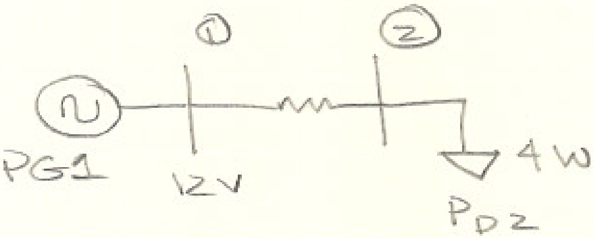
EX: GAUSS SEIDEL

given the following purely resistive power system.




solve for $V_2$ using GS method:

SOL:

$$I_{12} = \frac{12 - V_2}{5}$$

$$P_{D2} = V_2 I_{12}^{*} = V_2 I_{12}$$

$$\therefore \quad I_{12} = \frac{P_{D2}}{V_2} = \frac{4}{V_2}$$

$$\frac{4}{V_2} = \frac{12 - V_2}{5}$$

$$\boxed{V_2^{(s+1)} = 12 - \frac{20}{V_2^{(s)}}}$$ general iteration.

let $V_2^{(0)} = 12$

$$V^{(1)} = 12 - \frac{20}{12} = 10.333\text{ V}$$

$$V^{(2)} = 12 - \frac{20}{10.333} = 10.064516\text{ V}$$

$$V^{(3)} = 12 - \frac{20}{10.064516} = 10.01282\text{ V}$$

$$V_2^{(4)} = 12 - \frac{20}{10.01282} = 10.00254 \text{ V}$$

find error

$$\left| V_2^{(4)} - V_2^{(3)} \right| = 0.0102592 \text{ V}$$

we may continue to get more accurate results.

## THE GAUSS SEIDEL LOAD FLOW

At any load bus or P, Q bus, equation 8 can be written as:

$$\bar{V}_k^{(n+1)} = \frac{1}{\bar{y}_{kk}} \left[ \frac{\bar{S}_k^*}{(\bar{V}_k^{(n)})^*} - \sum_{j=1}^{\infty} \bar{y}_{kj} \bar{V}_j^{(n+1)} - \sum_{j=k+1}^{n} \bar{y}_{kj} \tilde{\bar{V}}_j \right]$$

where the subscript $(n)$ indicates the value obtained in the $n^{th}$ interation and subscript $(n+1)$ indicates the value obtained from the $(n+1)$ intration.

In effect, the knew value for $\bar{V}_k$ is determined using the latest value updates of $\bar{V}_j (j \neq k)$

There is a sequential correction for all bus voltages, then the next iteration will start.

The program starts with a initial guess for each voltage, and provided that the guesses are reasonable, converges will be obtained.

If convergence is based on voltage, then changes for convergence will be small

$$\left| \bar{V}_k^{N+1} - \bar{V}_k^{N} \right| < \boxed{\epsilon}$$

tolerance

For general buses $|\bar{V}_k|$ is specified but $Q_k$ is not known. In this case $Q_k$ is aproximated using equation (9b) with the latest voltage updates.

This value is then used to update $\bar{V}_k$. The resulting $\bar{V}_k$ will likely have the wrong magnitude, so it can be adjusted to,

$$\bar{V}_k^{(N+1)} = \left| \frac{\bar{V}_k^{(N)}}{\bar{V}_k^{(N+1)}} \right| \bar{V}_k^{(N+1)} \qquad (13)$$

and you may start with $\bar{V}_k^{(0)}$ which is now specified.

The process is not carried for the stack bus, whose equations are used only after convergence is now achieved to find $P_{(stack)}$ and $Q_{(stack)}$

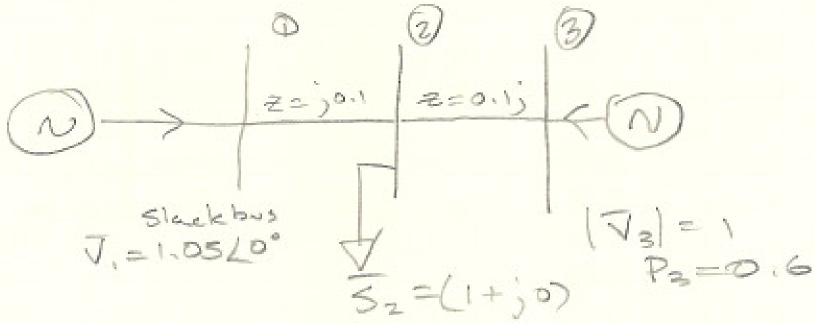
The convergence criterium equation (2) depends on voltages rather then P, Q mismatches.

With a little more effort, the P, Q mismatches can be used as the convergen criterion. This is a much better approach as the voltage convergence does not imply power convergence to the same accuracy. The rate of convergence can be accelerated by a factor of ($\alpha$) which is the acceleration factor usually $> 1$.

Typically 1.5, we may write:

$$\bar{V}^{(N+1)} = \bar{V}^{(N)} + \alpha \Delta \bar{V}^{(N)}$$

EX: Consider the 3 bus system shown below.




Use the GS method to determine bus voltages and powers to an accuracy to an $10^{-4}$ pu, use equation (12) to split the real an imaginary.

SOL:

$$\bar{Y}_{bus} = j \begin{bmatrix} -10 & 10 & 0 \\ +10 & -20 & 10 \\ 0 & 10 & -10 \end{bmatrix}$$

Expressing voltages and admitances in rectangular form, we have

$$\bar{V} = e + jf \quad , \quad \bar{V} = G + jB$$

$$e_2^{(N+1)} = \frac{1.05 + e_3^{(N)}}{2} + \frac{0.05 f_2^{(N)}}{\left(e_2^{(N)}\right)^2 + \left(f_2^{(N)}\right)^2} \quad \text{A}$$