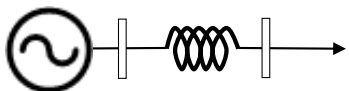


Solución de la Prueba escrita

En el siguiente circuito se dispone de 4 mediciones (z), todas con la misma precisión. Estime el valor de la demanda reactiva q_{D2} (Criterio de parada 1%):

$\theta_1 = 0, v_1$ θ_2, v_2



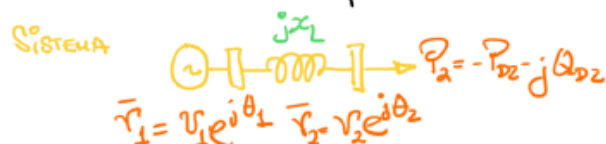
$X_L = 0.08j$

$$\mathbf{z} = \begin{bmatrix} \theta_2^m \\ v_1^m \\ v_2^m \\ p_2^m = -p_{D2}^m \end{bmatrix} = \begin{bmatrix} 0.0324 \\ 1.0000 \\ 0.9481 \\ -0.820 \end{bmatrix}$$

Para verificar solución, ir al GitHub del curso
https://github.com/pmdeoliveiradejesus/MASEP_SGE/FullSSE, y correr el programa FullSSE con el caso prueba_escrita.m

Se incluyen todas las derivadas del Jacobiano:

$$\begin{aligned}
 \frac{\partial P_i}{\partial V_i} &= \sum_{j=1}^N V_j (G_{ij} \cos \theta_{ij} + B_{ij} \sin \theta_{ij}) + V_i G_{ii} \\
 \frac{\partial P_i}{\partial V_j} &= V_i (G_{ij} \cos \theta_{ij} + B_{ij} \sin \theta_{ij}) \\
 \frac{\partial Q_i}{\partial V_i} &= \sum_{j=1}^N V_j (G_{ij} \sin \theta_{ij} - B_{ij} \cos \theta_{ij}) - V_i B_{ii} \\
 \frac{\partial Q_i}{\partial V_j} &= V_i (G_{ij} \sin \theta_{ij} - B_{ij} \cos \theta_{ij}) \\
 \frac{\partial P_i}{\partial \theta_i} &= \sum_{j=1}^N V_i V_j (-G_{ij} \sin \theta_{ij} + B_{ij} \cos \theta_{ij}) - V_i^2 B_{ii} \\
 \frac{\partial P_i}{\partial \theta_j} &= V_i V_j (G_{ij} \sin \theta_{ij} - B_{ij} \cos \theta_{ij}) \\
 \frac{\partial Q_i}{\partial \theta_i} &= \sum_{j=1}^N V_i V_j (G_{ij} \cos \theta_{ij} + B_{ij} \sin \theta_{ij}) - V_i^2 G_{ii} \\
 \frac{\partial Q_i}{\partial \theta_j} &= -V_i V_j (G_{ij} \cos \theta_{ij} + B_{ij} \sin \theta_{ij})
 \end{aligned}$$



DATA

$$\theta_1 = 0^\circ \text{ REFERENCIA}$$

$$X_L = 0.08 \text{ pu}$$

$$Z = \begin{bmatrix} \theta_2^m \\ V_1^m \\ V_2^m \\ P_2^m \end{bmatrix} = \begin{bmatrix} 0.0324 \\ 1.0000 \\ 0.9481 \\ -0.5200 \end{bmatrix}$$

MATRIZ DE ADMITANCIA:

$$Y = G + jB = \begin{bmatrix} B_{11} & B_{12} \\ B_{21} & B_{22} \end{bmatrix} = \begin{bmatrix} -12.5 & 12.5 \\ 12.5 & -12.5 \end{bmatrix} \text{ pu}$$

INICIAMOS

$$H = \begin{bmatrix} \theta_2 & V_1 & V_2 \\ 0 & 0 & 0 \\ \frac{\partial P_2}{\partial \theta_2} & \frac{\partial P_2}{\partial V_1} & \frac{\partial P_2}{\partial V_2} \end{bmatrix} \begin{bmatrix} \theta_2 \\ V_1 \\ V_2 \\ P_2 \end{bmatrix} \quad \text{donde } \begin{aligned} \frac{\partial P_2}{\partial \theta_2} &= V_1 V_2 B_{21} \cos \theta_2 \\ \frac{\partial P_2}{\partial V_1} &= V_2 B_{21} \sin \theta_2 \\ \frac{\partial P_2}{\partial V_2} &= V_1 B_{22} \sin \theta_2 \end{aligned}$$

Comenzamos con $X^0 = [\theta_2^0 \ V_1^0 \ V_2^0]^T = [0 \ 1 \ 1]^T$

$$h(x) = \begin{bmatrix} \theta_2 & V_1 & V_2 \\ \theta_2 & V_1 & V_2 \\ V_1 V_2 B_{21} \sin \theta_2 \end{bmatrix} = [0 \ 1 \ 1 \ 0]^T$$

$$H^0 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{aligned} x^1 &= x^0 + [H^T \omega \cdot H]^{-1} H^T \omega \cdot [z - h] \\ x^1 &= x^0 + \Delta x^0 \end{aligned} \quad \max(\|\Delta x^0\|)$$

$$H^0 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow \begin{aligned} x^1 &= x^0 + [H^T \omega \cdot H]^{-1} H^T \omega \cdot [z - h] \\ x^1 &= x^0 + \Delta x^0 \end{aligned} \quad \max(\|\Delta x^0\|)$$

$$\begin{bmatrix} \theta_2^1 \\ V_1^1 \\ V_2^1 \end{bmatrix} = \begin{bmatrix} -0.0650 \\ 1.0065 \\ 0.9481 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} + \begin{bmatrix} -0.065 \\ 0 \\ -0.0519 \end{bmatrix} = 0.06 > 1\% \quad \text{NO Converge!}$$

$$h(x) = [\theta_2^1 \ V_1^1 \ V_2^1 \ P_2^1]^T = [-0.065 \ 1.000 \ 0.9481 \ -0.7695]^T$$

$$H(x) = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \Rightarrow x^2 = x^1 + \Delta x^1$$

$$\begin{bmatrix} \theta_2^2 \\ V_1^2 \\ V_2^2 \end{bmatrix} = \begin{bmatrix} -0.065 \\ 1.0065 \\ 0.9481 \end{bmatrix} + \begin{bmatrix} -0.0027 \\ 0.0065 \\ 0.0869 \end{bmatrix} = \begin{bmatrix} -0.0676 \\ 1.0065 \\ 0.9549 \end{bmatrix}$$

$$\max(\|\Delta x^1\|) = 0.0069 < 1\% \quad \text{Converge!}$$

$$h(x) = [-0.0676 \ 1.0065 \ 0.9549 \ -0.8120]^T$$

$$J(x) = \sum_{i=1}^4 \omega_{ii} (z_i - h_i)^2 = 0.0102$$

$$P_{d2} = -h(4) = 0.8120$$

La demanda de Potencia Reactiva ESTIMADA es:

$$Q_{d2} = V_2 V_1 B_{21} \cos \theta_2 + V_2^2 B_{22} = 0.588$$

% Prueba escrita – Estimación de Estado

```
clc
clear all
t1=0;
XL=.08;
S=-complex(.8,.6);
v1=1;v2=1;
for k=1:3
v2=v1+complex(0,XL)*conj(S/v2);
end
z=[angle(v2)+.1; 1; abs(v2)+.001; real(S)-.02];
W=eye(4,4);
B11=-inv(XL);B21=inv(XL);B22=-inv(XL);
%flat begin
t2=0;v1=1;v2=1;
e=1;
dP2dt2=v2*v1*B21*cos(t2-t1);
dP2dv1=v2*B21*sin(t2-t1);
dP2dv2=v1*B21*sin(t2-t1);
H=[1 0 0; 0 1 0; 0 0 1; dP2dt2 dP2dv1 dP2dv2]
P2=v2*v1*B21*sin(t2-t1);
h=[t2; v1; v2; P2]
x=[t2; v1; v2];
```

Para verificar solución, ir al GitHub del curso
https://github.com/pmdeoliveiradejesus/MASEP_SGE/tree/master/FullSSE/casosdeestudio/prueba_y_correr_programa_solucion_prueba_escrita.mlx (MATlab Live Script)

```
dx=inv(H'*W*H)*H'*W*(z-h)
e=max(abs(dx))
disp('NO Converge!')
x=x+dx
t2=x(1);v1=x(2);v2=x(3);
P2=v2*v1*B21*sin(t2-t1);
h=[t2; v1; v2; P2]
dP2dt2=v2*v1*B21*cos(t2-t1);
dP2dv1=v2*B21*sin(t2-t1);
dP2dv2=v1*B21*sin(t2-t1);
H=[1 0 0; 0 1 0; 0 0 1; dP2dt2 dP2dv1 dP2dv2]
dx=inv(H'*W*H)*H'*W*(z-h)
x=x+dx
t2=x(1);v1=x(2);v2=x(3);
e=max(abs(dx))
disp('Converge!')
P2=v2*v1*B21*sin(t2-t1);
h=[t2; v1; v2; P2]
J=sum((z-h).^2)
pd2=-h(4)
qd2=+v2*v1*B21*cos(t2-t1)+v2^2*B22
```