A Report on Industrial Visit To
"National Atmospheric Research Laboratory (NARL)"
Gadanki, Pakala, Andhra Pradesh 517112
Organized by Department of Computer Science & Engineering on 24.11.2023

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Faculty Members Accompanied : Dr R. Sudhakar Associate Professor/CSE Mrs. V Nirupa Assistant Professor/CSE
Total no. of Participants : 49

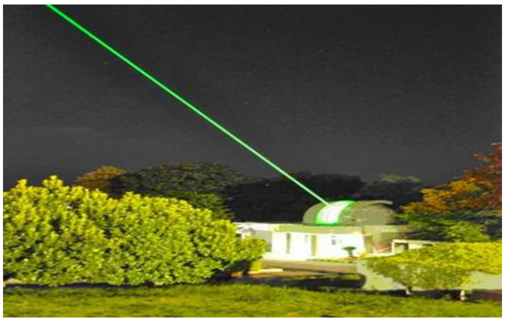
One-day Industrial Visit to National Atmospheric Research Laboratory (NARL) was organized for the II Year B.Tech [CSE] students on 24th November 2023. The Industrial Visit to NARL started at 6.30 AM by college bus and reached NARL by 10.30 AM. The students along with faculty members visited the NARL facilities between 10.30 AM and 1.30 PM.

ABOUT NARL:

NARL is an autonomous research laboratory fully funded by the Department of Space, Government of India and involved in carrying out fundamental and applied research in Atmospheric and Space Sciences. It had its humble beginning in 1992 as the National Mesosphere-Stratosphere-Troposphere (MST) Radar Facility. Over the years several complementary techniques such as Rayleigh/Mie lidars, wind profilers have been added. NARL is administered by a Governing Council with Secretary, DOS as the Chairman and Director, NARL as member secretary. The Governing Council sets broad policy guidelines for NARL. A Scientific Advisory Committee consisting of eminent scientists in the field of atmospheric science, monitors the research activities and progress of NARL and provides future directions.

Places Visited in NARL:

Rayleigh Doppler Lidar :
The project Rayleigh Doppler Lidar (RDL) uses a high energy laser with 30W power @532nm and 50Hz repetition rate to get atmospheric backscattering from molecules and particles. A 750mm telescope in Newtonian configuration is used to collect the signal from the atmosphere and a Fabry Perot Interferometer as frequency discriminator is employed to get the radial winds. A few photographs of Pic 1 and 2 of the system are shown. The Project is completed, and Zonal and Meridional winds are obtained between 10-50km. Sample results are shown in the Fig 1 and 2. The winds derived from this indigenously developed system have compared well with near simultaneous GPS Radio Sonde winds. The RDL system is regularly operated. The system capability of moving the telescope in 0–360-degree azimuth and 0-45 degrees off-zenith is fully utilized to get the temperature structure.

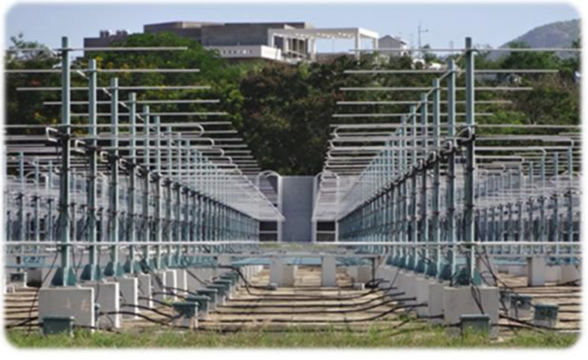


2. **GPS Radiosonde:**

NARL launches GPS radiosonde (RD-11G, Meisei make) every day around 1730 LT (12 UTC). It provided profiles of Pressure, Temperature, Relative humidity, Wind Speed and Wind Direction up to the balloon burst altitude typically 30-35 km. These have been launched regularly since April 2006. The RD-11G ground station is designed for the Upper Air Observing System using the D- GPS (Differential Global Positioning System). The GPS receiving device in a Radiosonde tremendously improves observation accuracy, thus allowing the GPS ground station to be simplified and compact. The RD-11G Upper Air Observing System consists of a radiosonde receiving antenna system, GPS receiving antenna, GPS Sonde Receiver, and the data processor, PC computer which is connected to a networking subsystem via a TCP/IP. The system is also provided with the Base Line Checker (BLC) used for ground check before launching a radiosonde. The GPS receiving device in a radiosonde obtains information on the direction and the velocity of the GPS satellite with the frequency deviation of radio signals from the satellite due to the Doppler shift and transmits the positioning information of the radiosonde to the RD-11G ground station. Upon receiving radio signals from the radiosonde, the RD-11G ground stations processes the data obtained by the radiosonde and GPS satellites to observe wind direction and wind speed in the upper air.

3. **MST Radar:**

The MST radar is an excellent system used for atmospheric probing in the regions of Mesosphere, Stratosphere and Troposphere (MST) covering up to a height of 100 Km. It is also used for coherent backscatter study of the ionospheric irregularities above 90 km. MST radar is a state-of-the-art instrument capable of providing estimates of atmospheric parameters with very high resolution on a continuous basis, which is essential for the study of different dynamical process in the atmosphere. Radar operates at 53 MHz with a peak power of 2.5 MW. The phased antenna array consists of two orthogonal sets, one for each polarization of 1024 three element Yagi-Uda antennas arranged in a 32 x 32 matrix over an area of 130 m x 130 m. The two sets are co-located with pairs of crossed Yagis mounted on the same set of poles. The array is aligned along the geomagnetic axes to enable the radar beam to be transverse to the Earth's magnetic field for ionospheric backscatter application. The array of either of the polarizations is illuminated using 32 transmitters of varying power, each feeding a linear sub-array of 32 antennas. The power distribution across the array follows an approximation to modified Taylor weighting in both principal directions. The radar beam can, in principle, be positioned electronically at any look angle within ± 200 off-zenith in the East-West and North-South planes. It is possible to transmit both coded and un-coded pulses with pulse repetition frequency in the range of 62.5 Hz to 8 KHz, with a maximum duty of 2.5 %. Coded and un-coded pulse can be varied from 1 to 32 µs with a baud length of 1 µs providing a range resolution of 150 m. The radar operates under instruction from a PC based radar controller that executes an experiment according to the experimental specification set by the scientists. Both time series and power spectrum data canbe recorded on-line. The recorded data can be processed offline to derive various atmospheric parameters.



4. **Automatic Weather Station:** The automatic weather station consisting of 5 sensors and tipping bucket rain guage is installed at NARL. The sensors measure pressure, temperature, humidity, wind speed and wind direction. Except the pressure sensor and the rain gauge, the other sensors are mounted on a 3-m tower. Temperature compensated piezo-resistive pressure sensor is used to measure the pressure with a resolution of 0.1 mb. For humidity measurement, a thin film capacitance sensor is used which provides an accuracy of ± 3%. RTD type sensor is used to measure temperature with a resolution of 0.1o C. 3-cup rotor type sensor is used to measure wind speed with an accuracy of ± 1%. Potentiometer type sensor is used to measure the wind direction with a resolution of < 1o. A tipping bucket rain gauge provides rain rate information with a resolution of 0.5 mm.

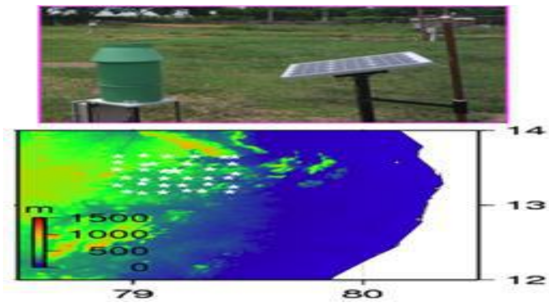
5. HPC Facilities:

We visited the High-Performance Computing (HPC)Lab Facility in NARL, high performance computing cluster facility for accelerating analysis of genomics and transcriptomics data is available. This facility comprises with the following Configurations

- 96 Parallel processing
- 200TB of RAM
- 200GBPS Connectivity
- 2 petabytes of Data Storage
- 32GPU's

6. Rain Guage Network:

One of the vital assessments after the launch of any Microwave and Infrared (IR) remote sensing satellite is to validate of the derived products (ex. rainfall estimates), preferably by comparing with the products obtained by ground-based instruments by considering them as reference. In this regard, to validate the rainfall parameters retrieved from Megha-Tropics mission, NARL is chosen as a super-validation site and ameso-rain gauge network extending from 78.9° E to 79.4° E and 13.1° N to 13.6° N, covering an area of 50×50 km2was established during 2011-12. This rain gauge network, which is centred on Gadanki, includes 36 rain gauges arranged in nearly a square grid with a spatial resolution of ~10 km. Several factors were considered while choosing the location for the rain gauge installation, like its suitability for rain measurement, safety of the instrument, accessibility to the location, coverage of BSNL network, etc. The rain gauges are of tipping bucket type having bucket volume of 0.2 mm with one minute temporal resolution. There is a provision to store the data at the site and also to transfer the data to a server located at NARL through GPRS technology.



Conclusion:

The students observed the working environment of the NARL by undergone the visit. They experienced the usage of the technology in practical aspects. The visit was more interactive with effective learning and the students were made to learn the innovative technologies used in NARL. We extend our sincere thanks to the Management, Principal, Vice Principal and Head of the Department for their support in arranging & organizing the industrial visit.

Outcomes of Industrial Visit:

- Students gained knowledge on real time OS implementation in research area.
- Students explored about super computers and its practical working functions.
- Students gained knowledge on real-time application areas of Python, Java, SQL database and analysed their importance in scientific area.
- Students understood the cyber security involvement in space research.