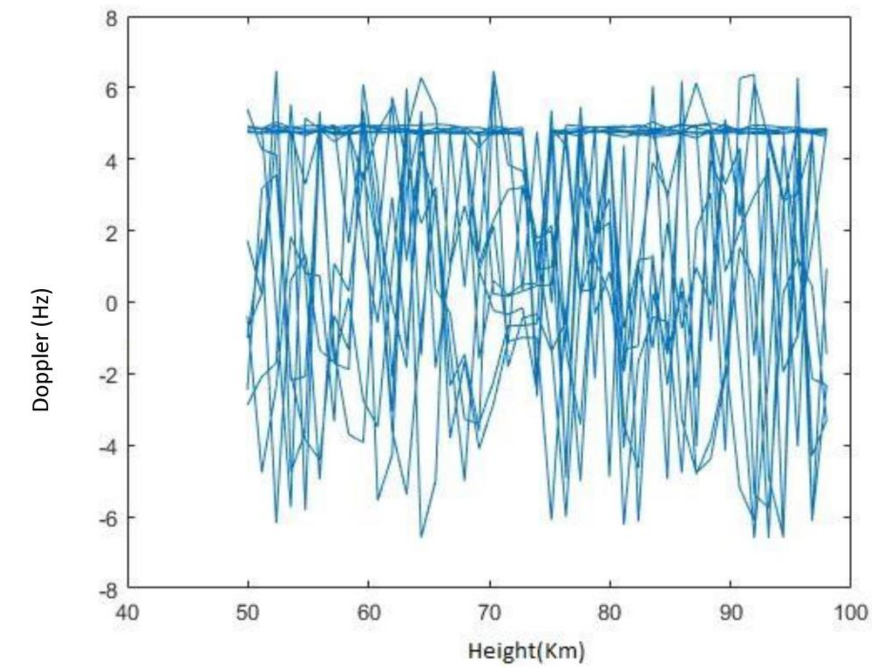
1. First convert d(spectrum files) to m(moments files) where spectrum means frequency domain data and moments means peak power, Doppler shift, Doppler width. The process are given as

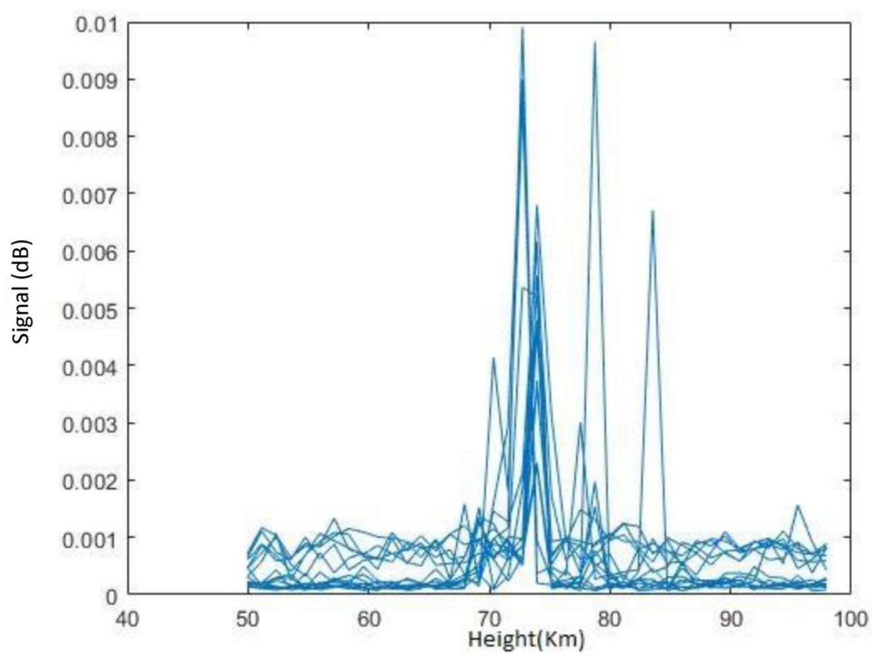
File
↓
Read file(21 April 2014.D4)
↓
Write file(21 April 2014.m4)
↓
Auto
↓
Macro define
↓
Reset
↓
Fetch
↓
Moments
Source 0
Destination 1
↓
Write
Source 1
↓
Display
2. m(moments) to ASCII file
Read file(21 April 2014.m4)
↓
Write file(21 April 2014.a4)
↓
Auto
↓
Macro define
↓
Fetch
↓
Copy
Source 0
Destination 1
↓
Write
Source 1
↓
Auto

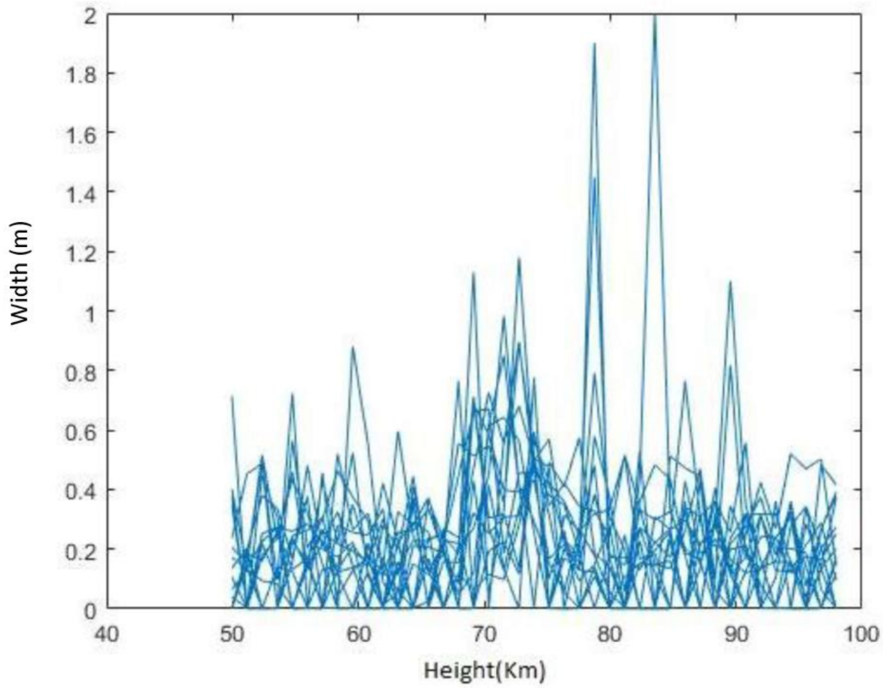
↓

Auto run

After this ASCII file convert text data using excel then use text data we import in MATLAB software plot the graph.







4. CONCLUSION

Due to the MST radar's adaptation to technological advancements, it has been operationally successful. Near a some tens of Ph.D.s and a some hundreds of publication with a high impact factor have resulted from systematic scientific research. Within a 25-year period, we provide winds vectors measurements for near 50 satellite start on campares, with 100% achievement rate for every starts mission. Excellent scientific findings were obtained as a result of the radar's ongoing maintenance and improvement efforts.

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