ELEC0447 – Analysis of electrical power and energy systems

Programming Assignment 2

Friday, 20 October 2023

The objective of this assignment is to study the impact of phase shifting transformers and generators' reactive power limits on the solution of a power flow. In programming assignment 1, you were asked to solve a power flow using the Newton-Raphson method. You were given an electrical network composed of 1 *PV* bus, 2 *PQ* buses and a slack bus. You are now asked to include in your previous algorithm, and based on the given template named `pf2_template.py`, a limit on the reactive power of the *PV* bus generator. The topology of your electrical network is the same as for programming assignment 1, **except one line that has been replaced by a phase-shifting transformer** (PS TO BUSX). The impedance associated with the phase shifting transformer is equal to $Z_{pst} = 0.310^{-3} + j9.995410^{-3}$ *pu*.

Your final code should take as arguments the reactive power limit *q_lim* as well as the phase shift in degree *phase_shift*. After filling in the template, you are asked to upload it on **Gradescope** (**do not forget to rename your file `pf2.py`**). A power flow for a 3-bus system has already been solved, and comes with the other files that you have received (`pf2_example.py`). In the tables below, you will find the physical quantities given at buses in the network and the topology of the electrical network corresponding to your case number.

Your case number is: 0

BUS0		BUS1		BUS2	
V	*θ*	*P*	*V*	*P*	*Q*
1	0	2	1.05	5	1

Table 1. Given physical quantities at buses in the network. Values are given in **per-units** and in **radians**. PV buses are generator buses : P is the active power produced. PQ buses are considered as loads : P and Q are the active and reactive powers consumed.

	BUS0	BUS1	BUS2
Coordinates (x, y)	(0, 0)	(100, 111.8034)	(200, 0)
Connections	PS TO BUS1	BUS2	BUS0

Table 2. Topology of the electrical network. The position of buses is described by x and y coordinates expressed in **kilometers**. The **Connections** row indicates the buses to which a bus is connected.

The due date is: Thursday, 2 November 2023