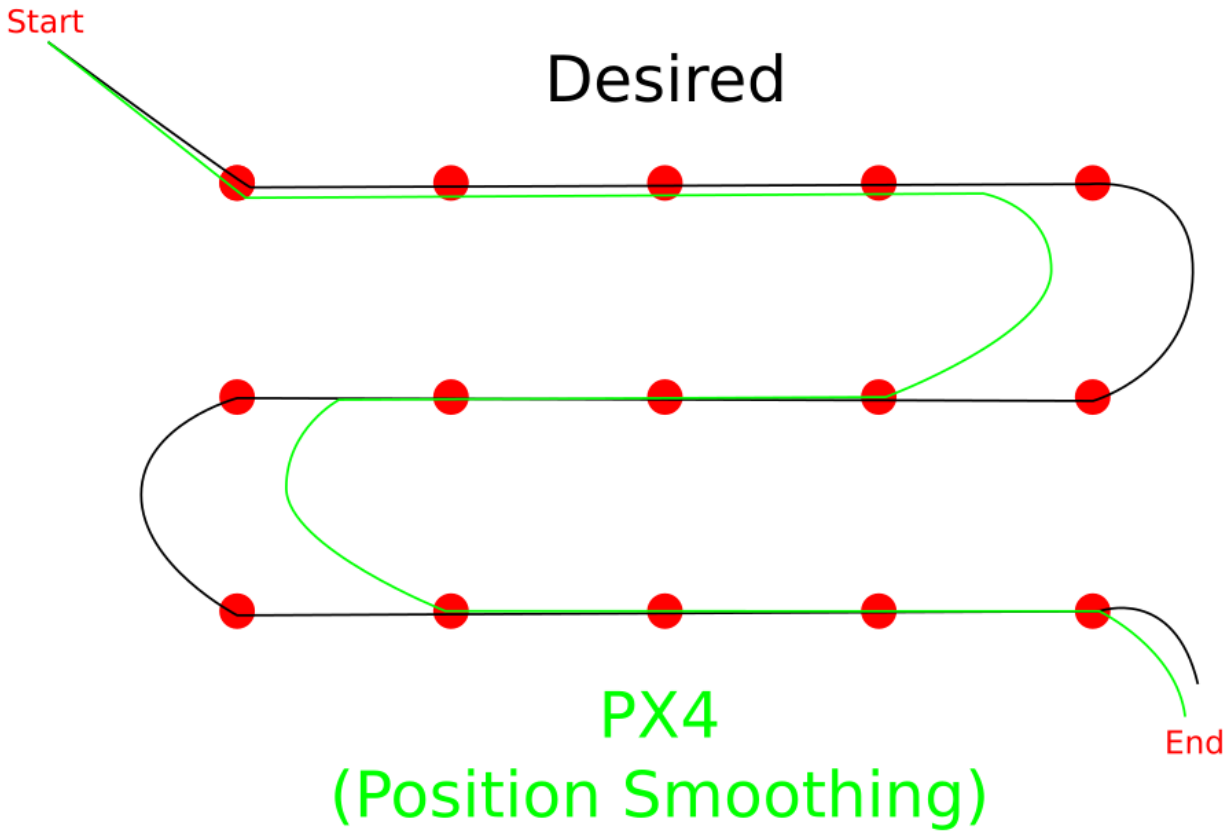
About

I remembered that during lunch, Claudio from Auterion mentioned to me that PX4 doesn't do a good job in following a path for surveillance application with a quadcopter, where it does something like this:



This feature was also made into a video by Auterion:
https://www.youtube.com/watch?v=ur9peWIvkQ4

What is the problem?

1. **The waypoints where the quadrotor turns aren't reached.** As it gets only as close as (approximately) the waypoint acceptance radius.
    a. This leads to multicopter not being able to capture the area below theses waypoints
2. Vehicle slows down when turning (to be confirmed via Simulation)

Comments

Discussed during weekly meeting Jan 9, 2023 :

1. Reason PX4 does that is not related to path-following, at the end it's doing a 'position following', which isn't a path
2. It's more of an implementation detail. NPFG for example shouldn't technically be used on a waypoint missions, but it still does & it's just because it needed to be implemented on PX4
3. Implementing a notion of 'Path' on PX4 would be the goal before using NPFG on a Multicopter 🤔
4. Also, including temporal information (e.g. 'stop at the waypoint, desired velocity == 0') violates the definition of a path
    a. Although 3D NPFG paper defines a desired velocity on path, it isn't necessarily correct to define it (apparently it was done to allow Fixed-Wing guidance. But why?)

Analysis

The path following & trajectory following (in PX4, both are sort of synonymous?) is controlled by the `motion_planning/PositionSmoothing.hpp` library.

In its core, the core logic is similar to the L1 guidance (NLGL), where the `_getCrossingPoint` function finds a Virtual Target Point that is at distance 'L1' (which is capped minimum at 5 meters & otherwise is 'target acceptance radius'):

https://github.com/PX4/PX4-Autopilot/blob/fe80e7aa468a50bec6b035d0e8e4e37e516c84ff/src/lib/motion_planning/PositionSmoothing.cpp#L128-L139

But this problem is also noted in the L2+ paper:

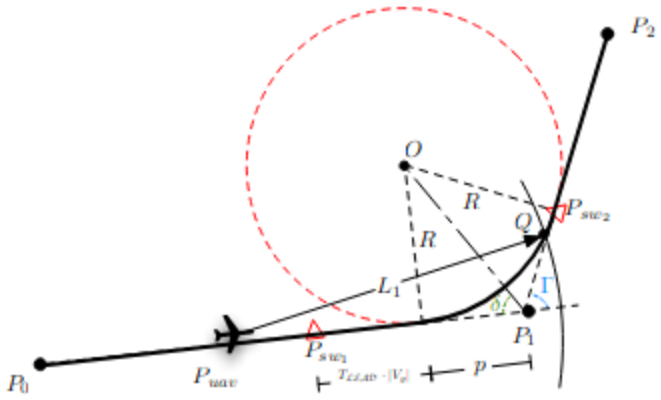


Fig. 6: Waypoint switching geometry showing the circular arc connecting two legs.

And it even considers the trajectory that forms an arc using the 3 waypoints (which I thought was undesirable), an ideal trajectory.