Dept. Electrical and Computer Engineering
The University of British Columbia
EECE560 Network Analysis and Simulation January 2021
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ASSIGNMENT No. 4

Due Date: 5 March 2021

Transmission Line Functions

The accompanying data file shows the frequency dependence of the line parameters $R(\omega)$ and $L(\omega)$ for a typical three-phase transmission line 300 km long and 500 kV. Subscript "zero" refers to Eigenmode 1, where the return conductor is the ground, while subscript "positive" refers to Eigenmode 2, where the return conductor is a normal conductor. The capacitance C and the shunt conductance G are assumed to be constant with frequency. Notice that G is not zero but a small value.

For the given data, evaluate and plot the transmission line propagation functions for eigenmodes 1 and 2:

1. The characteristic impedance $Z_c(\omega)$ in magnitude and phase angle
2. The propagation function $e^{-\gamma(\omega)\ell}$ in magnitude and phase angle. Make sure the angle of this function is a monotonic function, that is, it does not wind up every 2π radians .
3. The attenuation $\alpha(\omega)$ is in nepers/km, the phase displacement $\beta(\omega)$ is in radians/km, and the propagation speed $a(\omega)$ is in km/s.
4. Comments:
   (a) Compare the positive and zero sequence shapes of $Z_c(\omega)$ and $e^{-\gamma(\omega)\ell}$.
   (b) Why is the velocity of propagation $a(\omega)$ not equal to the speed of light for all frequencies?
   (c) Any other relevant comment.

Annexes:

- Data file "Data_Assign04.txt"