SPACETIME PROPERTIES IN FLUID ELECTRODYNAMICS INDUCED BY MATERIAL FIELDS AND POTENTIALS.

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ABSTRACT

It is shown that material or circuit potentials and electric and magnetic fields induce fluid dynamical properties in the surrounding spacetime (or vacuum or aether) as a direct result of ECE2 unified field theory. The spacetime becomes a richly structured fluid characterized by all the properties of fluid dynamics. The fluid dynamical spacetime induces potentials and electric and magnetic fields in a circuit, as observed in UFT311.

Keywords: ECE2, fluid electrodynamics, aether fluid dynamics induced by material fields and potentials.

UFT 356

1. INTRODUCTION

In recent papers of this series {1-12} the subject of fluid electrodynamics has been initiated, a subject which is based on ECE2 unified field theory and which merges electrodynamics and fluid dynamics. In this paper consideration is given to fluid dynamical properties induced in the spacetime of aether surrounding the potentials and electric and magnetic fields of a material or circuit. The spacetime or aether or vacuum becomes a fluid characterized by properties precisely analogous to those of a material fluid. This type of spacetime induces potentials and electric and magnetic fields in another circuit or material.

This paper is a condensed synopsis of detailed calculations contained in the background notes accompanying UFT356 on www.aias.us. Note 356(1) describes the spacetime velocity field induced by a plane wave and B(3) field. Note 356(2) repeats note 356(1) for the material magnetic field induced by a circular current loop. Note 356(3) defines the spacetime velocity field induced by a material electric field. Note 356(4) calculates the spacetime velocity field due to a static electric field in spherical polar coordinates. Note 356(5) gives a particular solution of Note 365(4). Note 356(6) calculates the spacetime velocity field in the Cartesian coordinate system. Note 356(7) calculates the spacetime velocity field directly from the material vector potential, giving several examples. Note 356(8) calculates a range of spacetime fluid dynamical properties from the velocity field.

Section 2 gives a summary of the basic method, together with example calculations, and Section 3 summarizes the computational and graphical work for this paper, giving examples of the fluid dynamical properties of the spacetime or aether surrounding a circuit for example, or any material. In fluid electrodynamics,, spacetime or the vacuum or the aether is a richly structured fluid. Potentials and electric and magnetic fields can induce fluid dynamical properties in the aether, which can in turn induce material potentials and fields.

2 SUMMARY OF METHOD AND EXAMPLES.

Consider the velocity field $\underline{v}_F$ of any fluid. As in UFT349, 351-353 and 355, the fluid magnetic field is defined by the vorticity $\underline{w}_F$:

$$\underline{B}_F = \underline{w}_F = \underline{\nabla} \times \underline{v}_F \quad -(1)$$

and the fluid electric field is defined by:

$$\underline{E}_F = \left(\underline{v}_F \cdot \underline{\nabla} \right) \underline{v}_F . \quad -(2)$$

The fluid velocity field itself is the fluid vector potential:

$$\underline{W}_F = \underline{v}_F . \quad -(3)$$

Define:

$$x := \left(\frac{\rho}{\rho_m} \right) (\text{material}) \quad -(4)$$

where ρ_m is the mass density of the material, and ρ is its charge density. It follows that the vector potential $\underline{W}$, electric field strength $\underline{E}$ and magnetic flux density $\underline{B}$ of a material in contact with spacetime or the aether are defined by:

$$\underline{W} = x \underline{W}_F , \quad \underline{E} = x \underline{E}_F , \quad \underline{B} = x \underline{B}_F \quad -(5)$$

in any coordinate system.

For example consider a static electric field in the spherical polar coordinate system as in Note 356(4):

$$\underline{E} = \frac{-e}{4\pi \epsilon_0 r^2} \underline{e}_r = x \left(\underline{v}_F \cdot \underline{\nabla} \right) \underline{v}_F \quad -(6)$$

where - e is the charge on the electron, $\underline{e}_r$ is the radial unit vector, r the distance between two charges and ϵ_0 the S. I. permittivity in vacuo. Eq. (6) is a non linear partial differential equation in the spacetime velocity field $\underline{v}_F$. It may be solved using advanced code packages designed for use with systems of partial differential equations. The system of relevance to a static electric field is as follows:

$$E_r = -\frac{e}{4\pi\epsilon_0 r^2} = x\left(\underline{v}_F\cdot\underline{\nabla}\right)v_{rF} \quad -(7)$$

$$E_\phi = 0 = x\left(\underline{v}_F\cdot\underline{\nabla}\right)v_{\phi F} \quad -(8)$$

$$E_\theta = 0 = x\left(\underline{v}_F\cdot\underline{\nabla}\right)v_{\theta F} \quad -(9)$$

and may be solved using Maxima to give the solution:

$$v_{RF} = \frac{\left(-\frac{e r^3}{\epsilon_0 x} - \frac{12\pi C}{x}\right)^{1/2}}{(6\pi)^{1/2}\, r^2} \quad -(10)$$

where C is a constant of integration. This solution is graphed in Section 3. The same type of solution applies to a gravitational field:

$$\underline{g} = -\frac{MG}{r^2}\underline{e}_r \quad -(11)$$

where G is Newton's constant and m and M are gravitating masses separated by a distance r,

$$\underline{F} = m\underline{g} = -\frac{mMG}{r^2}\underline{e}_r \quad -(12)$$

A gravitational field sets up fluid dynamical properties in the surrounding spacetime according the philosophy of ECE2.

To illustrate the method in Cartesian coordinates consider a static electric field aligned in the Z axis:

$$\underline{E} = -\frac{e}{4\pi\epsilon_0 Z^2}\underline{k} = x\left(\underline{v}_F\cdot\underline{\nabla}\right)\underline{v}_F. \quad -(13)$$

It follows that the system of equations to be solved is:

$$E_Z = x\left(v_{FX}\frac{\partial}{\partial X} + v_{FY}\frac{\partial}{\partial Y} + v_{FZ}\frac{\partial}{\partial Z}\right)v_{FZ} = -\frac{e}{4\pi\epsilon_0 Z^2} \quad -(14)$$

$$E_Y = x\left(v_{FX}\frac{\partial}{\partial X} + v_{FY}\frac{\partial}{\partial Y} + v_{FZ}\frac{\partial}{\partial Z}\right)v_{FY} = 0 \quad -(15)$$

$$E_Z = x\left(v_{FX}\frac{\partial}{\partial X} + v_{FY}\frac{\partial}{\partial Y} + v_{FZ}\frac{\partial}{\partial Z}\right)v_{FX} = 0 \quad -(16)$$

There are three non linear differential equations in three unknowns. These need advanced methods of numerical solution which can be developed in later work for any boundary conditions.

The above equations are augmented by Eq. (5a), which calculates the spacetime velocity field $\underline{v}_F$ directly from the material vector potential $\underline{W}$ of ECE2 theory. Knowing $\underline{v}_F$, the $\underline{B}_F$ and $\underline{E}_F$ of the spacetime can be calculated without having to solve differential equations. The $\underline{B}_F$ and $\underline{E}_F$ of spacetime induce material electric and magnetic properties as follows:

$$\underline{E} = x\,\underline{E}_F, \quad \underline{B} = x\,\underline{B}_F \quad -(17)$$

and this is energy from spacetime, an unlimited source of energy currently being considered by a House of Commons select committee (see UFT311).

Various types of material vector potential are listed in Note 356(7), and each type is used to compute spacetime properties using Maxima, as summarized in Section 3.

Having computed the $\underline{v}_F$ induced in spacetime by material potentials and fields, Note 356(8) lists some fluid dynamical properties of spacetime (or aether or vacuum), all of which are calculable from $\underline{v}_F$. These are the following aether properties.

1) The induced aether acceleration field, defined by:

$$\underline{a}_F = \frac{\partial \underline{v}_F}{\partial t} + (\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \quad -(18)$$

where:

$$(\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F = \frac{1}{2} \underline{\nabla} v_F^2 - \underline{v}_F \times (\underline{\nabla} \times \underline{v}_F) \quad -(19)$$

2) The induced fluid electric charge of the aether:

$$q_F = \underline{\nabla} \cdot \underline{E}_F . \quad -(20)$$

3) The induced fluid electric current of the aether:

$$\underline{J}_F = a_0^2 \, \underline{\nabla} \times (\underline{\nabla} \times \underline{v}_F) - \frac{\partial \underline{E}_F}{\partial t} \quad -(21)$$

where a_0 is an assumed constant speed of sound,

$$a_0 = \text{constant}. \quad -(22)$$

4) The induced aether Lorenz condition:

$$\frac{\partial \underline{\Phi}_F}{\partial t} + a_0^2 \, \underline{\nabla} \cdot \underline{v}_F = 0 \quad -(23)$$

where $\underline{\Phi}_F$ is the scalar potential defined in UFT355.

5) The induced aether magnetic field, defined by the vorticity:

$$\underline{B}_F = \underline{W}_F = \underline{\nabla} \times \underline{v}_F . \quad -(24)$$

6) The induced aether electric field, defined by:

$$\underline{E}_F = (\underline{v}_F \cdot \underline{\nabla}) \underline{v}_F \quad -(25)$$

$$= \frac{1}{2} \underline{\nabla} v_F^2 - \underline{v}_F \times (\underline{\nabla} \times \underline{v}_F)$$

$$= - \underline{\nabla} \underline{\Phi}_F - \frac{\partial \underline{v}_F}{\partial t} .$$

7) The induced aether wave equations:

$$\Box \underline{\Phi}_F = q_F \quad -(26)$$

and

$$\Box \underline{v}_F = \frac{1}{a_0^2} \underline{J}_F \quad -(27)$$

where the d'Alembertian is defined by:

$$\Box := \frac{1}{a_0^2} \frac{\partial^2}{\partial t^2} - \nabla^2 \quad -(28) .$$

8) The induced aether enthalpy gradient:

$$\underline{\nabla} h_F = \frac{1}{\rho_F} \underline{\nabla} P_F = - \frac{\partial \underline{v}_F}{\partial t} - \underline{E}_F . \quad -(29)$$

9) The induced baroclinic torque of the aether:

$$\frac{1}{\rho_F^2} \underline{\nabla} \rho_F \times \underline{\nabla} P_F = \frac{\partial \underline{w}_F}{\partial t} + \underline{\nabla} \times (\underline{w}_F \times \underline{v}_F) - \frac{1}{R_F} \nabla^2 \underline{w}_F \quad -(30)$$

where R_F is the induced Reynolds number of the aether.

10) The induced Reynolds number of the aether for an assumed zero baroclinic torque:

$$\frac{\partial \underline{w}_F}{\partial t} + \underline{\nabla} \times (\underline{w}_F \times \underline{v}_F) = \frac{1}{R_F} \nabla^2 \underline{w}_F . \quad -(31)$$

All these quantities can be computed and graphed for any material vector potential.

Spacetime properties in fluid electrodynamics induced by material fields and potentials

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3 Computations and graphics

We start with the important operator $(\mathbf{v}\cdot\boldsymbol{\nabla})\mathbf{v}$. This is part of the total derivative of variables, sometimes named the convective derivative or material derivative. In the examples of this paper, in particular Eq. (6), it has to be expressed in spherical coordinates. In detail, this operator in cartesian, cylindrical and spherical coordinates is for arbitrary vector functions $\mathbf{a}$ and $\mathbf{b}$ [13]:

$$(\mathbf{a}_{\mathrm{cart}}\cdot\boldsymbol{\nabla})\mathbf{b}_{\mathrm{cart}}=\begin{bmatrix} a_X\frac{\partial b_X}{\partial X}+a_Y\frac{\partial b_X}{\partial Y}+a_Z\frac{\partial b_X}{\partial Z}\\ a_X\frac{\partial b_Y}{\partial X}+a_Y\frac{\partial b_Y}{\partial Y}+a_Z\frac{\partial b_Y}{\partial Z}\\ a_X\frac{\partial b_Z}{\partial X}+a_Y\frac{\partial b_Z}{\partial Y}+a_Z\frac{\partial b_Z}{\partial Z}\end{bmatrix}, \tag{32}$$

$$(\mathbf{a}_{\mathrm{cyl}}\cdot\boldsymbol{\nabla})\mathbf{b}_{\mathrm{cyl}}=\begin{bmatrix} a_r\frac{\partial b_r}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_r}{\partial \theta}+a_Z\frac{\partial b_r}{\partial Z}-\frac{a_\theta b_\theta}{r}\\ a_r\frac{\partial b_\theta}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_\theta}{\partial \theta}+a_Z\frac{\partial b_\theta}{\partial Z}+\frac{a_\theta b_r}{r}\\ a_r\frac{\partial b_Z}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_Z}{\partial \theta}+a_Z\frac{\partial b_Z}{\partial Z}\end{bmatrix}, \tag{33}$$

$$(\mathbf{a}_{\mathrm{sph}}\cdot\boldsymbol{\nabla})\mathbf{b}_{\mathrm{sph}}=\begin{bmatrix} a_r\frac{\partial b_r}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_r}{\partial \theta}+\frac{a_\phi}{r\sin\theta}\frac{\partial b_r}{\partial \phi}-\frac{a_\theta b_\theta+a_\phi b_\phi}{r}\\ a_r\frac{\partial b_\theta}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_\theta}{\partial \theta}+\frac{a_\phi}{r\sin\theta}\frac{\partial b_\theta}{\partial \phi}+\frac{a_\theta b_r}{r}-\frac{a_\phi b_\phi\cot\theta}{r}\\ a_r\frac{\partial b_\phi}{\partial r}+\frac{a_\theta}{r}\frac{\partial b_\phi}{\partial \theta}+\frac{a_\phi}{r\sin\theta}\frac{\partial b_\phi}{\partial \phi}+\frac{a_\phi b_r}{r}+\frac{a_\phi b_\theta\cot\theta}{r}\end{bmatrix}. \tag{34}$$

The operator (34) for spherial coordinates has to be used in Eq. (6), leading to the solution for the radial velocity component

$$v_r=\pm\frac{e}{\sqrt{2\pi\epsilon_0 x}}\sqrt{\frac{1}{r}-c} \tag{35}$$

with an integration constant c. This is a function of type $1/\sqrt{r}$ and has been graphed in Fig. 1 for three values of c. Setting $c>0$ gives imaginary solutions, and $c<0$ gives asymptotes different from zero for $r\to\infty$, therefore $c=0$ seems to be the physically best choice.

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In the following we will consider examples for vector potentials of given material fields. These give rise to spacetime fluid effects as described by Eqs. (18-31). We will present selected cases with graphics.

3.1 Simple rotating field

The first example is a magnetic vector potential

$$\mathbf{W} = \frac{B^{(0)}}{2} \begin{bmatrix} Y \\ -X \\ 0 \end{bmatrix}. \tag{36}$$

This gives a spacetime velocity field

$$\mathbf{v}_F = \frac{\rho}{\rho_m}\mathbf{W} = \frac{B^{(0)}\rho}{2\rho_m} \begin{bmatrix} Y \\ -X \\ 0 \end{bmatrix} \tag{37}$$

and the resulting vacuum electric field

$$\mathbf{E}_F = (\mathbf{v}_F \cdot \boldsymbol{\nabla})\mathbf{v}_F = \frac{(B^{(0)})^2\rho^2}{4\rho_m^2} \begin{bmatrix} -X \\ -Y \\ 0 \end{bmatrix}. \tag{38}$$

Eq. (37) describes a rigid mechanical rotation since the rotation velocity rises linearly with radius, see Fig. 2. The total derivative operator transforms this into a central electric field, also increasing linearly with radial distance. The velocity field is that of a rigid body but there is no classical counterpart for the induced electric field. The spacetime velocity further induces a magnetic field

$$\mathbf{B}_F = \boldsymbol{\nabla} \times \mathbf{v}_F = \frac{B^{(0)}\rho}{\rho_m} \begin{bmatrix} 0 \\ 0 \\ -1 \end{bmatrix} \tag{39}$$

which is constant everywhere, and a constant Kambe charge density

$$q_F = \boldsymbol{\nabla} \cdot \mathbf{E}_F = -\frac{(B^{(0)})^2\rho^2}{2\rho_m^2}. \tag{40}$$

The stationary part of the fluid electric current vanishes:

$$\mathbf{J}_F = a_0^2 \boldsymbol{\nabla} \times (\boldsymbol{\nabla} \times \mathbf{v}_F) = 0. \tag{41}$$

3.2 Plane wave potential

A potential for plane waves in the circular cartesian basis is given by

$$\mathbf{W} = \frac{W^{(0)}}{\sqrt{2}} \exp(i\omega t - \kappa_Z Z) \begin{bmatrix} 1 \\ -i \\ 0 \end{bmatrix} \tag{42}$$

where ω is the time frequency and κ_Z the wave vector component in Z direction. The derived spacetime quantities are

$$\mathbf{v}_F = \frac{W^{(0)}}{\sqrt{2}} \frac{\rho}{\rho_m} \exp(i\omega t - \kappa_Z Z) \begin{bmatrix} 1 \\ -i \\ 0 \end{bmatrix}, \tag{43}$$

$$\mathbf{E}_F = 0, \tag{44}$$

$$\mathbf{B}_F = \kappa_Z \frac{W^{(0)}}{\sqrt{2}} \frac{\rho}{\rho_m} \exp(i\omega t - \kappa_Z Z) \begin{bmatrix} 1 \\ -i \\ 0 \end{bmatrix}, \tag{45}$$

$$q_F = 0, \tag{46}$$

$$\mathbf{J}_F = a_0^2 \kappa_Z^2 \frac{W^{(0)}}{\sqrt{2}} \frac{\rho}{\rho_m} \exp(i\omega t - \kappa_Z Z) \begin{bmatrix} 1 \\ -i \\ 0 \end{bmatrix}. \tag{47}$$

In contrast to the simple rotating field, the derived fluid electric field and charge density disappear. Velocity, magnetic field and current density are all in parallel, having no Z component. The real part is schematically plotted in Fig. 4 for an instant of time t. The tops of the vector arrows describe a helix in space.

3.3 Magnetostatic current loop

The field of a circular current loop is best described in spherical coordinates polar coordinates (r, θ, ϕ). The vector potential of a loop with radius a and current I has only a ϕ component given by

$$\mathbf{W} = \begin{bmatrix} 0 \\ 0 \\ \frac{\mu_0\, a^2\, r \sin(\theta)\, I \left(\frac{15\, a^2\, r^2 \sin(\theta)^2}{8\, (r^2+a^2)^2} + 1 \right)}{4\, (r^2+a^2)^{\frac{3}{2}}} \end{bmatrix}. \tag{48}$$

This gives the velocity field

$$\mathbf{v}_F = \frac{\rho}{\rho_m} \mathbf{W} \neq 0 \tag{49}$$

and an electric field perpendicular to $\mathbf{v}_F$ in the (r, θ) plane:

$$\mathbf{E}_F = \frac{\mu_0^2\, a^4\, r\, \rho^2\, I^2 \left(\frac{15\, a^2\, r^2 \sin(\theta)^2}{8\, (r^2+a^2)^2} + 1 \right)^2}{16\, \rho_m^2\, (r^2 + a^2)^3} \begin{bmatrix} -\sin(\theta)^2 \\ -\cot(\theta)\, \sin(\theta)^2 \\ 0 \end{bmatrix}. \tag{50}$$

The other fields $\mathbf{B}_F, q_F, \mathbf{J}_F$ are also different from zero but highly complicated. $\mathbf{B}_F$ has components in r and θ direction and $\mathbf{J}_F$ in ϕ direction.

The dependence of the component v_ϕ is graphed in Fig. 5 for $a = 1$. this is largest in the XY plane ($\theta = \pi/2$) and vanishes at the poles. The absolute strength decreases with distance from $r = a$ as expected. The angular distribution of electric field components E_r, E_θ is shown in Fig. 6.

3.4 Centre fed linear antenna

Next we consider a linear antenna with length d and sinusoidal current density in the wire. The cartesian Z component of the vector potential is given [14] by

$$W_Z = \frac{\mu_0 \, e^{i\,k\,r} \left(\cos\left(\frac{d\,k\cos(\theta)}{2} \right) - \cos\left(\frac{d\,k}{2} \right) \right) I}{2\,\pi\,k\,r\sin(\theta)^2} \tag{51}$$

where $k = \omega/c$ is the wave number of the sinusoidal current with angular frequency ω. Since W_Z is given in dependence of the spherical polar angle θ, we first transform this expression to spherical coordinates:

$$\mathbf{W} = \begin{bmatrix} \cos(\phi)\sin(\theta) & \sin(\phi)\sin(\theta) & \cos(\theta) \\ \cos(\phi)\cos(\theta) & \sin(\phi)\cos(\theta) & -\sin(\theta) \\ -\sin(\phi) & \cos(\phi) & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 0 \\ W_Z \end{bmatrix} \tag{52}$$

$$= W_Z \begin{bmatrix} \cos(\theta) \\ -\sin(\theta) \\ 0 \end{bmatrix}. \tag{53}$$

There is no ϕ component because the vector potential is symmetric in azimutal direction (see graph in Fig. 7). The resulting electric field has components in r and θ coordinates as well as the current density. The magnetic field goes only in ϕ direction, this is similar as a magnetic field of a linear current wire. There is also a non-vanishing spacetime charge density. Both q_F and B_ϕ have been graphed in Fig. 8. B_ϕ is largest in the XY plane similar to the velocity in Fig. 5. The Kambe charge density is highest at the poles, i.e. in Z direction.

3.5 Nuclear dipole potential

Dipole fields were already investigated in previous papers (UFT336, UFT346). Here we start directly from a dipole vector potential in cartesian coordinates:

$$\mathbf{m} = \frac{\mu_0}{4\,\pi\,(X^2 + Y^2 + Z^2)^{\frac{3}{2}}} \begin{bmatrix} m_Y Z - m_Z Y \\ m_Z X - m_X Z \\ m_X Y - m_Y X \end{bmatrix}. \tag{54}$$

This field is plotted for

$$\mathbf{m} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \tag{55}$$

in Fig. 9 in the XY plane. It leads to an electric spacetime field similar to Fig. 3 but with increasing amplidudes for the radius going to zero according to r^{-3}. All spacetime fields do not vanish. The shapes of B_Z and q are presented in Fig. 10 along the X axis. There is a a divergence of both at the centre where the source dipole is located.

Additional references:

[13] http://mathworld.wolfram.com/ConvectiveOperator.html

[14] John David Jackson, Classical Electrodynamics, 3rd edition, Wiley 1998, p. 416

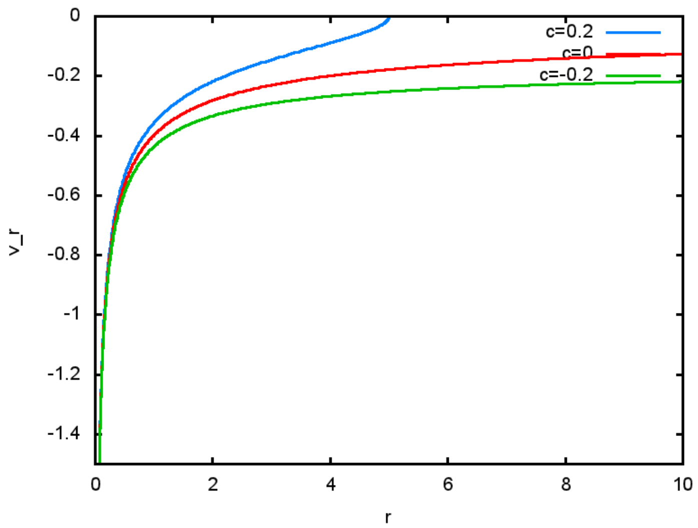

Figure 1: Radial velocity component (35) of solution for Eq. (6).

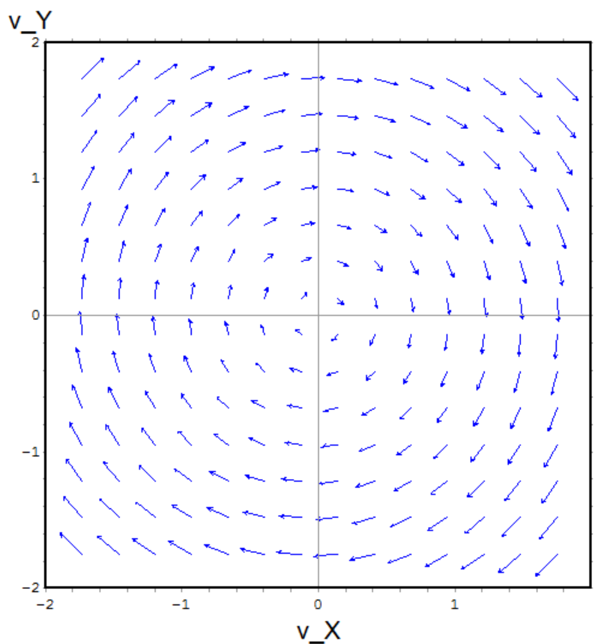

Figure 2: Simple velocity field (37).

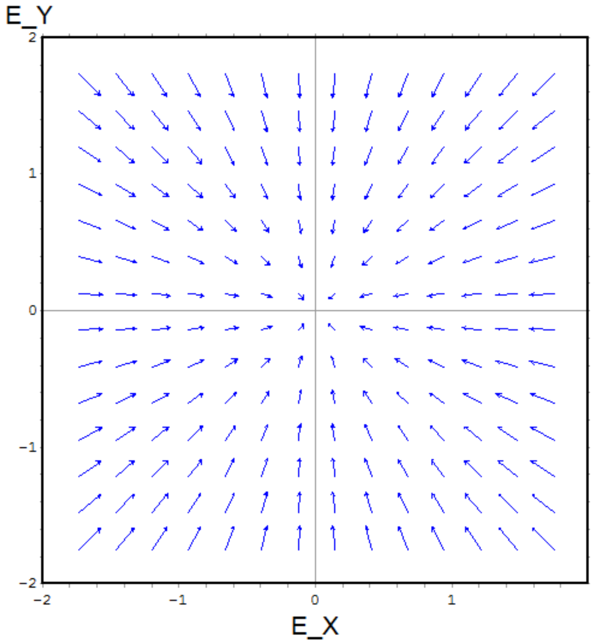

Figure 3: Central electric field (38) derived from (37).

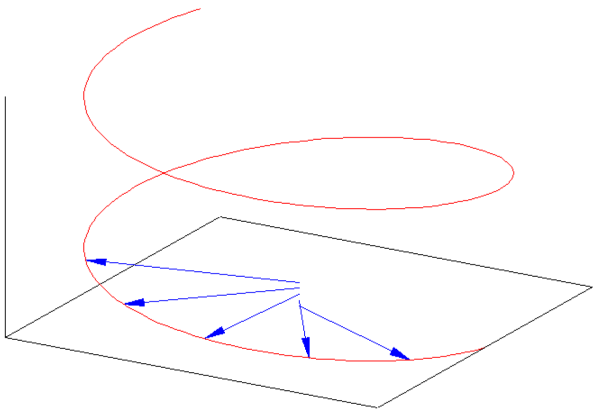

Figure 4: Vectors $\mathbf{v}_F$, $\mathbf{B}_F$, and $\mathbf{J}_F$ of the plane wave potential.

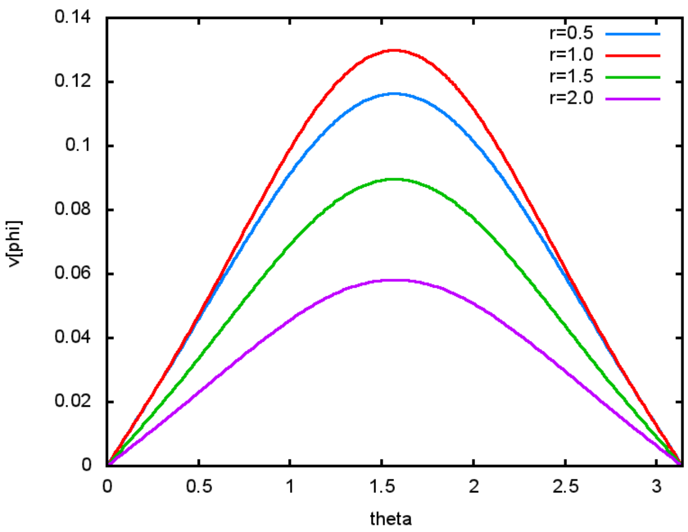

Figure 5: Velocity component v_ϕ of the magnetostatic current loop.

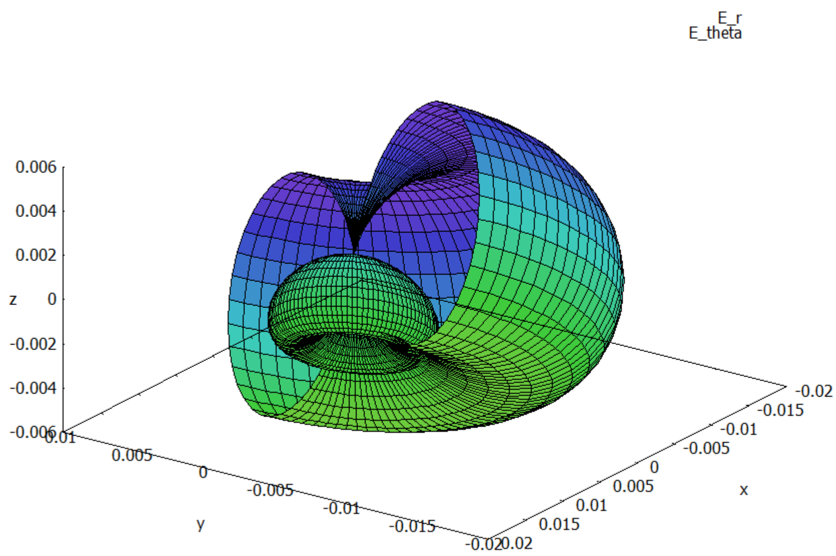

Figure 6: Components E_r (outer) and E_θ (inner) of electric field for the magnetostatic current loop, spherical distribution.

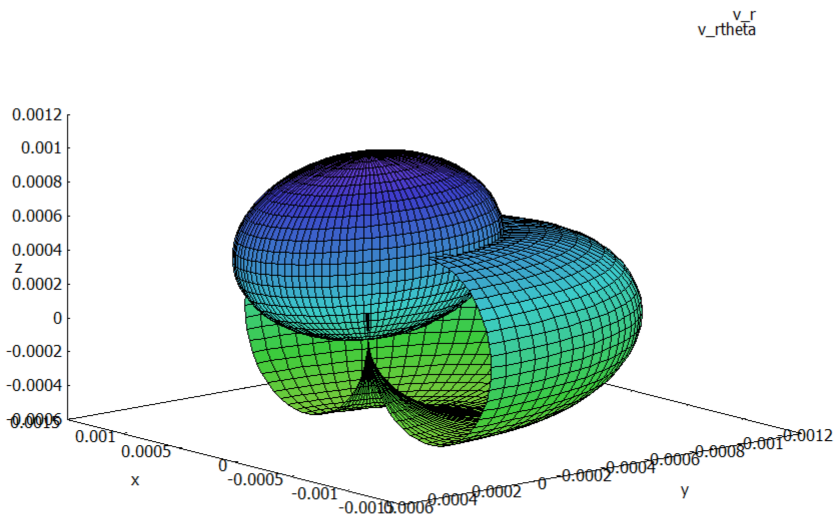

Figure 7: Components v_r (ellipsoid) and v_θ (torus) of velocity field for the center-fed antenna, spherical distribution.

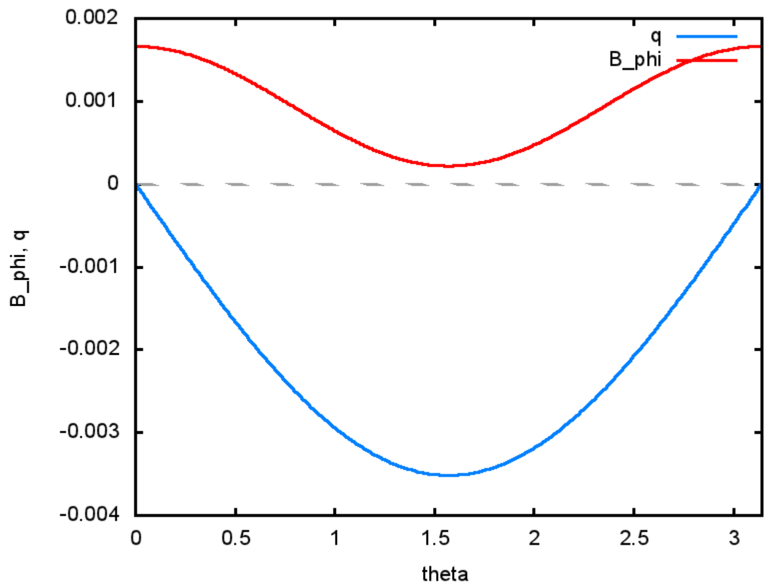

Figure 8: Component B_ϕ and q_F for the center-fed antenna.

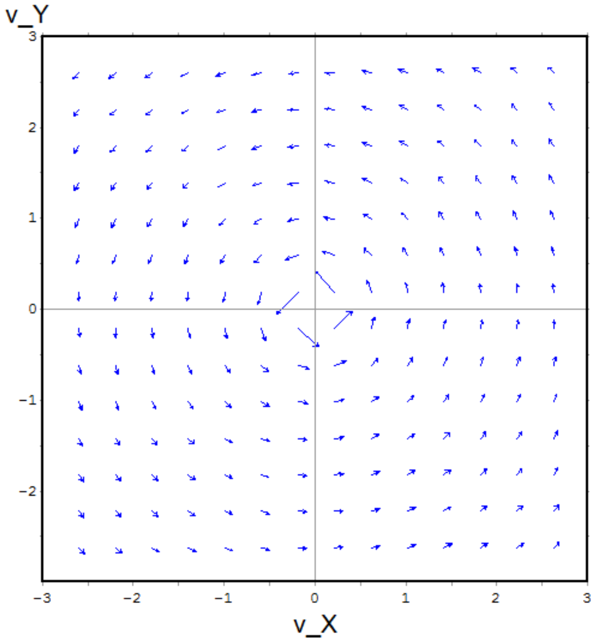

Figure 9: Velocity field (v_X, v_Y) in the plane $Z = 0$ for a nuclear dipole potential.

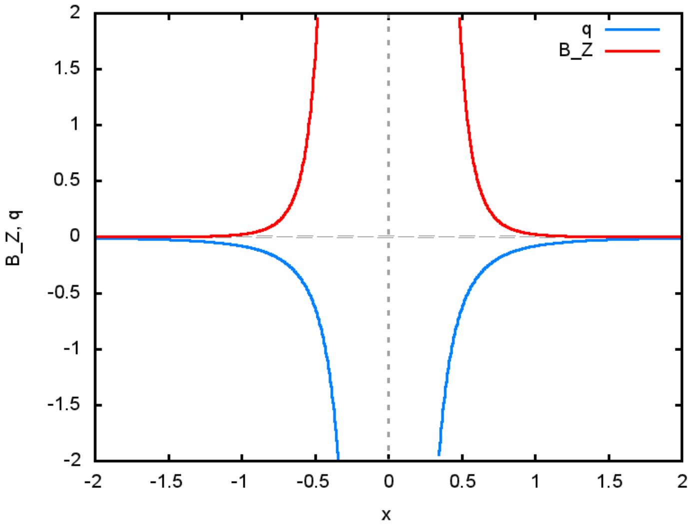

Figure 10: Component B_X and q_F at $Y = 0$, $Z = 0$ for the nuclear dipole potential.

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