

Trajectory Optimization

Different inner products

$$\xi = \begin{bmatrix} q_0 \\ q_1 \\ \vdots \\ q_n \\ q_{n+1} \end{bmatrix}$$

a 

b 

c 

time

$$a = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

$$b = \begin{bmatrix} 0 \\ 0 \\ 100 \\ 0 \\ 0 \end{bmatrix}$$

$$c = \begin{bmatrix} 0 \\ 100 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Euclidean $\langle \xi_1, \xi_2 \rangle = \xi_1^T \xi_2$

$$\left. \begin{array}{l} \|a-b\|^2 = 100 \\ \|a-c\|^2 = 150 \end{array} \right\} \Rightarrow b \text{ is closer to } a \text{ than } c \text{ is}$$

Detour 1: Gradient Descent $\xi_{i+1} = \xi_i - \frac{1}{\alpha} \nabla_{\xi_i} U$

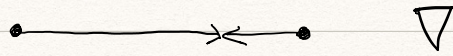
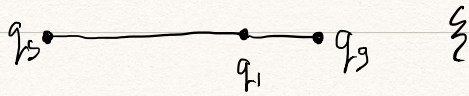
$$\xi_{i+1} = \arg \min_{\xi} U[\xi_i] + \nabla U[\xi_i]^T (\xi - \xi_i) + \frac{1}{2} \kappa \|\xi - \xi_i\|^2$$

$$\nabla: 0 + \nabla U[\xi_i] + \kappa (\xi - \xi_i) = 0$$

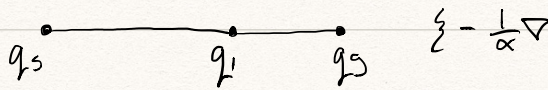
$$\xi_{i+1} = \xi_i - \frac{1}{\alpha} \nabla_{\xi_i} U$$

Idea: redefine $\langle \xi_1, \xi_2 \rangle$ s.t. c is closer to a





$$\leftarrow -\frac{1}{\alpha} \nabla$$



$$\xi_{i+1} = \arg \min_{\xi} U[\xi_i] + \nabla U[\xi_i]^T (\xi - \xi_i) + \frac{1}{2} \alpha \|\xi - \xi_i\|_A^2$$

$$\nabla: 0 + \nabla_{\xi_i} U + \alpha A (\xi - \xi_i)$$

$$\alpha A (\xi - \xi_i) = -\nabla_{\xi_i} U$$

$$\xi - \xi_i = -\frac{1}{\alpha} A^{-1} \nabla_{\xi_i} U$$

$$\xi_{i+1} = \xi_i - \underbrace{\frac{1}{\alpha} A^{-1} \nabla_{\xi_i} U}_{\text{still our gradient}}$$

$$U[\xi] \approx U[\xi_i] + \nabla_{\xi_i}^A U^T A (\xi - \xi_i)$$

$$\nabla_{\xi}^A U = A^{-1} \nabla_{\xi} U$$

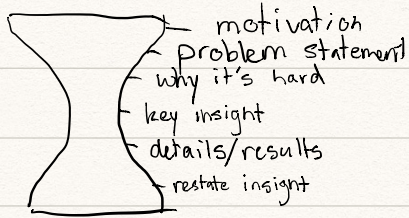
Presentations

- 2 papers. For each:

PRO presenter

≈ 15 min

- pretend you wrote the paper and are presenting it
- don't be procedural
- identify key insight



CON presenter

≈ 10 min

- outline ways it could improved
- how would you do it differently? Whole process ^{implementation} ← experiments writing

BOTH

Relate it back to lecture material:

- vocab/notation consistency
- how does it fit?

Slides:

- be visual
- informative title ("x had a positive effect on y")
- ONE point per slide
- Don't put anything you won't talk about