ELK14: Methods and Algorithms for Power Systems

Assignment 4: Benders Decomposition - Optimal DC Power Flow

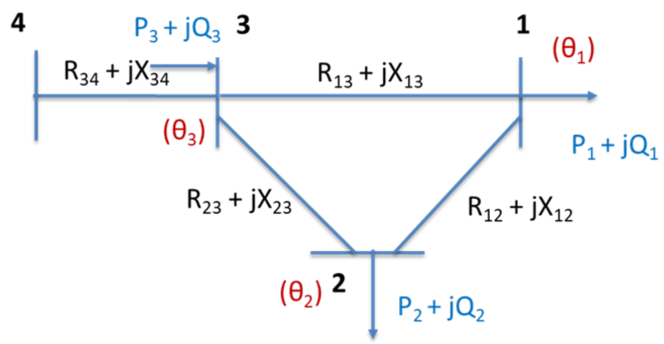

Figure 1: Example system – all data in PU.

The bus 4 can be used as slack bus (reference).

The calculations will be done on the example system shown in figure 1.

The transmission line 2 – 3 is a double line with transfer capacity of 1.5.

All the other transmission lines have a transmission capacity of 1.0 PU.

Network	
R_{12}	0.0
X_{12}	0.2
R_{13}	0.0
X_{13}	0.1
R_{23}	0.0
X_{23}	0.2
R_{34}	0.0
X_{34}	0.25
Loads	
P_1	-1.6
P_2	-0.9
P_3	-0.6
Gen. Costs	
G1	4
G2	5
G3	3
G4	2

Part 1: Base case conditions (Lecture 8)

1. Build the system matrix and find the optimal solution using the specified cost data while keeping the transmission line flow below their limits. It may be convenient to calculate all the distribution factors of the lines. You can use the LP-solve module (link provided in lecture 8). You don't have to integrate the solver in your code as it is easier to just set up the case in LP-format using the standalone package.
2. Check the marginal costs of the solved case (reduced cost, dual variables) and check these against the operating cost at each bus. The different outputs are described in the use guide for the programs

Part 2: Contingency case (Lecture 8)

A contingency occurs by outage of one of the transmission lines between 2 and 3.

1. Calculate the flows after such a contingency using the IMML
2. Formulate a subproblem to solve this case after the contingency. Use the formulation from from L8 and where an incremental case is built with penalties for deviation It may be convenient to calculate all the distribution factors for this outage case
3. Solve the case to make the transmission line flows feasible
4. Formulate one constraint based on the objective function, that marginal costs (reduced costs) and add this to the optimization problem for the base case.
5. Solve this new case and check the flow for the base case and the contingency case.