Homework 6: Soft And Hard Constrained Trajectory Optimization

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1. Matlab Part

Bezier curve coefficients are organized as $\boldsymbol{c} = [c_7, c_6, c_5, c_4, c_3, c_2, c_1, c_0]^T$. The sparsity patter of matrix Q0 is showed in Figure 1. The results of corridor-based trajectory optimization with Bezier curve are showed in Figure 2.
Compare curve's quality with three different time duration.

- Time is 0.25 second, curve is not smooth, trajectory quality is not good.
- Time is 0.5 second, curve looks smooth and efficient.
- Time is 1.5 second, there are some additional unnecessary paths in each corridor.

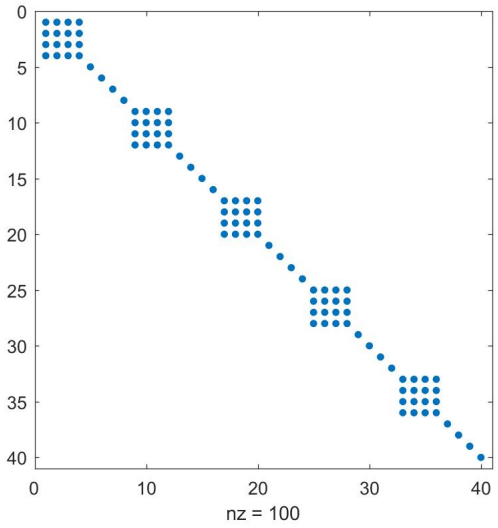
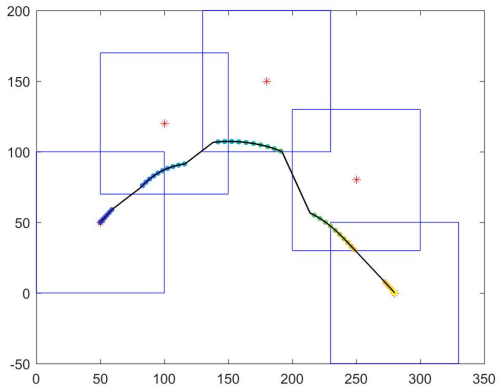
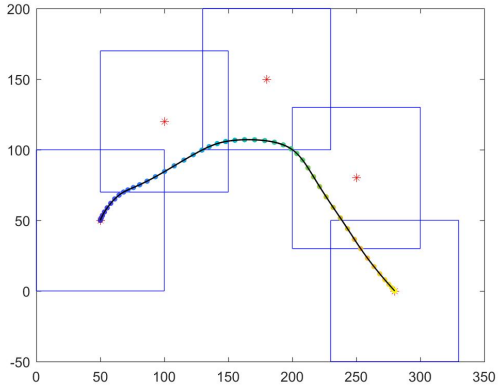


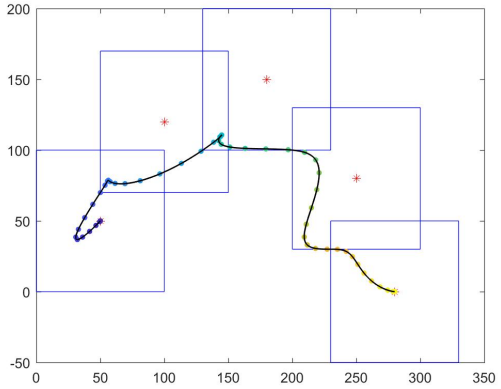
Figure 1: The shape of Q0.



(a) Time duration is 0.25 second



(b) Time duration is 0.5 second



(c) Time duration is 1.5 second

Figure 2: Corridor-based trajectory optimization with Bezier curve

2. Main Takeaways

Based on the previous lecture, this part focus on constraints on the trajectory itself.

1. Cons of minimum snap framework: overshoot unavoidable, not for collision avoidance.
2. What are hard/soft constraints.
3. Corridor-based trajectory optimization.
    - Pros and Cons of polynomial form.
    - Bezier curve optimization and its basic properties (pros).
    - Trajectory generation formulation based on Bezier curve.
    - Trajectory generation formulation, see slides.
4. Soft-constrained optimization: distance-based, numerical optimization.