2

$$f(v) = \begin{bmatrix} x^2 + y^2 \\ x^2 - y^2 \end{bmatrix} = \begin{bmatrix} 4 \\ 4 \end{bmatrix}, \quad v_0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

$$f(v+s) \approx f(v) + J_f(v)\,s$$

$$J_f(v) = \begin{bmatrix} 2x & 2y \\ 2x & -2y \end{bmatrix}$$

$$f(v_0) = \begin{bmatrix} 1+1 \\ 1-1 \end{bmatrix} = \begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$J_f(v_0) = \begin{bmatrix} 2 & 2 \\ 2 & -2 \end{bmatrix}$$

$$\vdots$$

$$s_0 = -J_f^{-1}(v_0)\,f(v_0)$$

$$= -\frac{1}{8}\begin{bmatrix} -2 & -2 \\ -2 & 2 \end{bmatrix}\begin{bmatrix} 2 \\ 0 \end{bmatrix}$$

$$= \frac{1}{8}\begin{bmatrix} -2 \\ -2 \end{bmatrix}$$

$$s_0 = \begin{bmatrix} -\frac{1}{4} \\ -\frac{1}{4} \end{bmatrix}$$

$$v_1 = v_0 + s_0 = \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} -\frac{1}{4} \\ -\frac{1}{4} \end{bmatrix} = \begin{bmatrix} 1.25 \\ 1.25 \end{bmatrix}$$