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A METHOD OF TRANSFORMATION OF ELECTROMAGNETIC FIELDS FROM INERTIAL TO ROTARY REFERENCE SYSTEM WITH CYLINDRICAL COORDINATES AND BACKWARDS

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Based on strict electrodynamic relations, a new method is suggested for transforming the electromagnetic field, excited in an inertial system of reference, into electromagnetic field of a rotating (noninertial) reference system, and for transforming the field, excited in a rotating system of reference, into electromagnetic field of an inertial reference system. The general analysis of the excited electromagnetic fields is included.

In antenna equipment, radiolocation, measuring equipment, radio astronomy, and other fields of radioelectronics, the sources of electromagnetic field (radiators) may be a part of some rotary system or rest on an "immovable" object in an inertial system of reference. Information from the excited electromagnetic (EM) field is extracted in the "point" of observation by the measuring system located in the "immovable" inertial reference system (RS) or, vice versa, in the rotating noninertial RS. During the measurements we have to transform the objects of EM field, excited in the rotating RS, into objects of EM field of the "immovable" inertial RS and, straight conversely, the vectors of EM field, excited in the inertial RS, into objects of EM field of the rotating RS.

The strict solution to the problem of excitation, by external sources, of EM field in the Riemann space corresponding to a rotating reference system has been obtained in [1, 2]. At the zero frequency of rotation, it turns into solution of the problem of excitation of EM field in Euclidean space corresponding to the "immovable" inertial RS.

Introduce in a free space an inertial Cartesian reference system $K(x, y, z, \mathrm{i}ct)$ and a resting (in it) observation point $P(x, y, z, \mathrm{i}ct) = P(p, \mathrm{i}ct)$, where $p = p(x, y, z) = p(r, \varphi, z)$; r, φ, z are variables of a cylindrical coordinate system; "i" is the imaginary unit; c is the light speed; and t is the universal time [3]. In a domain of the space $V'_{j'}$, revolving about the point P with a constant angular frequency Ω, we have the preset complex amplitudes of densities of external electric and magnetic currents and charges of the frequency ω_0 exciting EM field. Let us align the origin of the reference system K with the center of rotation, and direct the z-axis along the axis of rotation. Introduce a rotating system of reference $K'(x', y', z', t) = K'(p', t)$, in which the domain $V'_{j'}$ is at rest. Denote by $P'(x', y', z', t) = P'(p', t)$ the observation point, which is at rest in RS K', where $p' = p'(x', y', z') = p'(r', \varphi', z')$, and r', φ', z' are variables of the coordinate system. If $\bar{E}'(P') = (E'_1, E'_2, E'_3)$ is the vector of electric field strength in RS K', and $\hat{\bar{H}}'(P') = (H'_1, H'_2, H'_3)$ is the vector density of the magnetic field strength, then [2], in cylindrical coordinates for the electric type waves, we have

$$E'^{\mathrm{e}}_{r'} = e^{\mathrm{i}\omega_0 t} \sum_{n=-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{1}{\nu_n^2} \frac{\partial^2 U'^{\mathrm{e}}_n(h)}{\partial r' \partial' z'} \mathrm{d}h, \quad E'^{\mathrm{e}}_{\varphi'} = e^{\mathrm{i}\omega_0 t} \sum_{n=-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{1}{\nu_n^2 r'} \frac{\partial^2 U'^{\mathrm{e}}_n(h)}{\partial \varphi' \partial' z'} \mathrm{d}h,$$

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