2.5 Wave propagation in layered media

Developing Matlab

Subprograms of the main program layers.m read the input quantities and send them to the computational kernel compute.m. Here, the basic quantities (wavelength, e.g.) are computed first, using elementary relations:

```
lambda0 = 300/f*1000;
k0 = 2*pi/lambda0;
Z0 = 120*pi./sqrt(e);
K = k0*sqrt(e);
Lambda = 2*pi./k;
```

Second, reflection coefficient is computed for the central frequency in the m-file compu_v.m:

1. First, characteristic impedance is determined

```
Z0 = 120*pi./sqrt(e);
```

2. Second, impedance at the beginning of all the layers is computed:

```
for i=(I):-1:1
    Zvrch=Z0(i)*(cos(k(i)*l(i))+sqrt(-1)*Z0(i)/Z(i+1)*sin(k(i)*
    (l(i))));
    Zspod=(Z0(i)/Z(i+1)*cos(k(i)*l(i))+sqrt(-1)*sin(k(i)*(l(i))));
    Z(i)=Zvrch/Zspod;
end
```

3. Next, reflection coefficient on the boundaries can be determined:

```
for i=I:-1:1
    ro(i)=(Z(i+1)-Z0(i))/(Z(i+1)+Z0(i));
end
```

4. Finally, standing wave ratio in layers is computed:

```
for i=I:-1:1
    PSV(i)=(1+abs(ro(i)))/(1-abs(ro(i)));
end
```

Inside the layers, intensities of forward and backward waves are computed the following way:

```
Edop(i)= Edop(i+1)*exp(-sqrt(-1)*k(cislo_vrstvy(i))*...
(pole_vzd(i)-pole_vzd(i+1)));
Eodr(i)= Eodr(i+1)*exp(sqrt(-1)*k(cislo_vrstvy(i))*...
(pole_vzd(i)-pole_vzd(i+1)));
```

The total electric-field intensity is computed by adding intensities of forward and backward waves:

```
E(i)=Edop(i)+Eodr(i);
```

Transmitting the boundary between two layers:

```
Edop(i)=E(i)/(1+ro(cislo_vrstvy(i)));
Eodr(i)=ro(cislo_vrstvy(i))/(1+ro(cislo_vrstvy(i)))*E(i);
E(i)=Edop(i)+Eodr(i);
```

Magnetic-field intensity can be computed as:

```
H(i)=(Edop(i)-Eodr(i))/Z0(cislo_vrstvy(i));
```

Transmittance is given then by the relation:

```
T=1-(abs(ro(1)))^2;
```

Frequency course of standing wave ratio, transmittance and reflection coefficient is computed using the above-given relations.