ECE 524: Homework #6

Due: Session 41 (April 25)

1. You are given a 500 kV, 150 mile transmission line with a tower configuration as shown below. Use a dc resistance $R_{dc}'=0.0201\Omega$/mile, and $\mu_r=1$ and $\varepsilon_r=1$. Assume ground resistivity of 100 $\Omega$-m. The two shield wires each have a resistance $R_{dc}'=3.75\Omega$/mile. Assume phase conductors sag to 55% of their height at the tower at mid-span and the ground wires sag to 65% of their height at the tower at mid-span.

A. Model this line in your transient program at 60Hz and create a Bergeron line model.

B. Include your line model in a simple system with a 500kV source with a source impedance described by a short circuit MVA of 50000MVA with an X/R ratio of 12 (assume $Z_0 = 3Z_1$ and $Z_1 = Z_2$). Assume transposition points at at 50 miles (transition ABC to BCA), 100 miles (transition BCA to CAB) and assume it will transition back to ABC at the receiving end (you don't need to model it). Use untransposed line model and physically create transpose points at intermediate nodes.

C. Calculate sequence impedances for your line using the line model information. Based on these calculate positive sequence charging current for the line and compare to the simulation results.

D. Next test the accuracy of your line model by comparing the fault currents for a 3 phase fault and a SLG fault at 100 miles from the source to the currents you calculate using steady-state models from part C. Again assume the receiving end is open. Comment on your results and possible causes of any differences you see.