Homework5

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1 Smooth cubic-spline trajectory with polyhedron obstacles

Utilize SDQP to calculate the closest distance vector, it should be noted, if a point is inside the polyhedron, SDQP will return 0, under this situation, we need to find the minimum projection distance to the planes that generate the polyhedron.

Once we got the distance vector, the potential cost and gradient can be generated. Utilized code from Homework2 to generate the smooth path.

I utilized some visualization code from Gcopter to show the randomly generated polyhedron. The planning result is shown in Fig. 1

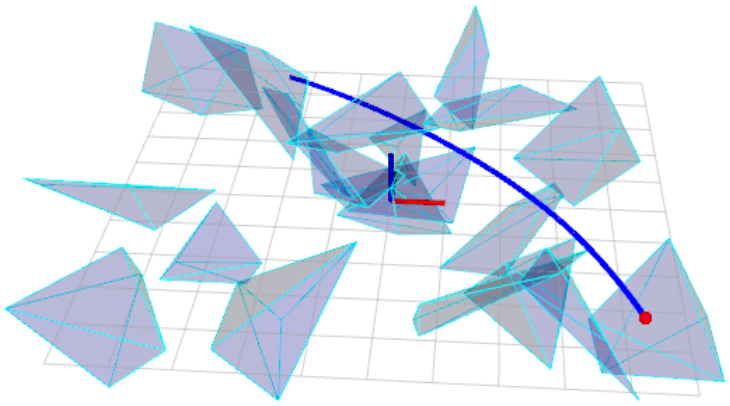

Figure 1: Smooth path planning with polyhedron obstacles

2 Time Optimal Path Parameterization

Solved through Conic-ALM. The slides of the course and the implementation shows everything, here we just mention some important procedures.

1. Once we got a smooth trajectory, uniformly sample it with equaled path parameter duration Δt.

2. Utilizing the arc-length formula and numerical integration to calculate s at t_i, together with $q(s), q'(s), q''(s)$

3. Formulate the topp as SOCP and solved with Conic-ALM.

The computational time is highly affected by the resolution of s, in current implementation , I keep about 100 s_k. The maximum velocity is set as $3m/s$ and maximum acceleration is $3m/s^2$.

once the optimization finished, it will output the final duration in the terminal. I also add the visualization of velocity and acceleration rqt plot. And once the Topp optimization finished, there will be a red dot representing the movement of the track show in the rviz.

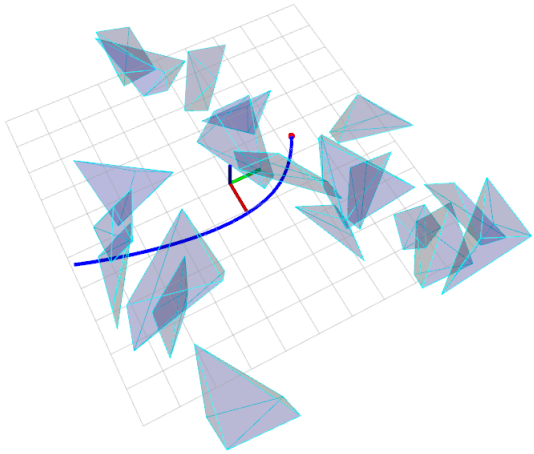

Figure 2: Topp Planing. The red ball will move along the trajectory under actual speed while the velocity file and acceleration file is plotting

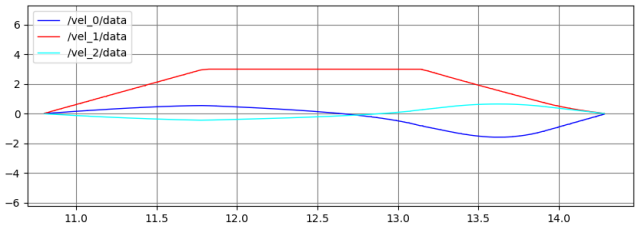

Figure 3: Velocity file of the planning trajectory

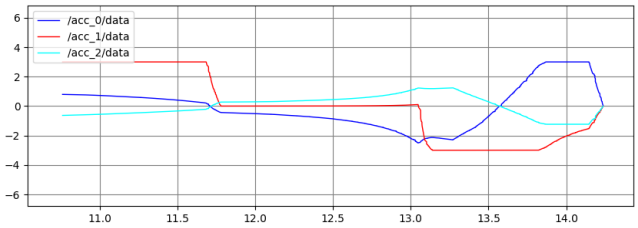

Figure 4: Acceleration file of the planning trajectory

3 Acknowledgements

Very interesting and hard-core Lecture, Thanks for all the helps form Dr. Wang and our hardworking TA. Wish you the best.