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ORIGINAL ARTICLE

SCATTERING PROPERTIES OF E. M. WAVES IN A MULTILAYERED CYLINDER FILLED WITH DOUBLE NEGATIVE AND POSITIVE MATERIALS

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ABSTRACT:

The meta-reinforcement cylinders have several layers. The patented expansion method in each region produces common formulas for electromagnetic fields. The picture property can be observed in a line source with a cylinder radius much larger than the wavelength.The distributions of the electromagnetic fields are shown if the line source is located near the two-façade cylinder alternately filled with double negative and double positive contents. The electrical field and energy with very little radius were investigated in the presence of a cylinder.

KEY-WORDS: E. M. Waves, Multilayered Cylinder, Double negative and positive, DNG.

INTRODUCTION:

In 1968 Veselago studied theoretically the characteristics of the waves in a particular medium, both of which are negatively permitted and permeable. Hypothesis materials are systematically studied once the structure of the Split Ring Resonator [SRR] has been proposed and experimentally checked. Double negative (DNG) content has many optical characteristics and may lead to a perfect lens.Kong formulated wave reflections or refractions for EM waves which spread through a stratified DNG medium. The purpose of this paper is to extend the currents from planar to cylindrical structures in order to better understand metamaterials hybrid effects and cylindrical curvatures.

FORMULATIONS:

Consider an endlessly big N-layered cylinder (ε_0, μ_0), as Figure 1 demonstrates. Per layer is filled with a DNG or DPS uniform material with varying permittivity and permeability. In the following analysis, the time dependence, $e^{-j\omega t}$,, to the full is abolished. The admissibility and permeability of the substance in the region f (f = 0,…N) is as following:

$$\varepsilon_f = u|\varepsilon_f| \quad (1)$$
$$\mu_f = u|\mu_f|, \quad (2)$$

Where;

$$u = \begin{cases} -1, & \text{DNG material} \\ 1, & \text{DPS material.} \end{cases} \quad (3)$$

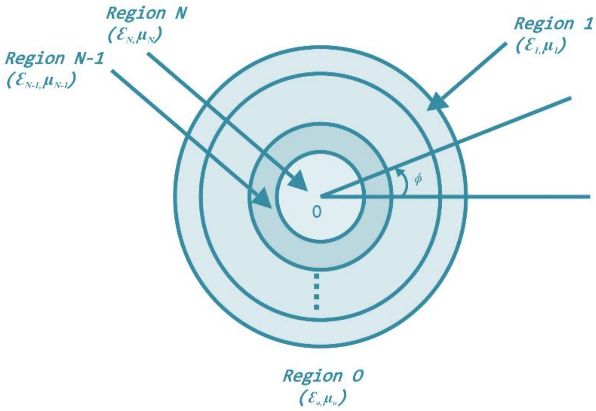

Figure 1:Multi-layer cylindrical geometry of different materials.

The layered cylinders would be illuminated at an arbitrary angles by an incident wave of transverse electric (TE) or transverse magnetic (TM).

$$\mathbf{M}_n^{(p)}(k_z) = \left[\hat{\rho}\frac{jn}{\rho}B_n^{(p)}(k_\rho \rho) - \hat{\phi}\frac{dB_n^{(p)}(k_\rho \rho)}{d\rho}\right] e^{j(n\phi + k_z z)} \tag{4}$$

$$\mathbf{N}_n^{(p)}(k_z) = \frac{1}{k}\left[\hat{\rho} j k_z \frac{dB_n^{(p)}(k_\rho \rho)}{d\rho} - \hat{\phi}\frac{n k_z}{\rho}B_n^{(p)}(k_\rho \rho) + \hat{z} k_\rho^2 B_n^{(p)}(k_\rho \rho)\right] e^{j(n\phi + k_z z)}, \tag{5}$$

The super scribble p is 1 & 3, representing the Hankel function of the first-type besserel and first-type cylinder and $k^2 = k^2_\rho + k^2_z$.where the cylindrical verbessels n function is defined by $B^{(p)}{}_n(k_\rho \rho)$

$$\mathbf{M}_n^{(p)}(k) = \left[\hat{\rho}\frac{jn}{\rho}B_n^{(p)}(k\rho) - \hat{\phi}\frac{dB_n^{(p)}(k\rho)}{d\rho}\right] e^{jn\phi} \tag{6}$$

$$\mathbf{N}_n^{(p)}(k) = \hat{z} k B_n^{(p)}(k\rho) e^{jn\phi}. \tag{7}$$

The region's electromagnetic areas f are Represented as follows via the personality-function expansion method$f$ (f = 1,...N − 1).

$$\mathbf{E}_f = \sum_{n=0}^{\infty}\left\{a_{nf}\mathbf{N}_n^{(3)}(k_{zf}) + b_{nf}\mathbf{M}_n^{(3)}(k_{zf}) + a'_{nf}\mathbf{N}_n^{(1)}(k_{zf}) + b'_{nf}\mathbf{M}_n^{(1)}(k_{zf})\right\} \tag{8}$$

$$\mathbf{H}_f = \frac{k_f}{j\omega|\mu_f|}\sum_{n=0}^{\infty}\left\{a_{nf}\mathbf{M}_n^{(3)}(k_{zf}) + b_{nf}\mathbf{N}_n^{(3)}(k_{zf}) + a'_{nf}\mathbf{M}_n^{(1)}(k_{zf}) + b'_{nf}\mathbf{N}_n^{(1)}(k_{zf})\right\}, \tag{9}$$

The unidentified extension variables are a_{nf}, b_{nf}, a'_{nf} and b'_{nf}.

In the outer layer area (i.e. area 0) and inner layer area (i.e. area N), the electromagnetic fields can be applied.

$$\begin{aligned}\mathbf{E}_0 &= \mathbf{E}^i + \mathbf{E}^s \\ &= \mathbf{E}^i + \sum_{n=0}^{\infty}\left[a_{n0}\mathbf{N}_n^{(3)}(k_{z0}) + b_{n0}\mathbf{M}_n^{(3)}(k_{z0})\right]\end{aligned} \quad (10)$$

$$\begin{aligned}\mathbf{H}_0 &= \mathbf{H}^i + \mathbf{H}^s \\ &= \mathbf{H}^i + \frac{k_0}{j\omega u|\mu_0|} \times \sum_{n=0}^{\infty}\left[a_{n0}\mathbf{M}_n^{(3)}(k_{z0}) + b_{n0}\mathbf{N}_n^{(3)}(k_{z0})\right]\end{aligned} \quad (11)$$

And

$$\mathbf{E}_N = \sum_{n=0}^{\infty}\left[a'_{nN}\mathbf{N}_n^{(1)}(k_{zN}) + b'_{nN}\mathbf{M}_n^{(1)}(k_{zN})\right] \quad (12)$$

$$\mathbf{H}_N = \frac{k_N}{j\omega u|\mu_N|}\sum_{n=0}^{\infty}\left[a'_{nN}\mathbf{M}_n^{(1)}(k_{zN}) + b'_{nN}\mathbf{N}_n^{(1)}(k_{zN})\right]. \quad (13)$$

Apply the measuring to cylindrical interfaces of the tangential electric or magnetic various strategies in the following formulas, a_{nf}, b_{nf}, a'_{nf}, and b'_{nf}, in $\rho = r_f$ (where $f = 0,1,\ldots, N-1$):

$$\hat{\rho} \times \begin{bmatrix} \mathbf{E}_f \\ \mathbf{H}_f \end{bmatrix} = \hat{\rho} \times \begin{bmatrix} \mathbf{E}_{f+1} \\ \mathbf{H}_{f+1} \end{bmatrix}. \quad (14)$$

Finally, for parameters [*Li et al.*, 2000], a recursive approach can be used:

$$C_{f+1} = \mathbf{T}_f C_f, \quad (15)$$

So, where's the meaning of [C_f]

$$C_f = \left[a_{nf},\ b_{nf},\ a'_{nf},\ b'_{nf}\right]^T, \quad (16)$$

The transmitter vector is defined in the own development domains

$$\mathbf{T}_f = \mathbf{F}_{f+1}^{-1}\mathbf{F}_f, \quad (17)$$

Two parameters arise from the variable matrices F_f and F_{f+1}

RESULT:

The length dispersion pattern of the two-layered cylinder (three areas) with various DPS components is determined to verify the correctness of these formulations, clarified by TE and TM waves and ray-coated, each with a separate line source.

Figure 2. Geometry screens. There are two layers a = 0.25λ from the inside to the outside and b = 0.3λ.This, compressibility is oscillating to oscillating ε r1 = 4.0 and to oscillating to oscillating to

oscillate ε r2 = 1.0. There is a μr1 = μr2 = 1.0.connexion between two layers. The aircraft's waves shall usually occur.

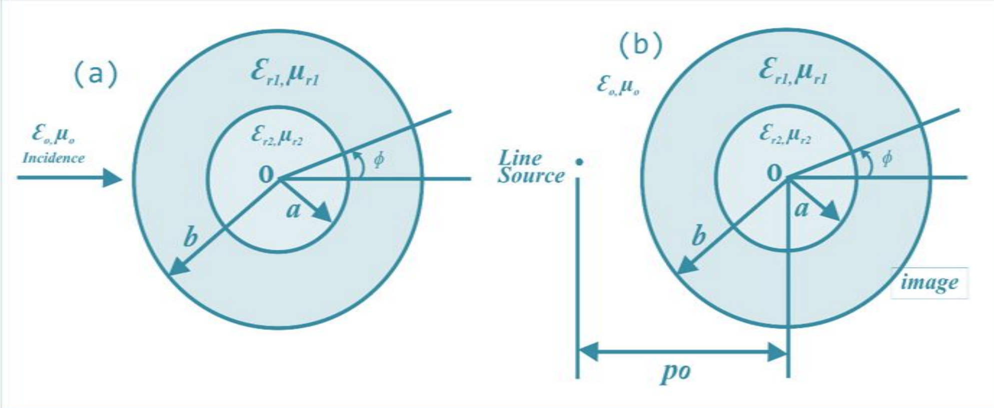

Figure: 2 Geometry of a two-layered cylindrical DPS-material.

CONCLUSION:

We utilize the autonomous extraction technique throughout this report to usually express areas in a double-negative and double-positive cylinder. The individual expansion coefficients are determined by continuous application of the electro-magnetic various strategies at their implementations. When a radius rλ is found, a line source is shown with this cylinders. DNG and DPS-based materials were tested in the electric field and power of these small radii-filled cylinders.

REFERENCES:

1. J. B. Pendry, A. J. Holden, D. J. Robbins, and W. J. Stewart,"Magnetism from conductors and enhanced nonlinear phenom-ena," IEEE Trans. Microwave Theory Tech., vol. 47, no. 11, pp.2075–2084, November 1999.
2. L.W. Li, D. You, M.S. Leong, and T.S. Yeo, Electromagneticscattering by multilayered chiral-media structures: a scattering-to-radiation transform, vol. 26, EMW Publishing, Cambridge,Boston, 2000
3. Chen, H. S., L. X. Ran, J. T. Huangfu, X. M. Zhang, K. S. Chen, T. M. Grzegorczyk, and J. A. Kong (2004), Left-handed materials composed of only S-shaped resonators, *Phys. Rev. E*, 70, 057605.
4. Markos, P., and C. M. Soukoulis (2002), Numerical studies of left-handed materials and arrays of split ring resonators, *Phys. Rev. E.*, 65, 036622.
5. Ward, A. J., and J. B. Pendry (1996), Refraction and geometry in Maxwell's equation, *J. Mod. Optics*, 43(4), 773– 793.
6. Zhang, Y., T. M. Grzegorczyk, and J. A. Kong (2002), Propagation of electromagnetic waves in a slab with negative permittivity and negative permeability, *Prog. Electromagn. Res.*, 35, 271– 286.
7. Katsarakis, N., T. Koschny, M. Kafesaki, E. N. Economou,E. Ozbay, and C. M. Soukoulis (2004), Left-and right-handedtransmission peaks near the magnetic resonance frequency incomposite metamaterials,Phys. Rev. B,70, 201101
8. Richmond, J. R. (1966), TE-wave scattering by a dielectriccylinder of arbitrary cross-section shape,IEEE Trans.Antennas Propag.,14(4), 460–464