EE2703 END SEM

Yaswanth Bandi,EE20B020

May 13, 2022

1 Pseudo Code for Question1

We are trying to compute points to work on.
1. Divide the wire into pieces of length dz and so, we have $2N$ pieces and $2N+1$ points.
2. Then we are going to create an array "z" of length $2N+1$ which contains point coordinates.This is done using "*linspace*" command.
3. We will take construct array of length $2N-2$ which will not have coordinates $-0.5, 0, 0.5$ was done by deleting it from z.
4. We are going to compute at $N = 4$.

1.1 Matrices Obtained

```
Vector z :
    [-0.5   -0.38  -0.25  -0.12   0.     0.12   0.25   0.38   0.5]
Vector u :
    [-0.38  -0.25  -0.12   0.12   0.25   0.38]
```

2 Pseudo Code for Question2

We need an equation for each unknown current. These equations are obtained by calculating the Magnetic field in two different ways.

From Ampere's Law:

1. We have $H = M * J$.We will compute H at $r = a$
2. We will construct matrix M by using "*identity*" command to get unit matrix of size $(2N - 2, 2N - 2)$

2.1 Matrices Obtained

```
Matrix M:
    [[15.92   0.      0.      0.      0.      0.   ]
     [ 0.    15.92    0.      0.      0.      0.   ]
     [ 0.     0.     15.92    0.      0.      0.   ]
     [ 0.     0.      0.     15.92    0.      0.   ]
     [ 0.     0.      0.      0.     15.92    0.   ]
     [ 0.     0.      0.      0.      0.     15.92]]
```

3 Pseudo Code for Question3

From Vector potential:

1. We have to construct two Matrices P and P_B.
P is the contribution to the vector potential due to currents unknown. It is a matrix with $2N-2$ columns and $2N-2$ rows.
P-B is the contribution to the vector potential due to current $z=0$. It is a column vector.
2. To construct those we are going to need Rz, Ru, RN.
Rz computes distances including distances to known current.
Ru is a vector of distances to unknown currents.
RN is distances with respect to z = 0 coordinate.
3. From Ru and RN we will get P and P_B.

3.1 Matrices Obtained

```
Matrix Rz :
[[0.01 0.13 0.25 0.38 0.5  0.63 0.75 0.88 1.  ]
 [0.13 0.01 0.13 0.25 0.38 0.5  0.63 0.75 0.88]
 [0.25 0.13 0.01 0.13 0.25 0.38 0.5  0.63 0.75]
 [0.38 0.25 0.13 0.01 0.13 0.25 0.38 0.5  0.63]
 [0.5  0.38 0.25 0.13 0.01 0.13 0.25 0.38 0.5 ]
 [0.63 0.5  0.38 0.25 0.13 0.01 0.13 0.25 0.38]
 [0.75 0.63 0.5  0.38 0.25 0.13 0.01 0.13 0.25]
 [0.88 0.75 0.63 0.5  0.38 0.25 0.13 0.01 0.13]
 [1.   0.88 0.75 0.63 0.5  0.38 0.25 0.13 0.01]]

 [1.  +0.j 0.88+0.j 0.75+0.j 0.63+0.j 0.5 +0.j 0.38+0.j
 0.25+0.j 0.13+0.j 0.01+0.j ]]

Matrix Ru :
    [[0.01 0.13 0.25 0.5  0.63 0.75]
    [0.13 0.01 0.13 0.38 0.5  0.63]
    [0.25 0.13 0.01 0.25 0.38 0.5 ]
    [0.5  0.38 0.25 0.01 0.13 0.25]
    [0.63 0.5  0.38 0.13 0.01 0.13]
    [0.75 0.63 0.5  0.25 0.13 0.01]]

Vector RN :
    [0.38+0.j 0.25+0.j 0.13+0.j 0.13+0.j 0.25+0.j 0.38+0.j]

Vector P_B*1e8:
    [1.27-3.08j 3.53-3.53j 9.2  -3.83j 9.2  -3.83j 3.53-3.53j 1.27-3.08j]
```

```
Matrix P*1e8 :
[[124.94-3.93j    9.2  -3.83j    3.53-3.53j   -0.   -2.5j
-0.77-1.85j
    -1.18-1.18j]
 [   9.2  -3.83j  124.94-3.93j    9.2  -3.83j    1.27-3.08j
-0.   -2.5j
    -0.77-1.85j]
 [   3.53-3.53j    9.2  -3.83j  124.94-3.93j    3.53-3.53j
1.27-3.08j
    -0.   -2.5j  ]
 [  -0.   -2.5j     1.27-3.08j    3.53-3.53j  124.94-3.93j
9.2  -3.83j
     3.53-3.53j]
 [  -0.77-1.85j   -0.   -2.5j     1.27-3.08j    9.2  -3.83j  124.94-3.93j
     9.2  -3.83j]
 [  -1.18-1.18j   -0.77-1.85j   -0.   -2.5j     3.53-3.53j
9.2  -3.83j
   124.94-3.93j]]
```

4 Pseudo Code for Question4

1. We have to construct two Matrices Q and Qb.
Q is the contribution due to currents unknown. It is a matrix with $2N-2$ columns and $2N-2$ rows.
Pb is the contribution due to current at $z=0$. It is a column vector.
2. To construct those we are going to need Rz, Ru, RN.
3. From Ru and RN we will get Q and Qb.

4.1 Matrices Obtained

```
Matrix Q :
[[9.952e+01-0.j  5.000e-02-0.j  1.000e-02-0.j  0.000e+00-0.j  0.000e+00-0.j
  0.000e+00-0.j]
 [5.000e-02-0.j  9.952e+01-0.j  5.000e-02-0.j  0.000e+00-0.j  0.000e+00-0.j
  0.000e+00-0.j]
 [1.000e-02-0.j  5.000e-02-0.j  9.952e+01-0.j  1.000e-02-0.j  0.000e+00-0.j
  0.000e+00-0.j]
 [0.000e+00-0.j  0.000e+00-0.j  1.000e-02-0.j  9.952e+01-0.j  5.000e-02-0.j
  1.000e-02-0.j]
 [0.000e+00-0.j  0.000e+00-0.j  0.000e+00-0.j  5.000e-02-0.j  9.952e+01-0.j
  5.000e-02-0.j]
 [0.000e+00-0.j  0.000e+00-0.j  0.000e+00-0.j  1.000e-02-0.j  5.000e-02-0.j
  9.952e+01-0.j]]

Matrix Qb :
[0.   -0.j 0.01-0.j 0.05-0.j 0.05-0.j 0.01-0.j 0.   -0.j]
```

5 Pseudo Code for Question5

1.Our final equation is $M * J = Q * J + QbIm$
i.e.,$(MQ) * J = Qb * Im$
2.We will use "$inv(M - Q)$ to solve for J.
3.We construct the another vector with known currents and unknown currents.
4.We will get the exact curves on increasing N value.

5.1 Matrices Obtained

```
I calculated :
[ 0.+0.j  -0.+0.j  -0.+0.j  -0.+0.j   1.+0.j  -0.+0.j  -0.+0.j  -0.+0.j
0.+0.j]

I assumed :
[0.    0.38  0.71  0.92  1.    0.92  0.71  0.38  0.   ]
```

5.2 Plots

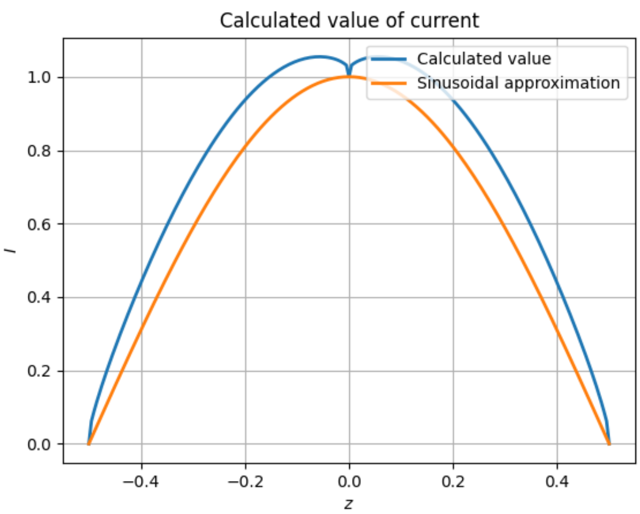

Figure 1: Antenna currents in a half-wave dipole antenna at N=100

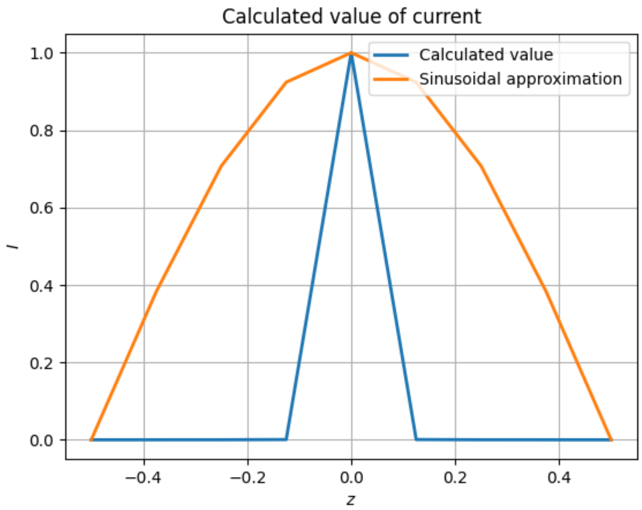

Figure 2: Antenna currents in a half-wave dipole antenna at N=4