

$$\begin{array}{l} ? \\ \textbf{Scipy} \\ \textbf{pyOpt} \\ \min f(x) \\ x_k \\ x^{k+1} \\ ? \end{array}$$

$$(1) \quad (t_{final}, C_0, , C_{d+n_{knot}-2})\min J = (t_{final}-t_{initial})^2$$

$$\forall k \in \{0, , N_s - 1\}$$

$$(2) \quad \begin{cases} \varphi_1(z(t_{initial}), , z^{(l-1)}(t_{initial})) = q_{initial} \\ \varphi_1(z(t_{final}), , z^{(l-1)}(t_{final})) = q_{final} \\ \varphi_2(z(t_{initial}), , z^{(l)}(t_{initial})) = u_{initial} \\ \varphi_2(z(t_{final}), , z^{(l)}(t_{final})) = u_{final} \\ \varphi_2(z(t_k), , z^{(l)}(t_k)) \in \mathcal{U} \\ d_{O_m}(t_k) \geq \rho + r_m, \forall O_m \in \mathcal{Q}_{occupied} \end{cases}$$

$$\begin{bmatrix} \dot{v}\dot{\omega} \\ \varphi_3 \end{bmatrix}$$

$$\varphi_3(z(t_k), , z^{(l)}(t_k)) \in \mathcal{A}$$

$$\begin{array}{l} A \\ \varphi_3 \\ \varphi_3(z(t_k), , z^{(3)}(t_k)) = \\ = \left[\dot{\psi}\right] = \left[\frac{\frac{\partial}{\partial t}\|\dot{z}\|}{\frac{\partial}{\partial t}\frac{(\dot{z}_1\ddot{z}_2-\dot{z}_2\ddot{z}_1)}{\|\dot{z}\|^2}}\right] = \left[\frac{\frac{\dot{z}_1\ddot{z}_1+\dot{z}_2\ddot{z}_2}{\|\dot{z}\|}}{(\ddot{z}_1\ddot{z}_2+z_2^{(3)}\dot{z}_1-(\ddot{z}_2\ddot{z}_1+z_1^{(3)}\dot{z}_2))\|\dot{z}\|^2-2(\dot{z}_1\ddot{z}_2-\dot{z}_2\ddot{z}_1)\|\dot{z}\|\dot{v}}\right] \end{array}$$

$$T_p \quad T_c$$

$$\tau_k = t_{initial} + k T_c k \in$$

$$\begin{array}{l} 2m \\ \left[\tau_{k-1}, \tau_k\right)(k \in \\) \\ \tau_k \\ T_k^+ \\ T_p \end{array}$$

$$(3) \quad (C_{(0,\tau_k)}, , C_{(d+n_{knot}-2,\tau_k)})\min J_{\tau_k} = \|\varphi_1(z(\tau_k+T_p,\tau_k), , z^{(l-1)}(\tau_k+T_p,\tau_k))-q_{final}\|^2$$

$$\forall t \in [\tau_k, \tau_k + T_p]$$

$$(4) \quad \begin{cases} \varphi_1(z(\tau_k,\tau_k), , z^{(l-1)}(\tau_k,\tau_k)) = q_{ref}(\tau_k,\tau_{k-1}) \\ \varphi_2(z(\tau_k,\tau_k), , z^{(l)}(\tau_k,\tau_k)) = u_{ref}(\tau_k,\tau_{k-1}) \\ \varphi_2(z(t,\tau_k), , z^{(l)}(t,\tau_k)) \in \mathcal{U} \\ d_{O_m}(t,\tau_k) \geq \rho + r_m, \forall O_m \in \mathcal{O}(\tau_k) \end{cases}$$

$$\begin{array}{l} [\tau_{-1}, \tau_0) \\ q_{ref}(\tau_0, \tau_{-1}) = q_{initial} \\ u_{ref}(\tau_0, \tau_{-1}) = u_{initial} \end{array}$$

$$\begin{array}{l} u \in^m q \in^n \\ N_s \\ n + \\ m \\ \tau_k \\ N_s(m + \\ \text{card}(\mathcal{O}(\tau_k))) \\ ?? \\ A \\ B \\ C \\ A \\ r_{0,1}^{0,1} \\ r_{0,3}^{0,3} \\ 0 \\ B \\ s_3 \\ r_{0,3}^{0,3} \\ r_{3,2}^{3,2} \\ C \\ A \\ B \\ C \end{array}$$