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Wave Propagation Processes Coupling with Ionospheric and/or Space Charge Irregularities Cooperating Together the Weather Activities: The Phantom Signal Effects in Communication Processes from Irregular Plasma

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Abstract

The waves are studied in a homogeneous isotropic space generating from irregularly deviating plasma. The wave equation is derived for mediums involving irregularly deviating objects and non-uniform charge distributions as differing from classical electromagnetism, which states the contribution of a stationary or moving surface to the electromagnetic field for smooth and regular cases; those are extended for either charges and currents on the surfaces when environs contain bodies, which make irregular motions or charge and current distributions, which are uncommon or irregular. If a convenient a priori statement is added then the extensions are possible. Those a priori stated extensions add new terms to Maxwell's equations. This paper reports the results handling the electromagnetic waves in cases both irregular and uncommon for both objects and sources.

1. Introduction

The studies of electromagnetic phenomena related with media, where characteristics change irregularly, still have some open problems, unclear points of view, and analytical difficulties [1, 2]. We can count geo-electromagnetism, geomagnetism, plasma physics, magneto hydrodynamics, fluid dynamics, space science, and the observations of great earthquakes among them. What can we say about the effect of irregularly moving objects in external electromagnetic radiation? The opposite of this question is the other side of the topic; i.e., what is the effect of external electromagnetic radiation to the object moving non-uniformly? There are a lot of studies related with discontinuous cases [3] and non-smooth analysis [4] in literature. There is no reason why we do not extend our analytical studies on electromagnetism to non-smooth [5] and irregular cases [6]. The Author suggests some alterations and generalizations about motions in oscillating and/or vibrating cases for deviations like vibration but irregular and/or uncommon cases. The definitions in below section open the way for this generalization.

2. Extension of Motion to Uncommon Cases

Definition 1 *(Irregular push/pull-like Motion, Ip_p-lM)*: Following theoretical experiment can open the way to reply the above said question: *Example 1*- Let us put a continuous charge distribution with a density ρ in a volume V around a surface S_1 when $t=t_1$ in Figure 1. Let us accelerate the charges toward surface S_2 along a path $L_{12}(P;t)$, where P illustrates a point on the smooth curve L_{12}, and pull it back in a different path; i.e., along a curve $L_{21}(P;t)$ to surface S_1 when $t=t_2$. The points P_1, P_2, P_2', and P_1' are irregular points of the paths and/or their vicinities are non-smooth (see Figure 1b). The unit tangential vector to the path $L_{12}L_{21}(P;t)$ is discontinuous and has not derivatives on S_2 and S_1. What happens if charge distribution repeats this motion, irregularly? There must be an additional effect, which may have an external or inner effect, to break the path on S_2 and S_1. This is an extended case to ordinary oscillation, which I call *regular* and/or *smooth oscillation*. This case of motion is different from a smooth oscillation in fact. The categorizations of *irregular* and *uncommon* cases are collected in following two definitions:

Definition 2 *(Generalized Oscillatory Motions Family)*: The Author calls this case *generalized oscillatory motion* of a charge distribution. The generalized oscillatory motion has a period T such that the period depends on time t; i.e., T=T(t). We can consider a more general case where the period depends on the space coordinates; i.e., $T=T(\vec{r};t)$. I call this more general case *universal oscillatory motion*. Here, t and $\vec{r}$ illustrate the time coordinate and radial displacement vector of the observation point P. The Author calls all of the uncommon, irregular, non-uniform, and/or non-smooth motions involving both *regular oscillation* and irregular cases as *oscillation-like* motions *generalized oscillatory motions family (GOMsF)*.

Definition 3 *(Universal Periods Family)***:** The Author calls *uncommon period* when T=T(t) and *irregular period* when $T= T(\vec{r};t)$. I call *stationary period* when $T=T(\vec{r})$. All of the regular, irregular, non-uniform, and/or uncommon periods are members of *Universal Periods Family (UPsF)*.

There is a discontinuity in the flow mechanism during a motion element of generalized oscillatory motions family. There are similar discontinuities when a surface deviates irregularly similar to a *vibration-like motion*. There are sharp discontinuities at the velocity and acceleration vectors of irregularly moving surfaces. What is the effect of the irregularity at the regions of sharp transitions on the path of generalized oscillatory motions families? There are objects and/or uncommon or non-uniform charge distributions, which move in generalized oscillatory motions family. Fano, *et. all.* explain the effects related with moving bodies for uniform and regular case in [7]; however, Maxwell's classical electromagnetic theory cannot give the induction currents and induced charges on surfaces moving irregularly in uncommon *vibration-like paths* as in this example, so some new extensions are necessary.

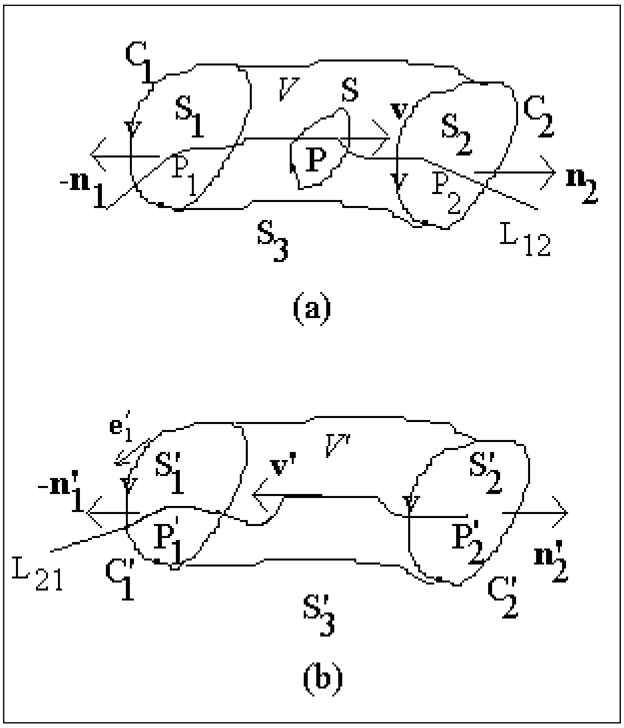

Figure 1. The irregularly moving surface S_1 in a push/pull-like deviation process on a vibration-like path $L=L_{12}L_{21}L_{12}$.

An extension to Faraday's law [8, 9] was given [10] in this manner. In this paper, the Author studies on the cumulative extensions of wave equations to uncommon irregularly deviating cases both objects and/or sources by extending Ampère's law [11, 12].

3. The Wave Equation for Irregularly Motion

Let us consider a region V moving on an irregularly vibration-like path with generalized period T along the path L and a small surface S in the normal plane of vibration-like path L in Figure 1. The field equations are extended to below equations in irregular push/pull-like motion case:

$$rot\left\{\boldsymbol{H}+\boldsymbol{v}_{bir}\wedge\boldsymbol{D}+T\boldsymbol{v}_{cir}\wedge\frac{\partial\boldsymbol{D}}{\partial t}\right\}=\frac{\partial\boldsymbol{D}}{\partial t}+\boldsymbol{J}^{e} \quad (1).$$

$$rot\left\{\boldsymbol{E}+\boldsymbol{v}_{bir}\wedge\boldsymbol{B}+T\boldsymbol{v}_{cir}\wedge\frac{\partial\boldsymbol{B}}{\partial t}\right\}=-\frac{\partial\boldsymbol{B}}{\partial t}+\boldsymbol{J}^{m} \quad (2).$$

$\boldsymbol{v}_{bir}$ and $\boldsymbol{v}_{cir}$ are backward velocity for irregularity history and cumulative velocity for irregularity history, respectively and defined below:

$$\boldsymbol{v}_{bir}=\frac{\boldsymbol{v}_{ir}}{2},\qquad \boldsymbol{v}_{cir}=\frac{\boldsymbol{v}_{fir}}{2} \quad (3).$$

$$\boldsymbol{v}_{ir}=\boldsymbol{v}+\boldsymbol{v}',\qquad \boldsymbol{v}_{fir}=\frac{\boldsymbol{v}_{ir}+\boldsymbol{v}'}{2} \quad (4).$$

$\boldsymbol{v}$ and $\boldsymbol{v}'$ are forward velocity and forward velocity for irregularity, respectively. The Author calls $\boldsymbol{v}_{ir}$ and $\boldsymbol{v}_{fir}$ irregularity velocity and forward velocity for irregularity history, respectively.

3.1 Interaction Between the External Fields and Irregularly Deviating Charges

The wave equation for irregularly deviating plasma is derived from Equations (1) and (2) and given below for electric field **E** when an external magnetic field **H** is stimulated in a homogeneous isotropic medium:

$$\Delta\boldsymbol{E}-\varepsilon\mu(1-Tdiv\boldsymbol{v}_{cir})^{2}\frac{\partial^{2}\boldsymbol{E}}{\partial t^{2}}+\varepsilon\mu(1-Tdiv\boldsymbol{v}_{cir})Tdiv\boldsymbol{a}_{cir}\frac{\partial\boldsymbol{E}}{\partial t}+\varepsilon\mu[(div\boldsymbol{v}_{bir})^{2}-(1-Tdiv\boldsymbol{v}_{cir})div\boldsymbol{a}_{bir}]\boldsymbol{E}==\boldsymbol{G}_{E}(\vec{\boldsymbol{r}};\boldsymbol{t}) \quad (5).$$

$$\boldsymbol{G}_{E}(\vec{\boldsymbol{r}};\boldsymbol{t})=\mu\left[\boldsymbol{H}\wedge graddiv\boldsymbol{v}_{bir}+T\frac{\partial\boldsymbol{H}}{\partial t}\wedge graddiv\boldsymbol{v}_{cir}\right]+\boldsymbol{\mu}div\boldsymbol{v}_{bir}\left(-\boldsymbol{J}^{e}+\rho^{e}\boldsymbol{v}_{bir}-T\boldsymbol{v}_{cir}\frac{\partial\rho^{e}}{\partial t}\right)+\mu(1-Tdiv\boldsymbol{v}_{cir})\left[\frac{\partial\boldsymbol{J}^{e}}{\partial t}-\rho^{e}\boldsymbol{v}_{bir}-\rho^{e}\boldsymbol{a}_{bir}+T\left(\boldsymbol{a}_{cir}\frac{\partial\rho^{e}}{\partial t}+\boldsymbol{v}_{cir}\frac{\partial^{2}\rho^{e}}{\partial t^{2}}\right)\right]+grad\frac{\rho^{e}}{\varepsilon}+\rho^{m}rot\boldsymbol{v}_{bir}-\boldsymbol{v}_{bir}\wedge grad\rho^{m}+T\frac{\partial\rho^{m}}{\partial t}rot\boldsymbol{v}_{cir}-T\boldsymbol{v}_{cir}\wedge grad\frac{\partial\rho^{m}}{\partial t} \quad (6).$$

The terms $\boldsymbol{a}_{bir}$ and $\boldsymbol{a}_{cir}$ are backward acceleration for irregularity history and cumulative acceleration for irregularity history, respectively. The definitions of these accelerations are below:

$$\boldsymbol{a}_{bir} = \frac{\partial \boldsymbol{v}_{bir}}{\partial \boldsymbol{t}}, \qquad \boldsymbol{a}_{cir} = \frac{\partial \boldsymbol{v}_{cir}}{\partial \boldsymbol{t}} \qquad (7).$$

The interaction mechanism will induce the deviation terms. The deviation in magnetic flux created these terms makes the contribution below in the electromagnetic forces, where S is union of S_1, S_2, and S_3 in Figure 1:

$$-\frac{T}{2} \oiint \frac{\boldsymbol{v} + 2\boldsymbol{v}'}{2} \wedge \frac{\partial \boldsymbol{B}}{\partial t} \cdot d\boldsymbol{S} \qquad (8).$$

The irregularities and uncommon cases, which occur in some phenomena of electromagnetic spectrum before, during, and after the significant hazardous interactions involving plasma moving vibration-like paths brings some additional electromagnetic fields and forces those might be significant [13-17].

4. Conclusions

The wave equation for irregularly deviating plasma in a homogeneous isotropic medium is derived. If the electrical charges move irregularly and their velocities vary on vibration-like paths with respect to time then it brings some additional electromagnetic fields and forces those might be significant. This situation results generating some new trends in plasma and space weather related areas. These trends give non-simple but very clear explanations for the irregularities and uncommon cases, which occur in some natural events related to electromagnetic spectrum before, during, and after the hazardous effects in nature.

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