Companion software for "Volker Ziemann, *Hands-on Accelerator physics using MATLAB, CRCPress, 2019*" (https://www.crcpress.com/9781138589940)

Pill-box explorer for TM modes(Section 5.1)

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In this example we display the longitudinal elelctric field E_z of a T_{mn0} mode in a pill-box cavity for values of m and n of up to 5.

For the radius of the cavity R_{cav} we assume the value of 1 m.

```
clear all;
Rcav=1;
```

We use sliders to select the values of m (order of the Bessel function or number of azimuthal zeros) and n, the number of the zero.

```
m=1;   % Slider to select m in J_m
n=2;   % Slider to select n-th zero
```

The longitudinal electric field is then given by Equation 5.21, where $J_m(k_cR_{cav})$ must be zero on the metallic boundary, which requires $\gamma_{mn} = k_cR_{cav}$ to be a zero of the m-th Bessel function J_m. Following the suggestion from "Matlab Answers" (https://se.mathworks.com/matlabcentral/answers/230834-zeros-of-bessel-functions) we first roughly estimate where the zero is and then use the function `fzero()` to find it accurately.

```
guess = 2.5505 + 1.2474*m + (n-1)*pi;       % From "Matlab Answers"
gamma_mn=fzero(@(x)besselj(m,x),guess)      % n-th zero of m-th Bessel function J_m
```

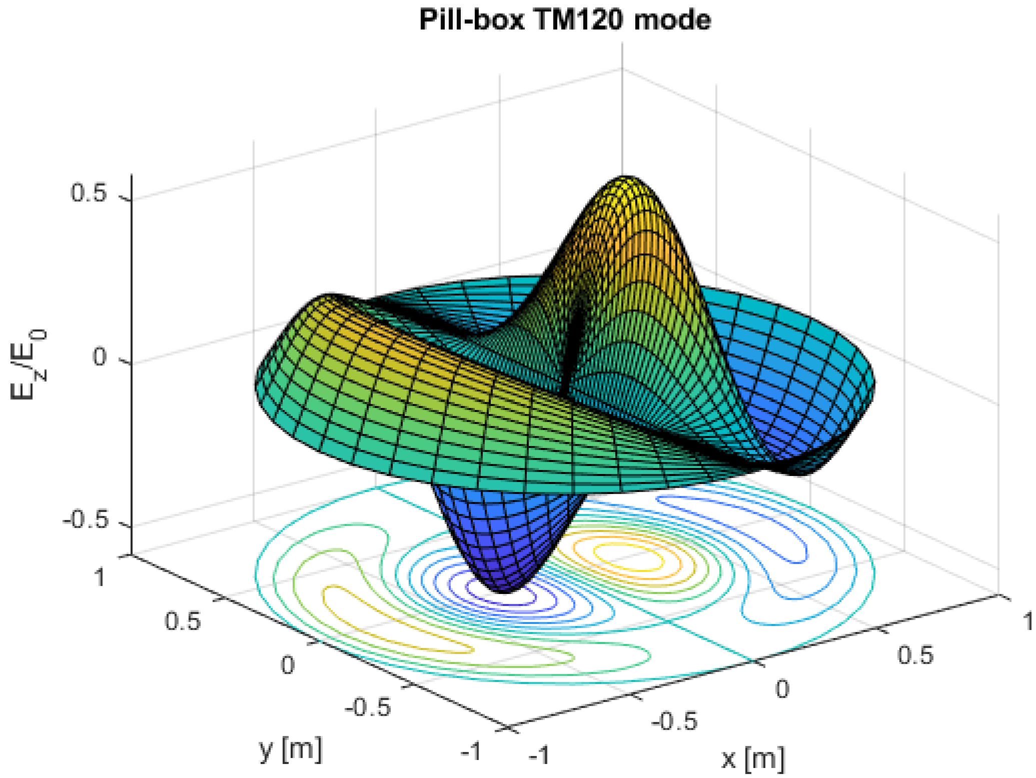
```
gamma_mn = 7.0156
```

In the next step we define a radial meshgrid and determine the longitudinal electric field E_z on the gridpoints.

```
r=0.0:0.02:1;                               % radial grid points
phi=0:pi/20:2*pi;                           % angular grid points
[R,PHI]=meshgrid(r,phi);                    % make meshgrid
Ez=besselj(m,gamma_mn*R/Rcav).*cos(m*PHI);  % Ez/E0
```

Finally, we plot the field as a surface plot with a contour map shown below.

```
surfc(R.*cos(PHI),R.*sin(PHI),Ez)
xlabel('x [m]'); ylabel('y [m]'); zlabel('E_z/E_0')
title(['Pill-box TM',num2str(m),num2str(n),'0 mode'])
```


Pill-box TM120 mode
0.5
0
-0.5
E_z/E_0
1
0.5
0
-0.5
-1
y [m]
-1
-0.5
0
0.5
1
x [m]