

Application of Radar Signal Processing Deriving the Lower Atmospheric Wind Parameters

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Abstract -Radio waves at VHF and UHF are often utilized to study the atmospheric parameters within the lowest atmosphere levels, owing to their dependency on scattering mechanisms under explicit and disturbing weather conditions. In particular, the UHF lower atmospheric wind profiler is a potential tool for studying the wind parameters under clear conditions (based on Bragg scattering) and rain events under disturbed weather conditions (based on Rayleigh scattering). Lower Atmospheric Wind Profiler (LAWP) is a remote sensing instrument to study the wind parameters up to a height of typically 7 km. This L-band wind profiler is being operated at 1280 MHz with a peak output power of 1.2 kW. LAWP employs a fully active array comprising 256 microstrip patch antenna elements arranged as 16 x 16 grid configurations. These elements, fed by dedicated solid-state transceiver modules, are utilized to operate the radar continuously in DBS mode to calculate the moments (viz., signal power, Doppler shift and Doppler width) in three directions. Doppler shift is utilized to calculate the radial velocities used to retrieve the wind components in three directions: zonal, meridional, and vertical. The spectral widths are finally used in investigating the variation of turbulence caused due to the convective and rainfall events. The data products derived from this radar include information about the melting layer, the height at which the ice crystals are melted into a supercooled water state, or vice versa, typically 3 to 4 km in the tropics. To study these parameters, the data must be carefully analyzed to estimate the moments. But very often, the moment estimation is affected significantly due to technical noise called interference.

The present study focuses on refining digital signal processing algorithms to reduce the interference noise level and increase signal detectability. This would be useful in better estimating the moments and thereby deriving the wind components. The study about the diurnal variation in wind parameters helps understand various atmospheric derivable and apply in diverse fields viz., atmospheric pollution, forecasting, aviation etc.

Keywords- L-band radar wind profiler, C.B.L. profiler, UHF profiler, cosmic noise absorption, Ground clutter.

1. INTRODUCTION

National atmospherical research lab Gandaki, India (13.58N, 79.28E) established an associate degree L-Band measuring instrument wind profiler. This utilizes a passive beam-forming network and an active array to produce never-ending high-resolution measuring of wind within the lower atmosphere. It generated a peak output power of one. Two power unit once it operated at 1280MHz. A vigorous array used here comprised 16*16 microstrip patch array probe components fed by consecrate solid-state transceiver segments. The associate association of every passive collection and active beam-forming the network that resulted inside the beam-forming network ends up augmenting the signal/noise ratio. The system designed with a digital receiver, pulse compression theme, and an immediate, immediate frequency, which ends up in a snap and greater altitude attention. This profile's most objective is to check the precipitations and atmospherically physical phenomenon dynamics—the results square measure valid exploitation G.P.S. [1].

The height of C.B.L., abbreviated as Connective atmospheric Boundary Layer with 915 MHz, has discussed in this research. Final results have compared with C.B.L. heights, which are pre-determined from radiosonde measurements. Profiler stipulates continuous height measurements of C.B.L. with a fair resolution that successfully permits copiousness understanding of each growth and fluctuations of C.B.L. This profiler jointly provides detailed information on the degree of definition of C.B.L. high and surroundings zone thickness [2]. Identification at 915 megacycles conferred in radio frequency developments, victimization microstrip 915 megacycles per second at intervals the half laboratory, advances in radio frequency identification comes for the primary development starting in eight years before. This analysis presents an outline of the planning of the frequencies profiler system [3] as an impact of its development over the period, which incorporates RASS accomplishment. The outline of expertise gained most of the installations, which delineate from hardware and computer code parts. Applications to precipitation profiling, flux measurement, wind profiling, and boundary layer height determination. Are been contemplate.

Broad beam antennas measurements of cosmic [4], radio absorption, area unit obtained within the polar region. In live this way, we tend to area unit able to get alone restricted data concerning the particular structure associate degree dynamics of associate degree aurora. In recent trends, radiometry has highlighted the many thin streams of sunshine probes that worked in mounted or one-dimensional scanning methodology to appear at smaller half regions. Another step throughout this direction is that the event of the IRIS. This instrument furnishes a sleek double of enhancing intergalactic[22] noise interest at thirty-eight.2 megahertz and a special resolution as a try of 0km and time resolution of 1s. IRIS may well be a dipole array with sixty-four elements that urge forty-nine freelance beams, that area unit viewing degree half house and altitude around 200km and 90km, severally. Since 1988, one IRIS device has been located at position and second instrument, which recently placed on an island. This paper represents a technical rationalization of the IRIS organization. The response of IRIS to sun aligned absorption arc is embellished, compared with a board beam radiometer [21]. An excellent restricted structure established among the angle determined by the IRIS to propagate the attractive poleward direction with the regulation of 1km/s. The presence of ground litter [5] might seriously bias measuring instrument computation of the Doppler shift, and this is often most explicit with wind profilers,

which undertakes border sheet dimensions. This appeared in each qualitative and quantitative with a sampled knowledge a straightforward de-trending of your time series of the information that successively reduces the litter downside. Here investigation is finished on the finite impulse response filters. Enhancements have conjointly determined once long records filtered before the statistic of spectral analysis. As extended as the filter width surrounds the clutter spectrum, results may not be susceptible to the filter's width.

2. SURVEY METHODS

Monitoring A.B.L., in turn, helps in grasping the precipitation [9] process and low atmospheric wind profile. 2D- modified Butler B.F.N. and Fully substantial state active array [1] entirely set up to the class for the first system. Staticdisplay, the configuration to the order tired such some way as feeding the weather on to the antenna by a number of the dedicated T.M.'s, setting the SNR to the utmost limit Active array and by eliminating feeder ways in which in every of TX and Rx ways in which. Implementing a high SNR system helps the system increase the coverage height and proposes a more robust place resolution. Array size will be notably small compared to passive array profiler, even supposing they're designed with equal SNR performance. There is another advantage by victimization an active array is that the performance of the variety can ne'er be degraded and that additionally not have an effect on the system style considerably once a number of the few T.M.'s did not perform. A full of life array is cost-friendly. Multiple beams second - changed provided by full manservant B.F.N. It nearly fills the whole measuring system exploring volume. Its passive nature avoids all the necessity for changes by providing a straightforward beam mechanism. Because short power solid-state B.S. variations switch the sunshine stream,an amendment is possible for a pulse-to-pulse beam. To chop back the American state power level up to 20dB among the steps of 2 dB, Tx-ATT is obtaining used among the microwave radar exciter. Identically, the Rx-ATT Rx chain is controlled for a varied gain of the receiver from a range of 20-90 dB among the steps of 5dB. These American state power and Rx gain management are achieved by perceptive the weather like transference participation events of various intensities. At first, a full-fledged active phased array [6] with the slight soreness of the beam designed to build for locating out all the 3D atmospherically [8] agitated in a {very} very whole exploring microwave radar volume. This concept born thanks to the cost-effectiveness and complexity involved in the system vogue. To compromise the superior system style, affordable second manservant B.F.N. if engineered to fill a second angular house capable of generating eighty-one mounted beams. The change of the measuring system beam to pulse-to-pulse basis designed to image measuring instrument consecutive explore volume. This profiler is restricted to 5 poles because it is not ready for technique booms on a pulse-to-pulse basis. The numerical designer is being customized, which is {able to} be able to method all the repetitions on pulse-to-pulse to perform 3-dimensional radar imaging later. For substantiating the LAWP information, a novel campaign is conducted, and also the performance of LAWP was terrific.

An elementary parameter for any physical phenomenon [2] model or study is either chemical or physical of the depth or height of the region physical phenomenon. The height of the natural phenomenon is measured by acoustic sodar, aircraft, towers, or radiosondes. For low physical phenomenon heights, towers and sodar work well throughout nights or robust sinking of lower [14] level episodes, but height coverage is very restricted to that vogue. C.B.L. [10] height measured by mistreatment craft. However, it cost-efficient and provides occasional measurements. Sonde live at many points in house and time the top-ranking not thought-about over the required space. On average, it should take issue by four-hundredth. Continuous measurements provided by C.B.L. height and turn out a decent time resolution of unit of time or less and height resolution of 60-100m. These measures unit of measurement colonists by white. throughout this study, the profiler delivers relating to the degree of the description of C.B.L. high and zone thickness of the setting. The check has conducted within the pine forest. In the forest, the sections cut and replanted in varied places in varied sizes. The profiler placed therein space before four years and tree height at concerning 2m high

and a few alternative lower brushes. The weather incredibly plans throughout the check conducted attributable to the thought atmosphere. The sky is pretty clear, and there aren't any lightweight winds and no precipitation. category provided by State Halfway purpose for half [11] analysis, that accumulated by the profiler for radiosonde dimensions. Profiler with frequency 915 megacycle [12] was meant by workplace Aeronomy laboratory, almost all unremarkably used for wind identification in various boundary layers. throughout the standard wind identification operations, these measurements tested. The profiler operated at 915 megacycles with one.8 m sq. four-panel little strip patch and peak power of five hundred W. Beam breadth of 1 manner zero. five power is nine deg. The antenna is directed into five beam positions so that one is at intervals the vertical position. So the various four-square lives in oblique positions with twelve deg off point, planes of two perpendicular planes by the automated platform. to stop ground muddle from trees close to AN large number thirteen honeycomb muddle wish to fence it. This looks at how finished by fixing the profiler used 100m vary gates and 100m pulse breadth. all-time low gate organized at centre 150m on prime of ground-level A.G.L. the look of the best C.B.L. is made public, that's nothing but inversion height. after we begin from the bottom, This C.B.L. is made upon AN external coating to regarding zero.1zi, mixed layer from regarding zero.1 to 0.8zi associated AN entertaining zone from regarding zero.8zi to 1.2zi. This diverting layer is also brought up as an associate interracial layer. every prime and bottom of natural phenomenon depth and amusement zone characterization unit of measurement denoted as h_0 and h_1 , severally. The top C.B.L. may vary, which is tough to style within the overlaying inversion, which can be robust or week. The higher than C.B.L. layer is outlined because of the layer. throughout night times, C.B.L. is modified by a gradual coating. A stable layer is underneath the littlest elevation of the profiler cannot live the peak of it. throughout morning times, that's nothing. However, once sunrise, the C.B.L. forms and multiply. This continues until the afternoon, or the peak could balance. It depends upon the conditions and additionally the number of surface buoyancy flux. This surface flexibility amendment develops into scanty to support C.B.L., and in turn, it results in sin decay of turbulence. In development profiler, affords incessant dimensions of C.B.L. height that reach agreement well with balloon surroundings. The system that responses to the concept of firm foundations and direct observations. For natural phenomenon studies, these measurements will prove. besides it, the profiler provides details regarding strength and depth regarding recreation. recreation influence intermixture may be a heap of monumental and localized once a robust transposition is a gift. In distinction, inversion is week induced intermixture less intense in recreation, which extends over a massive vary of heights. For a higher understanding of the data, more study is required. For higher understanding White 1993, one amongst the authors did some measurementto compare the physical phenomenon heights by similar profiler with raw in sonde inversion of height. because of low natural phenomenon height, some comparison is finished between profilers with some cases that don't seemfavourable. There's a median height distinction was 61m, which is mostly but the profiler pulse dimension. within the mornings, C.B.L is captured well by the profiler. C.B.L. could collapse thanks to the afternoon, which is extremely less clearly outlined. Registering a peak in SNR is continued by the profiler because the turbulence scale [7] to [*fr1] the measuring device wavelength 15cm exists when surface buoyancy flux is drop off when it slow. The profiler is turned sensitive for raindrops; thus, this profiler won't be measured at any height throughout the rain. Profiler turned too sensitive for cloud droplets too. Interpretation of the profiler information that sophisticated by the presence of cloud. Reflectivity in clouds will be very similar to increase the boundary layer top.

Sensitivity to clouds is available by the boundary layer height detection when the cloud coincides with inversion.

At government agency aeronomy laboratory, a mobile 915 MHz wind profiler developed for the employment of tropical Pacific sites that has undergone a fast inflating profile that desires within the tropics for all the centre and high latitudes. To date, profilers over fifty 915 rate square measure generated by the analysis and some of the economic groups for all the applications that range from all the air quality studies for a; the climate observance, this analysis sum-up with most of the event that has been occurring from the past five years. Here ultrahigh-frequency profiler [3] usage is highlighted during this analysis. Samples of profiler information obtained from tropics facilitate establishing the profiler power to urge continual wind grounds in associate passing vivacious layer with correct altitude and time determination. At intervals, the lower layer, signal strength is greatly stricken by the condition once clear air returns. Up to the 5 – cardinal kilometre measurement, the radio frequency profiler can usually observe wet tropics. This is often significantly on top of the most height coverage in different wet tropics.

Moreover, the radio frequency profiler [3] suffers from John William Strutt scattering from all provoking particles. Once the wind profiles measured frequencies profiler could provide measurements at an identical time. As degree outcome, analysis is compatible by the frequency's profiler and even precipitation identification. The provoke data can use to figure out the provoke kind. This frequencies identification has been used presently worldwide. This profiler purchases from an advertisement vendor for observance of the lower tropospheric winds, many operational applications on the brink of airports and all sides of major metropolitan areas. It appears that to provide flight information needed in want fundamental measure air quality models by quality air observance systems. These tools will finally offer a short-term forecast of air quality in urban air sheds. This analysis starts with a brief introduction of all the historical outline explaining lower tropospheric identification. Gift profiler hardware includes transmitter/receiver, system controller, particular signal method physics, phased array antennas. This hardware utilized in RASS techniques, information recording, and pulse writing shortly mentioned. A web pc of the profiler uses a graphical interface that narrates in some detail. A few samples of the profiler parameters area unit process choices, online spectral displays, and setup screens area unit relinquishment. The signal processor of real profiler time can dialogue. However, the profiler calculates S/N, spectral breadth, speed, and spectral dimension kind averaged physicist [23] spectra obtained at the same time at fifty or additional heights. During this analysis, the event of the 915 rate profilers has derived through the past decade.

Along with the fundamental aspects, both hardware and software components presented. In the processing of algorithms and the quality control procedures. Additionally, an in-depth description of aeronomy laboratory experience is earned in field experimentations and future explanations from the previous topics. Here we've over with an outline of the various capability's measurements—the event of the long-run of these profiler's look to steer in varied directions. The slight profiler delivers continuous development explanations for reflection of the air excellence. Among the lower layer, frequency profilers provide a cheap among the remote tropics. Precipitation activity is also created at an identical time like wind observations that profiler's area unit similar for the study of mesoscale convective system and low climatologies as half vapour contains among the lower layer, profiler's area unit in an exceedingly good state which will study status transport. The ability to diagnose and

observe motor clouds [15] suggests that they have to be compelled to supply variousvaluable data among the meteorology cloud system and vertical structure. The same observations are needed for the test to validate in the satellite.

To provide Two-dimensional pictures of a part wherever auroral [19]nonparticulate radiation absorption associated with energetic lepton precipitation, a spic-and-span instrument is being developed. Measurements unit conducted with the new device at pole discovered absorption activity to be very dynamic that occupies a small in region image during a plane. No matter sky brightness or weather [24] condition, this absorption imager may turn out continuous measurements all day, no matter a session. This can be one in every one of the many blessings of absorption imagery. This may monitor the measures unceasingly that amendment patterns of the particle precipitation, primarily beneath some conditions wherever the optical information is out of stock, represent the foremost necessity of the various studies of high latitude region and flux. We will also expect the information to be helpful for several applications like launchinga rocket here. The main scope is to find the location region of the precipitation in real-time [4].

The appearance of ground clutter in physicist measuring device measurements will seriously debase the rate estimates. This can be specifically true for discovering and going radio notice ion and go instrument measuring instrument live device} [13] wind profilers. They detect all the week signals that area unit gift in clear air. However,a weak muddle would possibly seriously bias all the wind estimates. Due to the symmetrical translation of circular velocities to parallel winds, these biases exaggerated. Profilers use frequency frequencies that get all the wind measurements at the point of ranges among those few hundred meters where will notice a variety of the muddle signals are durable. Vanishing of the flutter echo is due to atmospherically turbulence, wires, crooked trees, and lots of additional, which provides a finite spectral dimension that rolls out farther by window effects within the spectrum. Litter incorporates a severe drawback that recognized long back. Still, litter rejection algorithms utilized in an exceeding variety of the routine profiler operations, that area unit uncomplicated, like exchange the D.C. spectral half and plenty of points around the mean. This would possibly manufacture themselves generate a decent extent of biases. This could be multiple units as early profilers that technique data in time and had severe memory issues and method seed restrictions requiring simple algorithms. The matter in a ground litter is further natural compared to weather radars. The first reason for this could be data recorders, that area unit long, therefore good applied mathematics illustration is possible at intervals the litter signal and coming to the second, litter spectral breadth to clear air [16] spectral breadth relation that tends to be very little in profiler data compared to measuring system data. As a result, mounted beam directions used; thus, the litter signal not swollen by antenna motion and relative beam [20] widths of the numerous profilers, which generates exhaustive beam widening of the Christian Johann Doppler spectra. Still, filtering of data with low speed is further crucial in the measurements of a profiler. The other} profiler litter suppression algorithms [25] area unit a number of the least-squares approaches to muddle removal in time domain this mentioned in alternative papers. Spectral moments countable at intervals the method techniques like agreement averaging. These don't facilitate true, which can be in every estimate of speed. Frequency domain techniques like half-plane subtraction help remove all the spectral elements that unit radial concerning zero frequency unit attractiveness to profiler facts as a final alternative as profilers usually handle little or no man of science and substantial quantities of indication parts that are removed [5].

They have done some tests on some techniques by removing ground clutter effects and noted all the biased measurement results. Few degrees of the biases square measure notable for a sample, in weak perpendicular signals or low wind speed conditions, study biases unit comparable meteoric [18] movements. So here, the most aim is to stay down the result of chaos is most predominant. The wind profilers will achieve very little additional overhead once their square measures some substantial enhancements in ground litter treatment. So, by reducing the knowledge, significant development is probably going. With the strategy of de-trending, it's a heap of fascinating to use 3-point suppression. So, this overthrow is enough to slender once place next with characteristic clear mid-flight widths to provide cutting of the required signal, but there will be a reduction in a muddle to minimal levels. In the long run, it is a ton advisable to use digital filters [17]; once the signal rises on high of the noise level, power spectral points square measure sorted in ascending amplitude and may sight a chance in slope inside the distribution that resulted.

Similarly, if muddle is a gift at larger amplitudes, there'll be another break within the delivery. The information is re-filtered in additional comprehensive after we enable detective work remaining muddle. So, this approach will be able to differentiate echoes in precipitation in fifty Mc per second profiler info, which can habituate remove/detect bird contamination by exploitation 400-920 Mc per second profiler info. There's a priority like understanding the length of F.I.R. and I.I.R. filters to understand that investigation ought to do. Reducing the ocean muddle filters is also tailored, although we'd like another alternate technique for cluttering the targets like craft and birds. This paper's results provide additional counsel for radio detection and filter in the statistic for many samples of sequential AZ as one statistic. These may be used as sections of the filtered data point to recollect the angle [5].

3. CONCLUSION

In any profiler, the main parameter is height, so based upon the measurement, the radar waves or signals can capture using profilers. So, based upon the weather and layer of the atmosphere, the output will be calculable. Therefore in the profiler, each active and passive arrays are mountain thought-about to induce a most resolute end in any layer, but this C.B.L. works higher within the layer. The results might be degraded in alternative conferences within the morning session, and height is most regarding half during this profiler. If the layer's peak is on the far side of C.B.L. profilers, the results won't be that applicable. The most objective of this profile is to check the precipitations and atmospherically border coating dynamics. The system is designed with a digital receiver, pulse compression theme, and a right away immediate frequency, which ends up in flexibility and additional height coverage. The results are valid mistreatment G.P.S. The techniques chiefly devolve on direct observations and film foundations, by using C.B.L., these measurements evidenced. Besides, C.B.L. can offer the character of the surroundings, like depth and height. This profiler can become sensitive to clouds thanks to dullness within the lightweight and due drops. C.B.L. used chiefly to envision the standard of air. As this may diagnose the weather, it will track the standing and used for the long run use of the many applications in the area. A phased array radio radiation imager will capture continuous measurements although out the day regardless of a session to attain all the visual information, which is invisible concerning both latitude and longitude. Ground clutter is generating most noise to waves to reduce that in all the wind profilers by decreasing the data while filtering. When we want to trace the radio signal in sea and weather radar, we can break the particular

movement to an extent. The data will be reduced, and noise can be reduced so the resolution output can be obtained in time series by changing the signal's amplitude.

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