



$$\begin{pmatrix} z_2 \\ \varphi_2 \end{pmatrix}$$

$$X_i = \begin{pmatrix} z_{2i} \\ \varphi_{2i} \end{pmatrix}$$

$$X_{i+1} = X_i + J_i^{-1} F_i(X_i)$$

$$\bar{z}_1 + \bar{z}_2 - \bar{z}_3 - \bar{z}_4 = 0$$

$$\textcircled{F} \equiv \begin{cases} z_1 c q + \underbrace{z_2 c}_{\text{blue}} \underbrace{\varphi_2}_{\text{red}} - z_3 c (\underbrace{\varphi_2}_{\text{red}} + \pi - \lambda) - z_4 = 0 \\ z_1 s q + \underbrace{z_2 s}_{\text{blue}} \underbrace{\varphi_2}_{\text{red}} - z_3 s (\underbrace{\varphi_2}_{\text{red}} + \pi - \lambda) = 0 \end{cases}$$

$$\textcircled{J} \equiv \begin{bmatrix} c \varphi_2 & -z_2 s \varphi_2 + z_3 s (\varphi_2 + \pi - \lambda) \\ s \varphi_2 & + z_2 c \varphi_2 - z_3 c (\varphi_2 + \pi - \lambda) \end{bmatrix}$$

$$\begin{cases} -z_1 s q \dot{q} - z_2 s \varphi_2 \dot{\varphi}_2 + z_2 c \varphi_2 \dot{\varphi}_2 + z_3 s \varphi_3 \dot{\varphi}_2 = 0 \\ z_1 c q \dot{q} + z_2 c \varphi_2 \dot{\varphi}_2 + z_2 s \varphi_2 \dot{\varphi}_2 - z_3 c \varphi_3 \dot{\varphi}_2 = 0 \end{cases}$$

$$\begin{bmatrix} c \varphi_2 & -z_2 s \varphi_2 + z_3 s \varphi_3 \\ s \varphi_2 & z_2 c \varphi_2 - z_3 c \varphi_3 \end{bmatrix} \begin{Bmatrix} \dot{z}_2 \\ \dot{\varphi}_2 \end{Bmatrix} + \begin{bmatrix} -s q \\ c q \end{bmatrix} z_1 \dot{q}$$

$$\begin{Bmatrix} \dot{z}_2 \\ \dot{\varphi}_2 \end{Bmatrix} = \begin{matrix} \leftarrow \\ \leftarrow \\ \leftarrow \end{matrix} J^{-1} A \dot{q}$$

A