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Outpost Communication Signal Reduction due to Ionospheric Plasma Turbulence

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Abstract:

Attenuation of satellite communication signal by upper atmospheric plasma turbulence is of concern at higher signal frequencies. The molecular species such as are molecular oxygen, O_2 and water vapor (H_2O) are responsible for attenuation each of these molecules has its own set of frequencies where certain intermolecular resonances are excited. For satellite communication, the most important frequencies for resonance absorption are at 22 GHz in water vapor and 60 GHz in molecular Oxygen. The diversion of HF and some intermediate wave radio signals to Earth via the ionosphere gives increase to global HF radio transportations. This phenomenon becomes vital throughout sunshine hours, and for a little bit after sundown when the upper atmosphere is ionized.

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This idea has been deliberate by numerical analysis that comprises nasty nonconformity and probabilistic replicas are established to sightsee the ionospheric plasma turbulence. These models provided a comprehensive account of the fundamental procedure. The info reached from these estimates by examining these replicas can be additional engaged. The replicas offered in this session sideways with their corporeal clarifications are actual valuable for different linked society.

Key words: Attenuation, satellite, ionosphere, open system, plasma, turbulence

Introduction

Electromagnetic energy from the Sun ionizes particles of airborne in the reedy ionosphere of the Earth. The ions collect in numerous sheets, making the upper atmosphere at heights amid 85 and 1000 Km overhead the Earth's superficial. It is shaped of different five sheets D, E, F_{-1} and F_{-2} layers from the low to the high. Apiece sheet can reproduce radio waves. The earth base investigation of ionospheric plasma turbulence have been accepted out by DGS-sound, delivered us significant info visions into the space relation amid earth and interplanetary. The upper atmospheric area dishonesties amid sun and ground [1]. The sun is incessantly burning vigor to ionosphere, upper and lower atmosphere of the ground in the form of ultraviolet, extreme ultraviolet, and x-rays of the electromagnetic range. The degree of radiation of sun vigor from the sun is 3.8×10^{26} watt power and the degree at which the mass of the sun lessening per year 1.330×10^{17} Kg / year [2,3]. Annual consist of 3.16×10^{7} seconds / year. In special model of dependence entire vigor and mass are connected by mc^2. These energy have recurring and cyclical difference, disparity deliver numerous kinds of agitation in ionosphere. The diversion of HF and around intermediate wave radio indications to Earth via the upper atmosphere stretches increase to global HF radio transportations. This singularity develops likely throughout day hours, and for a little bit after sundown when the ionosphere is ionized.

Ionosphere parameters of higher thermosphere such as attention, agitation concentration, package rate and agitation package rate at air space it is significant to careful probabilistic simulations that permit for erraticism and relationship such simulations are significant for describing ionospheric plasma turbulence in term of factor. To clarify the evocative statistics about these relative ionospheric explanations, the rottenness theory for time series will be careful. It provide a brief description of inferior system in time series simulations.

Attenuation of Communication Signals

It has been known that turbulence affects the signal of radio wave thus attenuation occurs. This communication signal attenuation is comparable to frictional damage, since open electrons are produced to hesitate at the frequency of the communiqué indication, extracting vigor from it and misplaces some of that vigor in impact with other atoms in the ionosphere. Therefore, it can be supposed that the indication disappearing is due to both on the impact frequency and the electron concentration [4,5].

Plasma Turbulence

The interface between plasma and electromagnetic wave are recognized as plasma turbulence. The mingling of two different attentiveness gases at ionosphere is turbulence singularity.

Calculation of Plasma Wave Turbulence

We have computed plasma Turbulence flux of ionospheric layer at Pakistan region, by using perturbed electron concentration

(N‘) and perturbed parcel velocity (V'). Turbulent flow varies randomly with time at a location as shown in fig.1 (a), thus turbulent flow is unsteady [6].

The product $\overline{U^{/}N^{/}}$ represents the transport of turbulent flux:

$$\overline{U^{/}N^{/}} = \frac{U_E^{/}N_E^{/} + U_{F2}^{/}N_{F2}^{/}}{2}$$

$U_{F2}^{/}$ Perturbation velocity F2 layer

$U_E^{/}$ Perturbation velocity E layer

$N_{F2}^{/}$ Perturbation Plasma Concentration F2 layer

$N_E^{/}$ Perturbation Plasma Concentration E layer

Calculation Evocative Data

Concerning ionospheric plasma information for Asia upper space mentioning histogram and probabilistic plan to fig. 1(a), (b) & 2 and by the parametric standards assumed in Table 1.

Table 1: Evocative statistics

A _Squared	3.8
P-Value	0.01
Mean	2.50
St. Dev.	0.770
Variance	0.6
Skew-ness	1.1
Kurtosis	2.6
N	365
Min	0.81
1st. Quartile	1.921
Median	2.341
3rd. Quartile	2.9
Max	5.71
95% Confidence Interval for Mean	
2.40	2.50
95% Confidence Interval for median	
2.30	2.50

95% Confidence Interval for St. Dev.	
0.721	0.831

Time Series

A plasma turbulence time series data presented graphically as taking time along x-axis and the values of plasma turbulence time series along y-axis and then joining the plotted points by means of straight line.

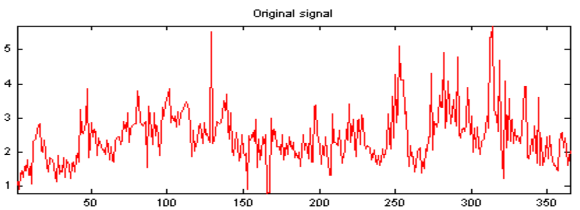

Fig. 1(a): Time series generated by plasma data at x-axis and y-axis are number of points and turbulence respectively.

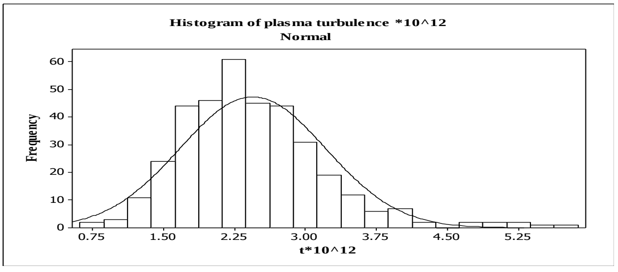

Fig. 1 (b): Histogram generated by plasma turbulence

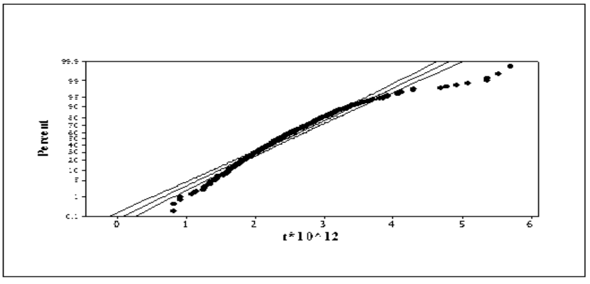

Fig. 2: Probability generated by plasma turbulence

Time Series Decomposition

An orderly arrangement of the statistical data by successive time periods is time series. Components of time series: the changes in the observations of a time series are due to four factors secular trend [T], seasonal variations [S], cyclic variations [C] and irregular variations [I]. Models of time series: the components of time series [T, S, C and I] may be associated in the form of a mathematical relationship [7,8]. This mathematical relationship between different components is model of a time series. Additive model { Y = T + S + C + I } and Multiple model { Y = T x S x C x I }

We expected plasma turbulence for the following 12 facts by information composed ended 365 facts, we applied the residuals from tendency examination to syndicate both tendency examination and rottenness for estimating. Fig. 3 exposed time series rottenness plan for plasma turbulence, stabilizer simulations and Table 2 exposed cyclical indices. Fig. 4 Constituent examination for plasma turbulence, stabilizer ideal innovative data and seasonally attuned data, Table 3 Predictions following retro for plasma turbulence.

M.A.P.E. = 25.8, M.A.D. = 0.56 and M.S.D. = 0.58

Table 2: Seasonal Indices

Period	Index
1	0.088746
2	0.183830
3	-0.139507
4	0.096122
5	-0.007830
6	-0.089409
7	-0.002020
8	0.011679
9	-0.067880
10	0.097894
11	-0.189293
12	0.017669

Table 3: Forecasts next period

Period	Forecast
366	2.35581
367	2.44319
368	2.45689
369	2.37733
370	2.54311
371	2.25592
372	2.46288
373	2.53396
374	2.62904
375	2.30571
376	2.54134
377	2.43738

Method of Least Squares

According to least squares method a trend is passed through the plotted points of a given time series data such that the sum of the squares of the deviations between the actual values and the trend values of the dependent variable y should be least.

The equation of trend line is $Y_t = 2.18759 + 0.00140777*t$. A trend line for plasma turbulence data and plot actual and trend values on the same graph.

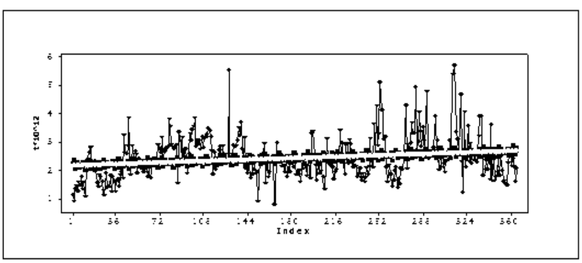

Fig. 3: Time Series Rottenness Plan, stabilizer simulations

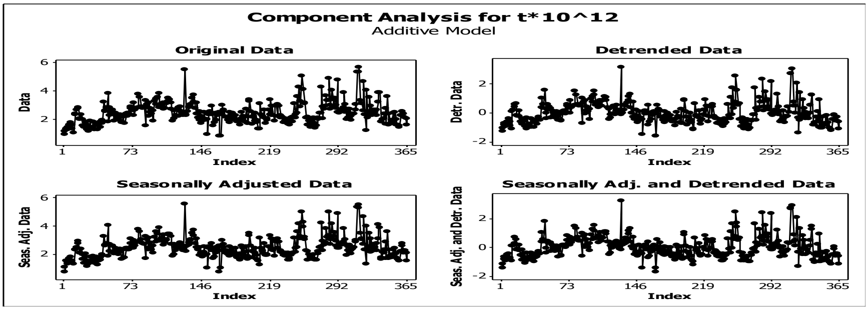

Fig. 4: Component analysis, stabilizer prototypical unique information and seasonally attuned information

Conclusion

Attenuation of satellite communication signal by upper atmospheric plasma turbulence is of concern at higher signal frequencies. In this broadside we have defined corporeal performance of turbulence at upper space by evocative data and rottenness technique. These simulations deliver complete account of procedure this method is fine clarified inside the computational examination that laterally with their corporeal clarifications is very valuable for altered group.

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REFERENCES

[1] Dieter Biskamp, "Magneto hydrodynamics Turbulence", (2003), Cambridge, UK

[2] J. K. Hargreaves, "The Upper Atmosphere and Solar-Terrestrial Relations", (1979), Van Nostrand Reinhold Co Ltd U.S.A.

[3] John R. Herman and Richard A. Goldberg, "Sun Weather and Climate", (1985), Dover Publications, Inc, New York.

[4] Adrian Graham, "Communications Radar and Electronic Warfare", (2011), John Wiley & Sons Ltd. U.K.

[5] Peter. O. Taylor, "Observing the Sun", I.S.T. published (1991), Cambridge University Press.

[6] S. Makridakis, "Forecasting Methods and application" 2nd Ed, (1983), John Wiley and sons, Inc. Canada

[7] Daniel S. Yates, David S. Moar and George P. Mc. Cabe, "the Practice of Statistics", (1996), W H Freeman and company, New York.

[8] Allan H. Murphy and Richard W. Katz, "Probability, Statistics, and decision making in the Atmospheric Sciences", (1985) by West view Press, Ine Boulder and London