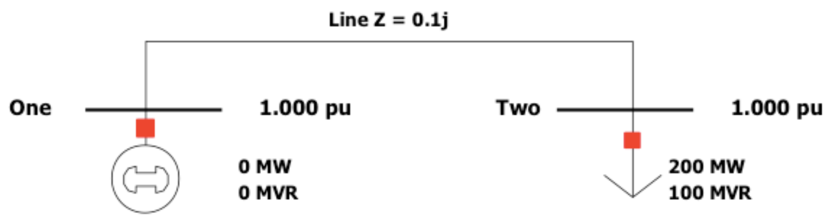
EE 137A Homework #9 amended

due Thursday, Nov 15 2018

Do Problems 2.37, 6.18 and 6.28 in GOS



4. Adapted Power Flow Example from Overbye's Lecture

Repeat the two-bus Newton-Raphson example shown in the lecture slides, but changed to the new P, Q values below. Bus 1 remains the slack bus, S_{BASE} = 100 MVA, and line impedance remains j 0.1 p.u. Using a flat start, determine all the power flows, bus voltages and angles until the mismatch $\varepsilon < 0.001$. Work the iterations by hand and show your steps.

Real power demanded at Bus 2 is 150 MW

Reactive power demanded at Bus 2 is 75 MVAR

Compare your solution for this case to the original case where $V_2 = 0.8554 \angle -13.52^\circ$.

Does the difference make sense?

5. Fast Decoupled Power Flow

Refer to the same two-bus power flow example. Using the same numbers as in the original case on slide 11 and in the diagram above (P_2 = 2.0 p.u., Q_2 = 1.0 p.u.) perform the iteration manually using *fast decoupled* power flow (assume J2 and J3 are zero, and don't update J1 and J4), until **$\varepsilon < 0.001$**. Does it converge to the same result as the one on slide 15? Was it faster and/or easier? If we create the Jacobian on the assumption that all the $G_{ik} = 0$, does that mean the solution should have no losses? Explain.

6. D.C. Power Flow

Formulate and solve this same case as a "d.c. power flow" problem. To do this, ignore reactive power completely, and assume all voltage magnitudes are 1.0 p.u. Thus, you decouple the problem, and only solve half of it – namely, voltage angles, based on real power. (Note that this approach is called "d.c." not because we assume it's actually direct current, but because there is only one variable per bus.) Does it converge to the same result? Was it faster and/or easier?

7. PowerWorld (added problem)

a. Study Example 6.9 in GOS. Draw equivalent circuit diagrams that show how transformers T1 and T2 are being modeled. Which of the two transformers seems more likely to impose a significant limitation on the system?

b. How would you edit the parameters to change T1 and T2 into ideal transformers? What would be the consequence for the voltage magnitudes and angles at their adjacent buses?

c. Go to Example 6.12 and open the corresponding case Example 6_9. Follow the procedure described. Note any observation in the process that you find interesting.
d. What level of generation at Bus 3 seems to minimize (real) system losses?
e. As you vary the generator output at Bus 3 between 330 and 1000 MW, note how the voltage magnitude and angle at Bus 4 changes. Create two plots that show real and reactive power flow vs. voltage magnitude drop and vs. voltage angle difference across the transmission line between Bus 4 and Bus 2. Do these look as expected? Discuss.
f. Go ahead and change T1 to an ideal transformer, like we contemplated in part b. What is the range of permissible Bus 3 generation now, to stay within all the system limits?
g. How can you tell that Bus 3 is modeled as a P,V bus in this example? I'd like you to change the MVAR injection at Bus 3, but the case seems to prevent you from making that edit. Extra credit if you find a way to hack into PowerWorld to change Q_3, and find a better dispatch of reactive power from Bus 3 to minimize (real) system losses!