ASSIGNMENT No. 8  
Due Date: 3 April 2020

System of Coupled Conductors

A system of conductors above ground has been equivalenced to a $[3 \times 3]$ system. The figure below shows the impedance and Maxwell coefficients matrices from the EMTP Line Constants program.

The impedance matrix

$$[Z_{ph}(\omega)] = [R_{ph}(\omega)] + j[X_{ph}(\omega)]$$

was evaluated at 1 kHz, and the matrix of equivalent Maxwell coefficients,

$$[P_{ph}]$$

is independent of the frequency.

1. Obtain the eigenvector transformation matrices $[P]$ and $[Q]$ that diagonalize matrices $([Z_{ph}][Y_{ph}])$ and $([Y_{ph}][Z_{ph}])$, respectively, in the wave propagation equations. Normalize $[P]$ and $[Q]$ according to the Euclidean norm, i.e., $|u_k| = 1$. 

"JOHN DAY—LOWER MONUMENTAL LINE" (222 Km). DATA AS IN BPA'S. Nov. 12, 1985. 

FOLLOWING MATRICES ARE FOR EARTH RESISTIVITY = 100.00 OHM-M AND FREQUENCY = 1000.00 HZ. EARTH WIRES WILL BE SEGMENTED

MATRICES OF EQUIVALENT PHASE CONDUCTORS

---> Ze  IMPEEDANCE MATRIX (OHM/KM)  

$\begin{bmatrix}
1 & \text{9.10681E-01} & \text{8.40059E+00} \\
2 & \text{8.28979E-01} & \text{8.55463E-01} & \text{9.10681E-01} \\
3 & \text{8.55535E-01} & \text{8.28979E-01} & \text{8.40059E+00} \\
\end{bmatrix}$

---> Pe  INVERTED CAPACITANCE MATRIX (KM/F)

$\begin{bmatrix}
1 & \text{7.85287E+07} \\
2 & \text{1.59905E+07} & \text{7.54166E+07} \\
3 & \text{1.36813E+07} & \text{1.59905E+07} & \text{7.85287E+07} \\
\end{bmatrix}$

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was evaluated at 1 kHz, and the matrix of equivalent Maxwell coefficients,

$$[P_{ph}]$$

is independent of the frequency.

1. Obtain the eigenvector transformation matrices $[P]$ and $[Q]$ that diagonalize matrices $([Z_{ph}][Y_{ph}])$ and $([Y_{ph}][Z_{ph}])$, respectively, in the wave propagation equations. Normalize $[P]$ and $[Q]$ according to the Euclidean norm, i.e., $|u_k| = 1$. 

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2. Obtain the decoupled modal domain impedance and admittance matrices \([Z_m]\) and \([Y_m]\).

3. With \([Z_m]\) and \([Y_m]\) above, obtain the corresponding diagonal matrices for the characteristic impedances \([Z_{cm}]\), the propagation functions \([e^{-\gamma_m \ell}]\), attenuation \([\alpha_m]\), phase displacement \([\beta_m]\) and propagation speed \([a_m]\).

4. Comment on your results.