2.2 General Theory of diffraction

Developing Matlab

The program is based on the general theory of diffraction. We suppose that the object (cylinder) is illuminated by a wave of known intensity (primary wave). Thanks to this wave, the cylinder becomes the source of other waves (secondary wave). The total wave is created by the interference of the primary wave and the secondary one.

User has to introduce two parameters to the input of the program: `a` (relative radius of the cylinder a/λ) and `r` (relative distance from the cylinder axis r/λ). Field intensity of the primary wave is then programmed by the following way:

```
Ezprim(theta) = cos(2*pi*r*cos((theta-1)*pi/180))+...
+j*sin(2*pi*r*cos((theta-1 )*pi/180));
```

Here `r` is a constant, `a` equals to a/λ , `theta` varies from 0° to 180°. `theta` is used even as an index of an array, its values have to be from the interval from `1` to `181`. The result is symmetrical with respect to the horizontal axis, and therefore, there is no need of computing to 360°.

Next, the secondary wave intensity is computed according to

$$E_{zsek} = \sum_{m=0}^{\infty} A_m H_m^{(2)}(kr)\cos(m\varphi). \qquad (2.2D.1)$$

In our situation, we limit the value of `m` by 150.

First, the term for `m` = 0 is computed:

```
Ezsekk = A0*besselh(0,2,2*pi*r)*cos(0);
```

where

```
A0 = -besselj(0,2*pi*a)/besselh(0,2,2*pi*a)
```

A cycle for computing `Ezsekk` is of the form:

```
for m=1:60+x
    Am(theta) = -2*j^m*besselj(m,2*pi*a)/besselh(m,2,2*pi*a);
    Ezsek(theta) = Ezsekk+Am(theta)*besselh(m,2,2*pi*r)*...*cos(m*(theta-
    1)*pi/180);
end
```

Summing `Ezprim` and `Ezsek`, the intensity `Ezvyst` is obtained, which is displayed together with `Ezsek` in charts `Ezsek=f(theta)` and `Ezvysl=f(theta)`.

The second part of the program computes the same dependencies, but *cuts* of the distribution of the secondary wave and the total one on the distance from the cylinder axis in given directions `theta` are displayed. For given direction, `theta` is a constant and r/λ is changed. The computation algorithm stays the same and only variables are changed. As a result, five charts for `theta` = (0, 45, 90, 135, 180)° containing `Ezsek` and `Ezvyslare` displayed.

Note: Programs are called in the following order:

`Valec.m` – `Inform.m` – `Zadanivalec.m` – `Vypocetvalec.m` – `Vypocetrezy.m`