EE2703 Final Exam

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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 co-ordinates $-0.5, 0, 0.5$ 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 $PandPb$.
P is the contribution to the vector potential due to currents unknown. It is a matrix with $2N2$ columns and $2N2$ rows.
Pb 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, RiN.
Rz computes distances including distances to known current.
Ru is a vector of distances to unknown currents.
RiN is distances with respect to z = 0 coordinate.
3. We will have zi in which we store all the points present in z vector multiple times in different rows of order$2N + 1$.We will do the same for zi, but we store it different coloumns. These matrices obtained using $Meshgrid$ command.
4. For Rz we will get the distances using these $Ziandzj$.
5. Similarly we will take $uianduj$ with all points in u vector to obtain $Ru.RiN$ is obtained by deleting $0, N, 2N$ indexed elements of Rz in $N+1th$ coloumn
6. From $RuandRin$ we will get $PandPb$.

3.1 Matrices Obtained

```
Matrix Rz :
[[0.01+0.j  0.13+0.j  0.25+0.j  0.38+0.j  0.5  +0.j  0.63+0.j
0.75+0.j  0.88+0.j  1.   +0.j]

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

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

 [0.38+0.j  0.25+0.j  0.13+0.j  0.01+0.j  0.13+0.j  0.25+0.j
 0.38+0.j  0.5  +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  0.13+0.j
 0.25+0.j  0.38+0.j  0.5  +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
 0.13+0.j  0.25+0.j  0.38+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  0.13+0.j  0.25+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  0.13+0.j]

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

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

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]]

Vector Pb*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]
```

4 Pseudo Code for Question4

1. We have to construct two Matrices $QandQb$.
Q is the contribution due to currents unknown. It is a matrix with $2N2$ columns and $2N2$ 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, RiN.
3. From $RuandRin$ we will get $QandQb$.

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.

We will get the exact curves on increasing N value.

5.1 Matrices Obtained

```
Icalculated :
[0. 0. 0. 0. 1. 0. 0. 0. 0.]

Iassumed :
[0.   0.38 0.71 0.92 1.   0.92 0.71 0.38 0.   ]
```

5.2 Plots

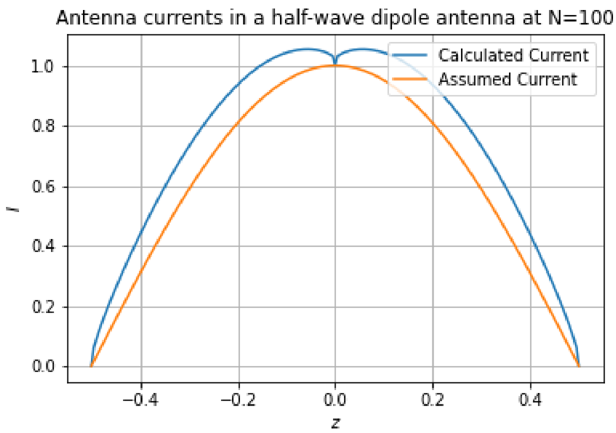

Figure 1: Antenna currents in a half-wave dipole antenna at N=10

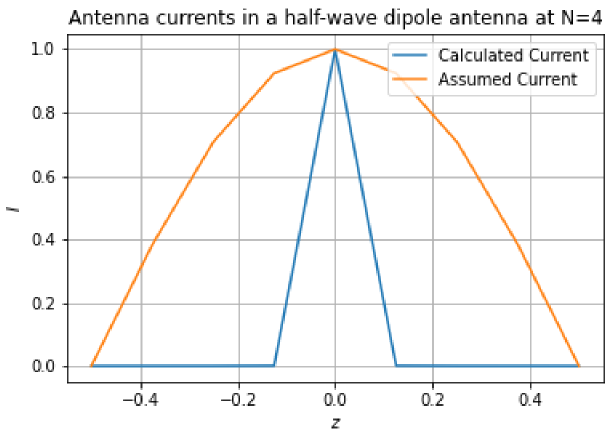

Figure 2: Antenna currents in a half-wave dipole antenna at N=4