The Nonlinear Electromagnetic Spectrum Frequency Scale

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Abstract – Electromagnetic geophysical studies have been using very low electromagnetic frequencies, below 1 Hz, transmitters and receivers for several decades. The devices that produce these frequencies are referred to as magnetotelluric transmitters and receivers. The frequencies for these devices are being identified by using a decimal notation, 0.1, 0.01, 0.001, 0.0001, 0.00001 Hz and below. Accepting frequency designations as tens divisions of one reveals that the current EM frequency scale is nonlinear. You can mathematically divide a unique unit of measurement into smaller and smaller parts, but this does not produce a mathematically equivalent relationship when there is an irrevocable inverse relationship between two different measurement values. Because of this lack of equivalency, all contemporary physical law equations that contain frequency directly or indirectly are invalid.

Introduction

Electromagnetic (EM) waves are a cyclic phenomenon. A cyclical phenomena is any repetitive or recurring process in which a sequence of events is followed by an identical sequence. Identifying the basic period of a cyclic phenomena requires observing multiple periods of a particular phenomenon to determine the time duration that encompasses the longest cyclic period. Some two centuries ago there were no detectors available when the EM phenomena was first being studied that could detect an EM wave that had a frequency of 1 cycle per second or lower. H. Hertz did not have that capability.

If the time period of the longest wave of a periodic function is not properly identified, you cannot use decimal fractions of frequency to identify frequency. The only thing that accomplishes is identifying the fraction of a particular wavelength that has a frequency below 1 Hz that can occur in a 1 second time duration.

History

The problem that resulted in a nonlinear EM frequency scale began when the duration of the second could be measured to some degree of precision. The first timing devices that could measure a period of one second reasonably accurately were the pendulum clocks invented in the 17th century. The duration of the second is classically defined as $1/86400^{th}$ of the rotation of the Earth. Ephemeris time improved the precision of the second. Atomic clocks are providing increased time measurement precision. Irrespective of the accuracy of the measurement device. When the basis for a time measurement duration is the time duration division of some small planets' rotation out of millions of planets in a galaxy, it has limited scientific measurement value.

The first known use of the term electromagnetic was about 1820 when the shortest measureable standard duration of time was the second. Who, or those that choose to use the duration of the second to define EM frequency some two centuries ago is not important now, but it is important today to ascertain why the EM frequency scale nonlinear characteristic was not immediately recognized when magnetotelluric devices (MTD) first produced EM waves with a frequency below 1 Hz. Magnetotelluric devices that use tens divisions of one for frequency have been in use for several decades. It is assumed electrical engineers were involved in developing the MTD that would produce EM frequencies below 1 Hz. Geophysicists would be involved with the use of the devices. Both disciplines require basic physics educations where they would be introduced to EM principles and the formula $\mathbf{c=\lambda f}$, where $\mathbf{c}$ is the speed of light, $\boldsymbol{\lambda}$ is the wavelength and $\mathbf{f}$ is the frequency. Why the electrical engineers did not recognize the issue is unknown. Mathematicians should have recognized the lack of equivalency as soon as a zero was placed between the decimal point and the number one.

Basic physics does not teach why the length of the EM wavelength at a frequency of 1 Hz is based upon the duration of the second. If this were taught, the presence of a nonlinear EM frequency scale would have been noted long before MTD produced EM frequencies below 1 Hz.

The scientific authority structure (SAS), a Thomas Kuhn term, is consistently guilty of condoning cargo cult science (CCS), a Richard Feynman term. Richard Feynman introduced the term CCS in his 1974 commencement address to the graduation class of the California Institute of Technology. CCS is the process of reaching a conclusion based upon incomplete information. It is not difficult to identify CCS conclusions made by the SAS over the centuries. The most recent overturned CCS conclusion is the crystal symmetry conclusion that held sway as settled science for over a century. Quasi crystals are now an accepted crystal symmetry form. Very few reports identify the issue that was the cause of the CCS conclusion. The xray equipment commonly used by crystallographers did not have the resolution the tunnelling electron microscope that Dan Shechtman used.

There is supposed to be a difference between scientific inquiry and indoctrination. The SAS consistently follows the Prussian education indoctrination system, which at the moment is the dominate teaching process worldwide. Current science texts do not describe how scientists some two centuries ago identified the longest period of the cyclic phenomenon that we call EM waves. Similarly, multiple conclusions have been made about the characteristics of the the Sun and the universe before it was known that EM waves, other than light, were propagating throughout the universe. [1-2] A major part of the problem is having not identified the purpose for the existence of EM waves.

Harmonics and Heterodynes

Harmonics and heterodynes are characteristics of EM waves and it is desirable to be able to properly detect their presence. The current nonlinear EM frequency scale allows identifying harmonics of frequencies above 1 Hz and additive heterodynes above 1 Hz, at least for those frequencies we have instruments to detect. As our technical capabilities allow the detection and use of frequencies below 1 Hz, it is desirable to have spectrum analyzers that can identify if a frequency being detected is a fundamental, a heterodyne or a harmonic.

Conclusion

Every physical law equation (PLE) that contains a variable for frequency (f) or a value that is specifically structured using frequency, such as **c,** will need to be critically examined to determine how the nonlinear EM frequency scale impacts their validity.

An IEEE paper offers a mitigation of the nonlinear EM spectrum frequency scale. [3]

From an electrical engineers perspective, EM waves exist for the purpose of energy transfer.

References

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[2] Reber, Grote National Radio Astronomy Laboratory “Grote Reber and his Radio Telescope” https://www.nrao.edu/whatisra/hist_jansky.shtml

[3] Makinson, F. H. “A methodology to define physical constants using mathematical constants.” IEEE Potentials Vol: 30, Issue: 4, July-Aug. 2011 Page(s): 39 - 43 Date: 25 July 2011 ISSN: 0278-6648 INSPEC Accession Number: 12136007 DOI: 10.1109/MPOT.2011.940377