

EE553—Homework 6, Problem 2

$$2. \quad \underline{z}^{(0)} = \begin{bmatrix} x_1 \\ x_2 \\ u \\ \lambda_1 \\ \lambda_2 \end{bmatrix} = \begin{bmatrix} 0 \\ 0.5 \\ 3.5 \\ 4.0 \\ 4.0 \end{bmatrix}$$

$$\ell(x, u, \lambda) = \ell(\underline{z}) = 1.5 + x_2 + 3x_2^2 + 0.5u + 0.5u^2 + \lambda_1(4 - \cos x_1 - 10\sin x_1 - x_2) + \lambda_2(2 - \cos x_1 + 10\sin x_1 - u)$$

$$\underline{H}_{ij} = \frac{\partial^2 \ell(\underline{z})}{\partial z_i \partial z_j}$$

$$\Rightarrow \underline{H} = \begin{bmatrix} \lambda_1(\cos x_1 + 10\sin x_1) + \lambda_2(\cos x_1 - 10\sin x_1) & 0 & 0 & \cos x_1 + 10\sin x_1 & \cos x_1 - 10\sin x_1 \\ 0 & 6 & 0 & -1 & 0 \\ 0 & 0 & 1 & 0 & -1 \\ \sin x_1 - 10\cos x_1 & -1 & 0 & 0 & 0 \\ \sin x_1 + 10\cos x_1 & 0 & -1 & 0 & 0 \end{bmatrix}$$

$$\nabla_{\underline{z}} \ell(\underline{z}) = \begin{bmatrix} [\sin x_1 - 10\cos x_1 \quad \sin x_1 + 10\cos x_1] \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} \\ 1 + 6x_2 + [-1 \quad 0] \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} \\ 0.5 + u + [0 \quad -1] \begin{bmatrix} \lambda_1 \\ \lambda_2 \end{bmatrix} \\ 0 \\ 0 \end{bmatrix}$$

$$\underline{z}^{(1)} = \underline{z}^{(0)} - [\underline{H}(\underline{z}^{(0)})]^{-1} \nabla_{\underline{z}} \ell(\underline{z}) = \begin{bmatrix} 0 \\ 0.5 \\ 3.5 \\ 4.0 \\ 4.0 \end{bmatrix}$$

z0=[0;0.5;3.5;4.0;4.0];

H = [z0(4)*(cos(z0(1))+10*sin(z0(1)))+z0(5)*(cos(z0(1))-10*sin(z0(1))) 0 0

cos(z0(1))+10*sin(z0(1)) cos(z0(1))-10*sin(z0(1));0 6 0 -1 0;0 0 1 0

-1;sin(z0(1))-10*cos(z0(1)) -1 0 0 0;sin(z0(1))+10*cos(z0(1)) 0 -1 0 0];

delta1 = [sin(z0(1))-10*cos(z0(1)) sin(z0(1))+10*cos(z0(1))]*[z0(4);z0(5)];

delta2 = 1+6*z0(2)+[-1 0]*[z0(4);z0(5)];

delta3 = 0.5+z0(3)+[0 -1]*[z0(4);z0(5)];

delta4 = 0;

delta5 = 0;

delta = [delta1;delta2;delta3;delta4;delta5];

z1 = z0-H^-1*delta