Autonomous Robots
University of Zaragoza

Escuela de Ingeniería y Arquitectura Universidad Zaragoza

Laboratory 6: Trajectory generation for drone racing

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During Laboratory Session 6, we designed a trajectory generator for drone racing with the objective of efficiently navigating through several pre-defined gates. The trajectory generator will be evaluated in two different scenarios (`gates.txt`, represented in Figure 1a, and `gates_hard.txt`, represented in Figure 1b).

The very first step in our implementation was to change the `drone_race.cpp` main function for choosing between the different scenarios to simulate the drone race, avoiding possible path finding errors. This was done by introducing the `ros/package.h` library and using the `ros::package::getPath()` for obtaining the path where the package was stored.

Latter, the `draw_gate_markers()` function was modified in order to represent the left corners of the gates as yellow balls, this modification eases the visualization of the gate orientation.

Afterwards, the `trajectory_generator()` function was implemented, where all the waypoints of the trajectory are generated with a sampling interval of 0.1s and establishing a position and velocity constraint in each gate (by using the gate's position and orientation), for making the drone pass through its center. Additionally, a maximum velocity and a maximum acceleration constraints (as shown in Table 1) have been used for the trajectory sampling.

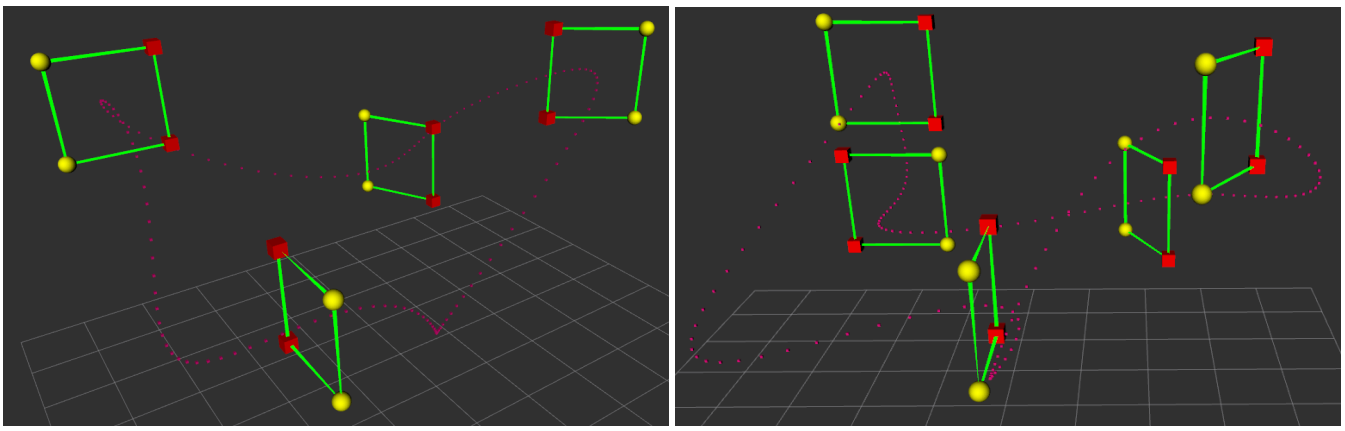
Finally, as it has been previously mentioned, these implementations have been evaluated by simulating the drone race in `Rviz` (as shown in Figure 1) and in `Gazebo` (by publishing the computed velocities within the `cmd_vel` topic, by using the `send_command()` function). The best times of each drone race have been presented in Table 2.

Metric	Value
Local velocity constraints (m/s)	(2.3, 0.0, 0.0)
Maximum velocity (m/s)	4.5
Maximum acceleration (m/s^2)	8.5

Table 1: Specific values of our implementation

Race tracks	Race time (s)
gates.txt	14.1904
gates_hard.txt	14.9486

Table 2: Race times on different race tracks



(a) Easy circuit.

(b) Hard circuit.

Figure 1: Simulated trajectories.