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POWER SYSTEM SIMULATION

Fast Decoupled Load Flow Analysis

Algorithm 1 : FDLF Analysis

Read network data. Define all variables with appropriate dimensions.
Form Y-bus matrix.
Form B' and B'' matrices. Ignore line resistance and shunt capacitance while forming B' matrix.
Calculate and store $B'_{inv} = [B']^{-1}$, $B''_{inv} = [B'']^{-1}$.
Initialize voltage magnitude and angle: Set $V_i = 1$ pu to a PQ bus i and $V_k = V_k^{sp}$ to a PV bus k. Set $\delta_i = 0$ for all buses.
for $itr = 1$ to $itrmax$ **do**
    for $i = 1$ to n_b, $i \neq s$ **do** ▷ s is the slack bus
        Calculate:
$$P_i^{cal} = V_i \sum_{k=1}^{n_b} V_k \{G_{ik} \cos(\delta_i - \delta_k) + B_{ik} \sin(\delta_i - \delta_k)\}$$
    end for
    Calculate $\left[\frac{\bar{\Delta P}}{V}\right]$ vector, where $\Delta P_i = P_i^{sp} - P_i^{cal}$.
    if $||\bar{\Delta P}||_\infty > \epsilon_p$ **then**
        Calculate
$$[\Delta\delta] = \left[B'_{inv}\right] \left[\frac{\bar{\Delta P}}{V}\right]$$
        Update δ.
    end if
    for $\forall i, i \in N_{PQ}$ **do** ▷ N_{PQ}: set of PQ buses
        Calculate:
$$Q_i^{cal} = V_i \sum_{k=1}^{n_b} V_k \{G_{ik} \sin(\delta_i - \delta_k) - B_{ik} \cos(\delta_i - \delta_k)\}$$
    end for
    Calculate $\left[\frac{\bar{\Delta Q}}{V}\right]$ vector, where $\Delta Q_i = Q_i^{sp} - Q_i^{cal}$.
    if $||\bar{\Delta Q}||_\infty > \epsilon_q$ **then**
        Calculate
$$[\ \Delta V] = \left[B''_{inv}\right] \left[\frac{\bar{\Delta Q}}{V}\right]$$
        Update V.
    end if
    if $||\bar{\Delta P}||_\infty \leq \epsilon_p$ and $||\bar{\Delta Q}||_\infty \leq \epsilon_q$ **then** ▷ Convergence checking
        Load flow converged. Prepare result.
    end if
end for
if $itr > itrmax$ **then**
    Load flow did not converge. ▷ Infeasible loading
end if

1. For all IEEE test systems:
   (a) Find bus voltage magnitude and angle using FDLF Method. Print:
      - Number of iterations required to converge.
      - In tabular format, print:
         - Bus Code
         - Converged voltage magnitude (p.u.)
         - Voltage angle (in degree)
         - Active power generation (p.u.)
         - Reactive power generation (p.u.)
         - Active power demand (p.u.)
         - Reactive power demand (p.u.)
         - Active power injection (p.u.)
         - Reactive power injection (p.u.)
   (b) Calculate feeder and transformer current (both ends) using obtained voltage.
      - In tabular format, print:
         - Feeder/Transformer Code
         - From bus
         - To bus
         - Magnitude (p.u.) of the current flowing from from-bus to to-bus
         - Angle (degree) of the current flowing from from-bus to to-bus
         - Magnitude (p.u.) of the current flowing from to-bus to from-bus
         - Angle (degree) of the current flowing from to-bus to from-bus
   (c) Calculate feeder and transformer power flow (both ends).
      - In tabular format, print:
         - Feeder/Transformer Code
         - From bus
         - To bus
         - Active power flow from from-bus to to-bus
         - Reactive power flow from from-bus to to-bus
         - Active power flow from to-bus to from-bus
         - Reactive power flow from to-bus to from-bus
         - Active power loss in the line
         - Reactive power loss in the line
   (d) Calculate generator current and power injection.
      - In tabular format, print:
         - Generator bus number
         - Magnitude (p.u.) of the current injected
         - Angle (degree) of the current injected
         - Active power injection (p.u.)
         - Reactive power injection (p.u.)
   (e) Validate KCL at each bus. Print ΣP and ΣQ in Tabular form.
   (f) Calculate total loss ($P_{loss} + jQ_{loss}$) in the network from 1.(c). Print $P_{loss} + jQ_{loss} - \sum_{i=1}^{n_b}(P_i + jQ_i)$.