TECHNICAL SCIENCES

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GRAPHIC MODELING OF PHYSICAL FIELDS IN A COAXIAL CABLE WITH AN OFFSET RESIDENTIAL PROGRAM USING FLEX – PDE

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Abstract

Examination of different types of cables. Construction of power, equipotential lines, as well as the electric displacement vector in a coaxial cable to be offset from the center of the living using the Flex-PDE.

Keywords: Coaxial Cable, Flex-PDE, damping.

Power lines are an important part of distributed systems and networks. They must ensure reliable communication between devices, generates signals in the network and equipment, receiving these signals. The problem of cable systems is the transmission signal by a predetermined distance at a desired speed. This cable is to protect the signal from the distortion and interference [1].

Cable types:

- Power Cable: used for the distribution of electrical voltage 660-1000 V, 50 Hz.

- Twisted Pair: mainly intended for construction of computer networks, consists of several pairs of wires intertwined pairs. Used on the following frequencies: 16 MHz, 20 MHz, 100 MHz.

- Fiber optic cable: the information on it is transmitted light signal. It is used at low frequencies.
- Coaxial cable: consists of a central (core) of copper wire, metal braid (screen), a dielectric layer and the outer shell of isolation. The cable is quite flexible, making it easy to seal.

Let us consider in more detail the coaxial cable.

The main purpose - to send a signal in various fields of technology: communications, broadcast networks, computer networks, antenna-feeder systems, automation and other industrial and research technical systems.

Classification [1]:

By appointment - for cable television systems, communications systems, aviation, space technology, computer networks, home appliances, etc.

According to the characteristic impedance - in principle, the characteristic impedance of the cable can be any, but the standard is 5 values by Russian standards and 3 international:

50 ohms - the most common type, is used in various fields of electronics.

75 ohms - common type, used mainly in television and video technology.

100 ohms - rarely used in pulse technique, and for special purposes.

150 ohms - rarely used in pulse technique, and for special purposes, international standards is not provided.

200 ohm - is rarely used, the international standards is not provided.

According to the diameter of the insulation [2]:

Subminiature - 1 mm.

Miniature - 1.5 - 2.95 mm.

Mid-size - 3.7 - 11.5 mm.

Large - more than 11.5 mm.

The specific attenuation in the coaxial cable can be determined by the formula [5]:

$$Apm = k1 \cdot \sqrt{F} + k2 \cdot F, \qquad (1)$$

where:

F- frequency, MHz

k1 - coefficient characterizing the losses in the conductors .
k2 - coefficient characterizing the losses in the dielectric internal insulation.

Since the production and operation of the cable may move the shells or central cores of interest simulation charts: vector of electric displacement, etc.

For example, a coaxial cable shifted living (Figure 1), simulate graphics power lines for charging the electric displacement vector, and compare them with similar schedules coaxial cable with the normal location in the center of the cable core.

Imagine the inner copper conductor and outer insulation (the screen), as a two point charge radii R1 = 4 cm and R2 = 10 cm. The distance between the charges D = 3 cm, the electric field E = 0,86 V/m , ε = 4 . We find the vector of electric displacement of the two point charges and simulate the force lines of the electric field vector of electric displacement and potential lines.

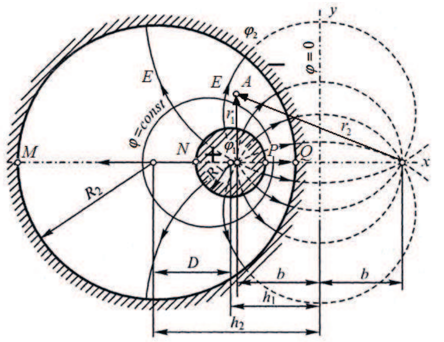

Figure 1. A coaxial cable with an offset from the center of the living

To solve this problem, we used the program Flex-PDE.

Writing this program:

TITLE '1'

VARIABLES

U The electrical potential (V)

DEFINITIONS

L=700 The distance D between two electrostatic charges (m)

R1=4e-2

R2=10e-2

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h=3e-2
h1=-(h*h+R1*R1-R2*R2)/2/h
h2=(h*h+R2*R2-R1*R1)/2/h
b=sqrt(h1*h1-R1*R1)
eps=7
eps0=8.85e-12 Dielectric constant (F/m)
Uv=12
m=12
n=8
E = -grad(u)
D = eps*eps0*E Vector electric displacement (C/m2)
Dm=magnitude(D)
EQUATIONS
div(D)=0 The basic equation
BOUNDARIES
REGION 1 Border conditions
start 'q 1' (-R2,R2)  value(u)= 0 arc( center=0,0)  angle= 360
start 'q 2' (-R1,R1)   value(u)= Uv arc( center=h,0)   angle= 360
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According to the boundary conditions, build a power line to charge the electric displacement vector and define the maximum voltage at point A, which is equal to 7.98 V/m.

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PLOTS
CONTOUR(u)
CONTOUR(Dm)
VECTOR(D)
END [2].
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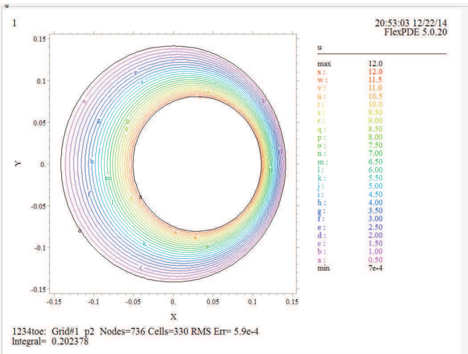

Figure 2. Equipotential lines in the coaxial cable shifted living

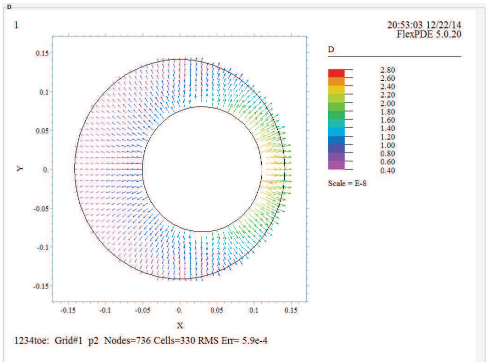

Figure 3. The vector of electric displacement in a coaxial cable shifted living

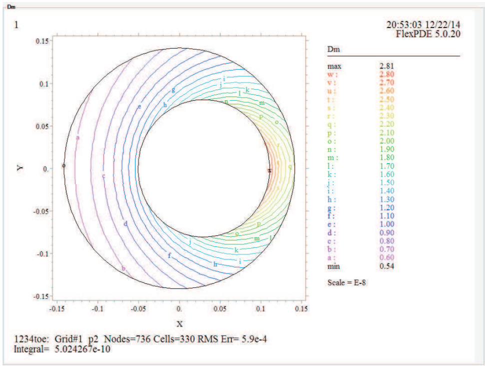

Figure 4. The lines of force of the electric field in the coaxial cable shifted living

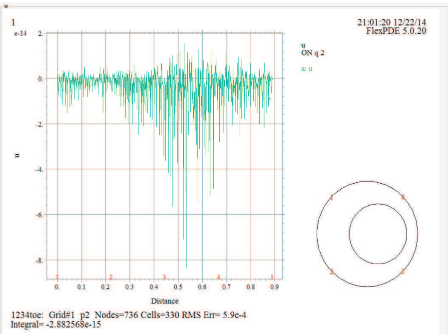

Figure 5. Distribution of charge through the dielectric on the surface of a sphere of radius R2, in the coaxial cable shifted living

For comparison, we construct a graph of the distribution charge for coaxial cable with the normal arrangement of veins in the middle.

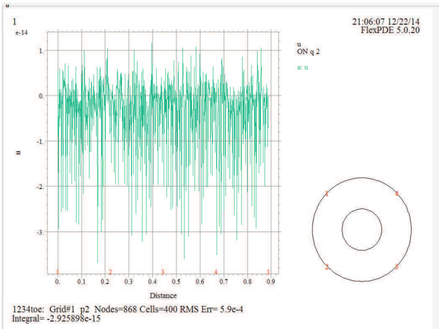

Figure 6. Distribution of charge through the dielectric on the surface of a sphere of radius R2, in a coaxial cable

Comparing the graphs of the charge distribution, it can be concluded that in the cable shifted residential peak voltage varies and fragmented, resulting in much more interference than a cable with a living centrally located. You can say that because of greater amplitude in the cable shifted residential interference is much more difficult to escape than a cable with a living centrally located. Accordingly, the displacement of the core significantly increases the presence of interference, as well as a bad effect in the cable shielding.

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